

KG

11366

4944

LXV



3010

3023

3024



Harvard Lunar Plates

Measure and Reductions

Mary Fowler

Volume ~~LXX~~

Plate No.	Date	Page
3010	1913 March 18	1
3023	1913 March 19	10
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3010

Stars - measures

1914 Mar 21.

1

	α	δ	α	δ
1	15551	16546	14421	16631
32	668690	1538782	601120	1504441
139	9590	88	11	45
	35	40	21	31
	<u>13.8847</u>	<u>8841</u>	<u>3.1592</u>	<u>1.1588</u>
2	19111	14707	18960	16666
20.4	1645651	736966	1144144	1418999
34.4	57	69	59739	9199
	20	01	56	69
	<u>34.2659</u>	<u>2664</u>	<u>20.2484</u>	<u>2474</u>
3	14198	14757	18510	14976
26.4	12931	603128	1184041	1167170
18.2	2937	29	40	70
		78	20	92
	<u>18.1266</u>	<u>1253</u>	<u>26.3323</u>	<u>3311</u>
4	19569	15669	9361	10240
4.1	1708987	811320	6062	984954
31.3	80	23	8970	5154
	59	51		
	<u>31.2482</u>	<u>2464</u>	<u>4.0391</u>	<u>0389</u>

Grade 2.

3010

Stars - measures

1117 mm 111

	dc	N	dc	N
1	15551	16546	14421	16631
32	6686	1538782	1601120	1504941
139	9590	88	11	45
	35	90	21	31
	<u>138847</u>	<u>8841</u>	<u>3.1592</u>	<u>1.588</u>

2	19111	14707	18960	16666
204	16456	736966	1144144	14189
394	57	69	53739	9199
	20	01	56	69
	<u>34.2659</u>	<u>2664</u>	<u>20.2484</u>	<u>2474</u>

3	14198	14719	18510	14976
264	12931	603128	1184041	1167170
182	2937	29	40	70
		78	20	92
	<u>18.1266</u>	<u>1213</u>	<u>26.3323</u>	<u>3311</u>

4	19569	15669	9361	10240
41	1708987	811320	6062	984954
31.3	80	23	8970	51
	59	51		
	<u>31.2482</u>	<u>2464</u>	<u>4.0391</u>	<u>0389</u>

Grade 2.

3010

Moon - measures

2

$$\begin{array}{r}
 \text{1 scratch} \\
 17.7 \quad 14819 \quad 13140 \\
 18.1 \quad 1364971 \quad 4142 \\
 \quad \quad 5264 \quad 11981 \\
 \hline
 18.1260 \quad 11160 \checkmark
 \end{array}$$

$$\begin{array}{r}
 d \quad n \\
 16990 \quad 19291 \\
 1330310 \quad 1300911 \\
 \quad \quad 00 \quad 11 \\
 \quad \quad 79 \quad 02
 \end{array}$$

$$\begin{array}{r}
 2 \\
 17.0 \quad 20245 \quad 18150 \\
 18.8 \quad 1177967 \quad 1659169 \\
 \quad \quad 8167 \quad 8580 \\
 \quad \quad 39 \quad 61 \\
 \hline
 18.8464 \quad 8429
 \end{array}$$

$$\begin{array}{r}
 3 \\
 16.9 \quad 16432 \\
 19.0 \quad 1567879 \\
 \quad \quad 7179
 \end{array}$$

$$\begin{array}{r}
 1457886 \\
 14580 \\
 \hline
 13804
 \end{array}$$

$$16.9244$$

$$.9223$$

$$\begin{array}{r}
 4 \\
 16.7 \\
 19.9 \\
 \text{min} \\
 \text{in} \\
 \text{X}
 \end{array}$$

$$\begin{array}{r}
 20180 \\
 1762110 \\
 \quad \quad 08 \\
 \quad \quad 78 \\
 \hline
 16.7434
 \end{array}$$

$$\begin{array}{r}
 20029 \\
 1260306 \\
 \quad \quad 99 \\
 \quad \quad 32 \\
 \hline
 7428
 \end{array}$$

$$\begin{array}{r}
 5 \text{ scratch} \\
 16.8 \quad 18221 \quad 19599 \\
 20.3 \quad 1436776 \quad 1348163 \\
 \quad \quad 7976 \quad 79 \\
 \quad \quad 25 \quad 99 \\
 \hline
 20.3849 \quad 3875
 \end{array}$$

$$\begin{array}{r}
 1 \\
 19171 \\
 1732829 \\
 \quad \quad 1129 \\
 \quad \quad 80 \\
 \hline
 16.8150
 \end{array}$$

$$\begin{array}{r}
 20031 \\
 1190510 \\
 \quad \quad 90 \\
 \quad \quad 34 \\
 \hline
 8131
 \end{array}$$

$$\begin{array}{r}
 6 \\
 17.0 \quad 14240 \quad 13350 \\
 20.8 \quad 13012 \quad 1209590 \\
 \quad \quad 3340 \quad 9890
 \end{array}$$

$$20.8774$$

$$8744$$

3010

moon - measures

2

1 scratch

17.7	14819	13190	
18.1	1364971	41	42
	5264	1.1981	

18.12601.1160 ✓

1.6990

1.9291

1330310

1300911

00

11

79

02

17.63166288

2 20245

18150

17.0 11779

1659169

18.8 8167

8580

39

61

18.84648429

3

16.9

19.0

16432

1457886

1567879

~~14580~~

7179

13804

16.92449223

4

16.7

19.9

mm

u

u

20180

20029

1762110

1260306

08

99

78

32

16.74347428

5 scratch

168 18221

19599

203 1436776

1348163

79

79

25

99

2038493875

1

19171

20031

1732829

1190510

11

90

80

34

16.81508131

6 14240

13350

17.0 3340

12095

208 13012

9890

20.87748744

3010 moon measures.

3

$$\begin{array}{r} 2 \\ 17.1 \\ 21.0 \end{array}$$

$$\begin{array}{r} 13161 \\ 57 \\ 12449 \end{array}$$

$$\begin{array}{r} 13050 \\ 1233120 \\ 27 \end{array}$$
17.0711.0724

$$\begin{array}{r} 8 \\ 18.0 \\ 21.7 \\ 17842 \\ 9688 \\ 8781 \\ 49 \\ 21.8163 \end{array}$$

$$\begin{array}{r} 16663 \\ 14781 \\ 8999 \\ 70 \\ 8126 \end{array}$$

$$\begin{array}{r} 9 \\ 18.9 \\ 22.0 \\ \text{max} \\ \text{in} \\ 4 \\ 12237 \\ 1210020 \\ 99 \\ 22.0131 \end{array}$$

$$\begin{array}{r} 12285 \\ 7980 \\ 12086 \\ .0094 \end{array}$$

not very clear image of moon.

3010 Moon - measures

3

$$\begin{array}{r} 2 \\ 17.1 \\ 21.0 \end{array}$$

$$\begin{array}{r} 1316161 \\ 57 \\ 12449 \end{array}$$

$$\begin{array}{r} 13050 \\ 1233120 \\ 27 \end{array}$$

$$\underline{170711}$$

$$\underline{0724}$$

$$\begin{array}{r} 8 \\ 18.0 \\ 21.7 \end{array} \quad \begin{array}{r} 17842 \\ 9688 \\ 8781 \\ 49 \\ \underline{21.8163} \end{array}$$

$$\begin{array}{r} 16663 \\ 14781 \\ 8999 \\ 70 \\ \underline{8126} \end{array}$$

$$\begin{array}{r} 9 \\ 189 \\ 22.0 \\ \text{max} \\ 99 \end{array} \quad \begin{array}{r} 12237 \\ 1210020 \\ 99 \\ \underline{22.0131} \end{array}$$

$$\begin{array}{r} 12285 \\ 7980 \\ 12086 \\ \underline{.0094} \end{array}$$

not very clear image of moon.

30 10

Times etc

Epitolas	1913 Mar 18,	10 ^h	32 ^m	✓	- 10 ^h	44 ^m	✓	1
moon		10	38	✓	17.8	✓	10 38	✓
clockfast			0	✓	58.6	✓	✓	✓
H. dist.		10	37	✓	19.5	✓	6 - K = +1 ^h 38 ^m 20 ^s	✓
H. comp		4	44	✓	31.0	✓		✓
G. dist.		15	21	✓	50.5	✓		✓
dist. to moon		23	41	✓	45.4	✓		✓
Interval		15	40	✓	05.15	✓		✓
Reduction			2	✓	34.0	✓		✓
G. M. T.		15	37	✓	31.1	✓		✓

from Kantalum

R. A.

Decl.

moon 15 ^h ✓	8 ^h	57 ^m	26.37	✓	+ 21°	36'	15.5	✓
moon in 1 ^m 2.4856 ✓				✓	12.277	✓		✓
... 37.519 ✓	+1	33.26	✓		- 7	40.6	✓	✓
Tabular place	8	58	59.65	✓	+ 21	28	34.9	✓

moon age 11 days

$$934 = 13.61$$

$$988 = 15.3$$

$$a = +0.1$$

parallax	60' 21.72	✓
semidiameter	16 28.4	✓
R	988.4	✓
Augmentation	1 15.3	✓
Irradiation (2)	- 0.5	✓
R	1003.2	✓
R	2150.5	✓
(1+2) R		✓
R	4624.6	✓

30 10

Timmer etc

Epistolar 1913 Mar 18, 10^m 32^m - 10^m 44^m
 known 10 38 17.8 - 10 38 18.9
 clock fast 0 586

H. L. T. 10 37 19.5 6 - X = +1^m 38^m 2
 H. H. T. 4 44 31.05
 G. L. T. 15 21 50.55
 2nd T. in house 23 41 45.40
 T. in house 15 40 05.15
 Reduction 2 34.01
 G. L. T. 15 37 31.14

from Nantahala R. A. Red.
 known 15^m 8^m 57^m 26.39 + 21^m 36^m 15^m 5^m
 unknown 1^m 2485.6 12 277
 37.519 +1 33.26 - 7 40.6
 Tabular place 8 58 59.65 - 21 28 34.9

known age 11 days.

parallax 60' 2172
 semidiameter 16 28.4
 R 9884
 Augmentation + 15.3
 Indication 05
 R 10032
 R 21505
 a = +0.1 (140) R
 R 96246

3010

Plate Constants

5

	1	3	4	2
x	3.1590	20.2479	26.3317	10.390
y	5.2347	22.2230	28.3844	6.0271
z	-2.0757	-1.9751	-2.0527	-1.9881
u	13.8844	34.2662	18.1260	31.2473
v	13.4379	33.8999	17.7853	30.7988
w	+4465	+3663	+3407	+4485

$x - z$	-49.44		$-1z$		$+214.35$
-2.0757 -	686	-21443	-0	-21443	= -8
-1.9881 -	1544	-21425	-0	-21425	= +10
-1.9751 -	1693	-21444	-2	-21446	= -11
-2.0527 -	895	-21422	-3	-21425	= +10
18.8946 $\checkmark$ -	981 $\checkmark$		-2 $\checkmark$		= 209398 $\checkmark$

$y - w$	+47.92		$-7z$		-46.32
+4465 +	151	+4616	-10	+4606	= -26
+4485 +	193	+4678	-22	+4656	= +24
+3663 +	970	+4633	-24	+4609	= -23
+3407 +	1261	+4668	-13	+4655	= +23
19.8588 $\checkmark$ +	905 $\checkmark$		-14 $\checkmark$		= 19.4847 $\checkmark$

Tables $a = +0.7$ $e = +0.2$ $a - e = +0.5$ $b + a = -0.9$
 Obs $a = +0.1$ $e = +0.7$ $a - e = -0.6$ $b + a = +1.5$

2010

Plane Constants

5

	1	3	4	2
2	3.1590	20.2479	26.3317	40.390
3	5.2347	22.2230	28.3844	60.271
2-3	-20757	-19751	-20527	-19881

4	13.8849	34.2662	18.1260	31.2473
3	13.4379	33.8999	17.7853	30.7988
4-3	+4465	+3663	+3407	+4485

2-3	-4947	-136	+21435
-20757	-686	-21443	-0
-19881	-1544	-21425	-0
-19751	-1693	-21444	-2
-20527	-895	-21422	-3
188946	-981	-2	+209398

4-3	+4792	-79	-4632
+4465	-151	+4616	-10
+4485	-193	+4678	-22
+3663	-970	+4633	-24
+3407	+1261	+4668	-13
198588	+905	-14	+4655
			+23
			-194847

Tables a = +0.7 2 = +0.2 a - 2 = +0.5 4 + a = -0.9
 Obs a = +0.1 2 = +0.7 a - 2 = -0.6 4 + a = +1.5

		$b-c$			D	$Corr$
1	216	201	+1.4	+50	-6.1	+0.2
2	242	227	+1.9	+37	-6.3	
3	246	231	+3	+34	-6.2	
4	270	255	+3.9	+14	-5.0	
5	284	269	+4.0	+3.1	-3.8	
6	298	283	+3.9	-1.2	-2.4	
7	302	287	+3.8	-1.6	-1.9	
8	335	320	+2.6	-4.1	+1.8	
9	0	345	+1.0	-5.2	+4.5	

$$\lambda = -4.0$$

$$b = -5.4$$

$$c = 1.5$$

	D		$Corr$	$Res.$	$O - C$
201	-3.7	+0.6	+55	+118	+63
227	-0.5	-0.5	-46	-61	-15
231	0.0	-0.7	-64	-9	+55
255	+2.8	+0.3	+28	+44	+16
269	+4.2	-2.0	-184	-174	+10
283	+5.4	-0.8	-74	-10	+64
287	+5.7	-0.6	-55	0	+55
320	+7.0	-1.2	-110	-5	+105
345	+6.5	+0.6	+55	+81	+26

	$old(O-C)$	$Haig$	$new(O-C)$
1	+143	+55	+88
2	-60	-46	-14
3	-14	-64	+50
4	+18	+28	-10
5	-213	-184	-29
6	-57	-74	+17
7	-48	-55	+7
8	-61	-110	+49
9	+31	+55	-24

3010

Moon's Center

6

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$	
1	17.6303	-1.2637	-2	1.5974	4.6389	+1.43	
2	17.0000	-1.8940	-1	3.5876	4.6186	-60	
3	16.9234	-1.9706	-1	3.8836	4.6232	-14	
-4	16.7431	-2.1509	0	4.6264	4.6264	+18	
5	16.8140	-2.0800	+0	4.3264	4.6033	-213	
6	17.0000	-1.8940	+1	3.5868	4.6189	-57	
7	17.0718	-1.8222	+1	3.3201	4.6197	-48	
8	18.0000	-0.8940	+2	0.7988	4.6185	-61	
9	18.8940	0.0000	+2	0.0000	4.6277	+31	

Comp R? 4.6246

	y	$y - y_0$	$(y - y_0)^2$
1	18.1160	-1.7440	3.0415
2	18.8446	-1.0154	1.0310
3	19.0000	-0.8600	0.7396
4	19.8600	0.0000	0.0000
5	20.3862	+0.5262	0.2769
6	20.8759	+1.0159	1.0321
7	21.0000	+1.1400	1.2996
8	21.8144	+1.9544	3.8197
9	22.0112	+2.1512	4.6277

Affine Center

$$x = 17.0 \quad y = 18.8446$$

$$20.8759$$

$$39.7205$$

$$y_0 = 19.8602$$

$$y_{\text{max}} = 22.0112$$

$$R = 2.1510$$

$$x_{\text{min}} = 16.7431$$

$$x = 18.8941$$

$$\text{Center } \begin{cases} x_0 = 18.8940 \\ y_0 = 19.8600 \end{cases}$$

3010

Proton Center

6

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 (y - y_0)^2$	$O - C$
1	17.6303	-1.2637	-2	1.5974	4.6389	+1.43
2	17.0000	-1.8940	-1	3.5876	4.6186	-6.0
3	16.9234	-1.9706	-1	3.8836	4.6232	-1.4
4	16.7431	-2.1509	0	4.6264	4.6264	+1.81
5	16.8140	-2.0800	+0	4.3264	4.603	-2.13
6	17.0000	-1.8940	+1	3.5868	4.6189	-5.7
7	17.0718	-1.8222	+1	3.3201	4.6197	-4.8
8	18.0000	-0.8940	+2	0.7988	4.6185	-1.61
9	18.8940	0.0000	+2	0.0000	4.6277	+3.1

Comp R? 4.6246

	y	$y - y_0$	$(y - y_0)^2$
1	18.1160	-1.7440	3.0415
2	18.4446	-1.0154	1.0310
3	19.0000	-0.8600	0.7396
4	19.8600	0.0000	0.0000
5	20.3862	+0.5262	0.2769
6	20.8759	+1.0159	1.0321
7	21.0000	+1.1400	1.2996
8	21.8144	+1.9544	3.8197
9	22.0112	+2.1512	4.6277

Alphons Center

$$x = 17.0 \quad y = 18.8446$$

$$20.8759$$

$$39.7205$$

$$y_0 = 19.8602$$

$$y_{\text{max}} = 22.0112$$

$$R = 2.1510$$

$$x_{\text{max}} = 16.7431$$

$$y = 18.8941$$

$$\text{Center } \left\{ \begin{array}{l} x_0 = 18.8940 \\ y_0 = 19.8600 \end{array} \right.$$

Formulation of Journals

	ab	an	bn	an	bn
1	+ 2.19	- 180.0	- 248.6	- 110.9	- 153.1
2	+ 1.93	+ 113.4	+ 61.1	+ 26.5	+ 14.3
3	+ 1.70	+ 27.6	+ 12.0	- 98.5	- 43.0
4	- 0.00	- 38.7	+ 0.0	+ 21.5	- 0.0
5	- 0.28	+ 110.8	- 27.2	+ 60.4	- 15.4
6	- 1.93	+ 107.8	- 58.1	- 32.1	+ 17.3
7	- 2.08	+ 87.4	- 54.8	- 12.7	+ 8.0
8	- 1.73	+ 54.2	- 118.9	- 43.7	+ 95.5
9	+ 0.00	+ 0.0	+ 66.6	- 0.0	- 51.6
	- 0.20	+ 282.5	- 367.9	- 189.5	- 128.0
(5) full wt.	- 0.83				
	- 1.03				

	O		C	O - C
1	+ 88	+ 9 + 15 =	+ 24	+ 64
2	- 14	+ 14 + 9 =	+ 23	- 37
3	+ 50	+ 15 + 7 =	+ 22	+ 28
4	- 10	+ 16 - 0 =	- 16	- 26
5	- 29	+ 15 - 5 =	+ 10	- 39
6	+ 17	+ 14 - 6 =	+ 8	+ 9
7	+ 7	+ 14 - 10 =	+ 4	+ 3
8	+ 49	+ 7 - 17 =	- 10	+ 59
9	- 24	- 6 - 19 =	- 19	- 5

+ 163 - 107

Average = 30.

3010 Moon's Center

7

	a	b	0	c	0-c
1	-1.26	-1.74	= +1.43	-1.6 + 4.1 = +2.5	+1.16
2	-1.89	-1.02	= -60	-23 + 24 = +1	-61
3	-1.97	-0.86	= -14	-24 + 19 = -5	-9
4	-2.15	+0.00	= +15	-26 - 0 = -26	+44
5	-2.08	+0.53	= -213	-13 - 6 = -19	-87 - 174
6	-1.89	+1.02	= -57	-23 - 24 = -47	-10
7	-1.82	+1.14	= -48	-22 - 26 = -48	0
8	-0.89	+1.95	= -61	-11 - 45 = -56	-5
9	+0.00	+2.15	= +31	+0 - 50 = -50	+81

+243 - 172

Average = 49

Normal Equations

$$+22.48 - 0.20 = +282$$

$$-0.20 + 15.66 = -368$$

$$+0.20 - 0.00 = +3$$

$$+15.66 = -365$$

$$b = -23.3$$

$$+22.48 = +282 - 5 = +277$$

$$a = +12.3$$

Normals with Hayn's correction (giving (5) full wt.)

$$+25.73 - 1.03 = -190$$

$$-1.03 + 15.88 = -128$$

$$+1.03 - 0.04 = -8$$

$$+15.84 = -136$$

$$b = -8.6$$

$$+25.73 = -190 - 9 = -199$$

$$a = -7.4$$

Arc measured = 144° Average (0-c) = +8

$$\frac{pc}{m} = 0.12$$

$$+ \frac{8}{12} = +0.67 \quad \Delta z = +0.7$$

3010 Mowus Center

7

	a	b	0	c	0-c
1	-126	-174	+143	-16+41 = +25	+118
2	-189	-102	-60	-23+24 = +1	-61
3	-197	-086	-14	-24+19 = -5	-9
4	-215	+000	+15	-26-0 = -26	+44
5	-208	+053	-213	-13-16 = -19	-87
6	-189	+102	-57	-23-24 = -47	-10
7	-182	+114	-48	-22-26 = -48	0
8	-089	+195	-61	-11-45 = -56	-5
9	+000	+215	+31	+0-50 = -50	+81
					+243-172

Average = 49

Normal Equations

$$+22.48 - 0.20 = +282$$

$$-0.20 + 15.66 = -368$$

$$+0.20 - 0.00 = +3$$

$$+15.66 = -365$$

$$b = -233$$

$$+22.48 - +282 = \sqrt{-} = +277$$

$$a = +1.23$$

Arc measured: 144° Average (0-c) = +8

$$\frac{pc}{m} = 0.12$$

$$+ \frac{8}{1.2} = +0.67 \quad \Delta z = +0.7$$

Red ad locum ahf

$$S' = +21^{\circ} 05'$$

$$H + \alpha \quad 3 \quad 07 = 46^{\circ} 45'$$

$$H \quad 18 \quad 09$$

$$\alpha \quad 8 \quad 58$$

$$G \quad 19 \quad 30$$

$$G + \alpha \quad 4 \quad 28 = 67^{\circ}$$

$$l \cos S \quad 9.9699$$

$$\quad \quad \quad 0.9107$$

$$(i) \quad 0.8806$$

$$l \sin S \quad 9.55560$$

$$\cos(H + \alpha) \quad 9.8358$$

$$h \quad 1.2737$$

$$\sin \quad 9.8624$$

$$\sec S \quad 0.0301$$

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

$$(S') \quad 0.6105$$

$$(g) \quad 9.3926$$

$$(h') \quad 0.6655$$

$$(h) \quad 9.9901$$

$$h \quad +0.60$$

$$g \quad +0.25$$

$$h \quad +0.98$$

$$\quad +1.83$$

$$S' \quad +4.08$$

$$h' \quad +4.63$$

$$L \quad -7.60$$

$$\quad +1.71$$

3010 Moon's mean position (1913.0)

8

$$X_0 = 188940 \checkmark$$

$$Y_0 = 198600 \checkmark$$

$$da = +6 \checkmark$$

$$db = -12 \checkmark$$

$$188946 \checkmark$$

$$198588 \checkmark$$

$$\text{Hayn (188936)}$$

$$(198596)$$

$$\text{From Plate Constants } X = 209398 \checkmark \quad Y = 194847 \checkmark$$

$$(209388) \quad (194855)$$

$$Z = +29398 \checkmark (29388)$$

$$\eta = -25153 \checkmark (-25145)$$

$$\log 5 = 046832 \checkmark (0.48817)$$

$$\log \tan \delta = 95842 \checkmark$$

$$\log 5 = 996990 \checkmark$$

$$\log 5 = 09366 \checkmark$$

$$850724 \checkmark$$

$$70534 \checkmark$$

$$(X-A) = 199118 \checkmark (199103)$$

$$\eta_1 = 75742 \checkmark$$

$$X-A = 13799 \checkmark (3796)$$

$$\eta_1 = +38 \checkmark$$

$$A = 85600 \checkmark$$

$$\eta_0 = -25191 \checkmark (-25183)$$

$$X_0 = 85737.99 \checkmark (37.96)$$

$$\log \mu_{\alpha} = 040125 \checkmark (4011)$$

$$733115 \checkmark$$

$$\text{Red} = +183 \checkmark$$

$$(W-D) = 307010 \checkmark (306996)$$

$$X' = 85739.82 \checkmark (3979)$$

$$\delta-D = -1935.2 \checkmark (34.8)$$

$$D = +2124.54 \checkmark$$

$$\delta_0 = +2105.188 \checkmark (19.2)$$

$$\text{Red} = +1.1 \checkmark$$

$$\delta' = +2105.199 \checkmark (20.3)$$

3010 known mean Position (1913.0)

8

$$\begin{array}{r}
 X_0 = 18.8940 \\
 + 6 \\
 \hline
 18.8946
 \end{array}
 \quad
 \begin{array}{r}
 Y_0 = 19.8600 \\
 - 12 \\
 \hline
 19.8588
 \end{array}$$

from Plate constants $X = 20.9398$ $Y = 19.4847$

$$Z = +29398$$

$$\eta = -25153$$

$$\begin{array}{r}
 \log 5 = 0.46832 \\
 \log 5 = 9.6990 \\
 8.50724
 \end{array}$$

$$\begin{array}{r}
 \log \tan 5^\circ = 9.5842 \\
 5^\circ = 0.9366 \\
 \hline
 7.0534 \\
 \eta_1 = 7.5742
 \end{array}$$

$$(x-1) = 199118$$

$$\eta_1 = +38$$

$$A = 137.99$$

$$\eta_0 = -25191$$

$$A = 85600$$

$$\begin{array}{r}
 \log \eta_1 = 0.40125 \\
 7.33115
 \end{array}$$

$$X_0 = 85737.99$$

$$Red = +183$$

$$(x-1) = 307010$$

$$X = 85739.82$$

$$S-D = 19352$$

$$D = 212454$$

$$S_0 = 210518.8$$

$$Red = +1.1$$

$$S = 210519.9$$

3010 Lunar Parallax.
 $\alpha = 8^h 57^m 39.82^s (39.79)$
 $\delta = 10 37 19.5^s$
 $G - \alpha = +1 39 39.7^s$
 $\quad \quad + 24^m 54' 56'' \checkmark$

$\quad \quad + 10 06^s \checkmark$

$\quad \quad + 24 44 50^s \checkmark$

9.95727[✓]
 0.00000[✓]
 0.04184[✓]
 9.99911[✓]

$\mu = 44 56 29^s \checkmark$

$\delta = 21 05 20^s \checkmark$

$\quad \quad 23 51 09^s \checkmark$

9.82640[✓]
 8.24447[✓]
 9.60679[✓]
 0.15096[✓]
 7.82862[✓]

$S - \delta = +23 10 1^s \checkmark$

$\delta + 21 28 (30.4)^s \checkmark$
 $\quad \quad 30.0$

hant Allen $\delta = +21 28 34.9^s \checkmark$

$O - C = -49^s \checkmark$

Hayn Correction (-4.5)

$\delta = +21^m 05' 19.9^s \checkmark$

$\mu = 60' 21.72^s \checkmark$

9.86913[✓]
 8.24447[✓]
 9.62457[✓]
 0.03125[✓]
 7.76942[✓]

$\alpha - \alpha' = +20' 12.97^s \checkmark$

$\quad \quad + 1^m 20.86^s \checkmark$

$\alpha = 8 59 (00.65)^s \checkmark$
 $\quad \quad 00.68$

$\alpha = 8 58 59.65^s \checkmark$

$+103^s \checkmark$

$(+1.00)$

3010

Lunar Parallax.

9

$$\begin{array}{rcl}
 \alpha - & 8^h & 57^m & 39.82 \\
 \theta - & 10 & 37 & 19.5 \\
 \theta - \alpha = & +1 & 39 & 39.7 \\
 & + & 24^0 & 54' 56''
 \end{array}$$

$$+ \quad \quad \quad 10 \quad 06$$

$$+ \quad 29 \quad 44 \quad 50$$

$$995727$$

$$000000$$

$$004184$$

$$\hline 999911$$

$$f - 44 \quad 56 \quad 29$$

$$s - 21 \quad 05 \quad 20$$

$$23 \quad 51 \quad 09$$

$$982640$$

$$824447$$

$$960679$$

$$015096$$

$$\hline 782862$$

$$S - S' = +23 \quad 10.1$$

$$S + 21 \quad 28 \quad 30.0$$

$$\text{Humboldt } S = +21 \quad 28 \quad 39.9$$

$$O - C \quad \quad \quad - 4.9$$

$$S = +21^{\circ} 05' 19''$$

$$\pi = 60' 21.72$$

$$986913$$

$$824447$$

$$962457$$

$$003125$$

$$\hline 776942$$

$$\alpha - \alpha' = +20' 12.97$$

$$- + 1' 20.86$$

$$\alpha : 8 \quad 57 \quad 00.68$$

$$\alpha : 8 \quad 58 \quad 59.65$$

$$+ 103$$

191
1
8.4
12.

2
3
4.

3
32
19

1

1913 Mar 19

3023

d

$\begin{array}{r} \sqrt{16177} \\ 8.4 \quad 10201 \\ 25 \quad 9999 \\ 70 \\ \hline 12.4974 \end{array}$

$\begin{array}{r} \sqrt{9423} \\ 3.1 \quad 925858 \\ 20 \quad 52 \\ \hline 29.0167 \end{array}$

$\begin{array}{r} \sqrt{19360} \\ 32.8 \quad 17404 \\ 193 \quad 0110 \\ 49 \\ \hline 19.1953 \end{array}$

or

$\begin{array}{r} 1252927 \\ 2427 \\ 11820 \\ \hline 18.9292 \end{array}$

Stars - measures

4

N

$\begin{array}{r} 15029 \\ 1000103 \\ 00 \\ 20 \\ \hline 4976 \end{array}$

$\begin{array}{r} 1925848 \\ 124948 \\ 9078 \\ \hline 0174 \end{array}$

$\begin{array}{r} 15297 \\ 7221 \\ 7073 \\ 06 \\ \hline 1969 \end{array}$

$\begin{array}{r} 7998 \\ 7300 \\ 0802 \\ \hline 9305 \end{array}$

grade 2

1914 Mar 24

10

2

N

$\begin{array}{r} 15500 \quad 15450 \\ 936158 \quad 11581 \\ 51 \quad 7679 \\ 90 \quad 46 \\ \hline 8.3863 \quad 3869 \end{array}$

$\begin{array}{r} 965552 \\ 44 \\ 9183 \\ \hline 23.0467 \end{array}$

$\begin{array}{r} 19890 \\ 1844646 \\ 4246 \\ 83 \\ \hline 32.8556 \end{array}$

$\begin{array}{r} 18486 \\ 1686266 \\ 6566 \\ 86 \\ \hline 32.7978 \end{array}$

$\begin{array}{r} 14059 \\ 608955 \\ 91 \\ 68 \\ \hline 7978 \end{array}$

1913 Mar. 19
3023

Stars - measures

1914 Mar. 24

10

1 16177

24 10201

125 9977

70

12.4974

15029

1000103

00

20

4976

15500

936158

51

90

8.3863

15450

11581

7679

46

2869

2 9423

231 925858

290 52

29.0167

1925848

24948

9078

0174

965552

44

9183

23.0467

9228

8742

3936

0989

3 19360

328 17404

193 0110

49

19.1953

15297

7271

7073

06

1969

19890

1844646

42

83

32.8556

14068

551510

11

69

1557

or

1252927

2827

11820

18.9292

7998

7300

0802

19305made 2

11

18886

1686266

65

86

32.7974

14059

602985

91

68

1974

1
15
16

2
17
19

3
17
76
M
W
S

4
17
20

M
S

5
17
2

6
18
21

3023

Moon. measures

11

d	4	N	a	x	N
1	18405	14855			
15.0	14161	9086			
15.5	5051	9288			
	96	61			
	<u>18.4247</u>	<u>.4231</u>			

2		18488	17603
17.6		13030	1272239
19.0		29 30	31 38
		80	90
		<u>17.4846</u>	<u>4864</u>

3 scratch

173	14085	16674
198	10088	1276869
min	1912	6269
in	70	89
x	<u>19.6060</u>	<u>.6086</u>

17140	17600
9459 63	1528931
4656	40
35	86
<u>17.2320</u>	<u>2360</u>

4		16237	17779
17.2		7906	1609892
20.2		90 00	8812
min		24	80
in		<u>17.1673</u>	<u>1686</u>
x			

5		16209	18787
17.4		978071	1518782
21.9		81	79
		19	86
		<u>17.3562</u>	<u>3609</u>

6	15225	16777
18.0	6880	1510564
21.8	8187	11
	38	71
	<u>21.8353</u>	<u>.8331</u>

3023

Moon measures

11

$\frac{1}{180}$	18405	14855
185	19161	9086
	5051	9288
	96	61
	<u>18.4247</u>	<u>4231</u>

$$\begin{array}{r} 2 \\ 176 \\ 190 \end{array}$$

18188	17603
13030	1272239
2930	3138
80	90
<u>17.4846</u>	<u>4864</u>

$\frac{3}{173}$	14085	16674
198	10098	1276869
min	1912	6269
to	70	89
the	<u>196060</u>	<u>6086</u>

17140	17600
945963	1523931
4656	40
35	86
<u>17.2320</u>	<u>2360</u>

$$\begin{array}{r} 4 \\ 172 \\ 202 \\ \text{min} \\ \text{to} \\ \text{the} \end{array}$$

16237	17799
790600	1609892
90	88
24	80
<u>17.1673</u>	<u>1686</u>

$$\begin{array}{r} 5 \\ 174 \\ 219 \end{array}$$

16209	18787
978071	1518782
81	79
19	86
<u>17.3562</u>	<u>3604</u>

$\frac{6}{180}$	15225	16777
218	688087	1510564
	81	11
	38	71
	<u>21.8353</u>	<u>8331</u>

3023

Moon measures

12

	d	N
7	15075	18521
190	12421	11177
223	19	8089
	80	10
	<u>22.2658</u>	<u>2669</u>

8	15089	18519
194	12131	11465
224	2630	6165
max	81	10
u	<u>22.2958</u>	<u>2950</u>
y		

9	19790	19522
200	12871	11409
223	6978	2910
	79	07
	<u>22.1915</u>	<u>1903</u>

3023

Kraus measures

12

	d	N	d	N
2	15075	18521		
190	12421	11177		
223	19	8089		
	80	10		
	<u>222655</u>	<u>2669</u>		
8	15089	18519		
194	12131	11465		
219	2630	61		
224	81	10		
	<u>222958</u>	<u>2950</u>		
1				
1	19790	19522		
200	17871	11409		
223	6978	2910		
	79	07		
	<u>221915</u>	<u>1503</u>		

3023

Trines etc.

13

Exh test 1913 March 19,

Moon

Clock fast

H. Hart.

H. Hong

G. S. Hart.

Sid. T. W. Moon

Interval

Reduction

G. W. T.

12^h 04^m

12 10 26.2

0 58.9

12 09 27.45

4 44 31.05

16 53 58.50

23 45 41.95

17 08 16.55

2 48.46

17 05 28.09

- 12^h 16^m

- 12 10 26.5

0 58.9

θ - κ = + 2^h 09^m

- 4 44 31.05

16 53 58.50

23 45 41.95

17 08 16.55

2 48.46

17 05 28.09

From Hunt, Allen

R. A.

Decl.

Moon 17^h

Motion in 2.3624

5.4682

Tabular plan

10^h 00^m 28.68

+ 12.92

10 00 41.60

+ 15 31 06.6

+ 15^h 32' 31.6

15.550

- 1 25.0

+ 15 31 06.6

Moon's age

12 days

parallax

semidiameter

R

Augmentation

Irradiation (2)

R

R

(1+a)R

R²

60' 53.59

16 37.0

997.0

+ 14.0

- 0.5

1010.5

2.1661

2.1662

9.6925

934 = 12.3

997 = 14.0

a = + 0.7

3023

Trines etc.

Sept 1913 March 19.

12 ^h 04 ^m	- 12 ^h 16 ^m
12 10	26.2 - 12 10 26.5
0 589	

H.W.T.	12	09	27.45	$\theta - \alpha = + 2^h 09^m$
Libby	4	44	31.05	
G. S. T.	16	53	58.50	
Sid. H. W. T.	23	45	41.95	
Ind. W. T.	17	08	16.55	
Reduction			48.46	
G. W. T.	17	05	28.09	

From Hunt Allen

R A

Decl.

17 ^h	10 ^h	00 ^m	28.68	+ 15 ^h	32'	31.6
23624				15.550		
5.4682			+ 12.92	-	1	25.0
Tabular place	10	00	41.60	+ 15	31	06.6

Moon's age

12 days

parallax	60' 53.59
Semidiameter	16 37.0
R	99.70
Augmentation	+ 14.0
Parallax (2)	- 0.5
15	1010.5
.R	216.61
(1+a)R	216.62
q ²	9.6925

$934 = 12.3$
 $957 = 14.0$
 $a = + 0.7$

Plate constants.

3023	α	δ	R.A.	Decl.
8.38.66	124975	9 53 11 ^s	+14° 01' 17"	
23 04 78	29.01.76	10 00 58	+16 10 51	
32 85 56	19.19.61	10 06 15	+14 54 41	
64 29	60.71	29 59 84	+44 65 109	
21 43	20.24	10 00 08	+15 02 16	
-18	-22	- 1 46	+ 13 41	
3.43	176	9 58 22	+15 15 57	
31	4662			
106 ^s	821"			

Center of plate $\left\{ \begin{array}{l} A = 9^h 58^m 22^s \\ D = +15^\circ 15' 57'' \end{array} \right.$

$$\begin{array}{rclcl}
 2-3 & -8374 & -0.72 & +75^{\checkmark} & \\
 +977 & -10465 & -69-6 & = 0 & \\
 +2369 & -2429 & = -60-16 & = -76 & \\
 +1556 & -1607 & = -51-23 & = -74 & \\
 193358^{\checkmark} & -1685^{\checkmark} & -14^{\checkmark} & = 19.1734^{\checkmark} &
 \end{array}$$

$$\begin{array}{rclcl}
 4-7 & +852 & +1.54 & -1486 & \\
 +753 & +713 & +1466 & +19 & +1485 & = -1 & \\
 -517 & +1959 & +1442 & +44 & = +1486 & = 0 & \\
 -1335 & +2793 & +1458 & +29 & = +1487 & = +1 & \\
 20.1282 & +1644 & +30^{\checkmark} & = 20.1470^{\checkmark} & & &
 \end{array}$$

$$\begin{array}{lclcl}
 \text{Tables} & a = -0.2 & e = -0.9 & a - e = +0.7 & b + e = -1.8 \\
 \text{Obs} & a = +0.7 & e = -1.5 & a - e = +2.2 & b + a = -1.3
 \end{array}$$

Plate Constants

14

3023	Plate Constants					Recd.		
x	y	u	v	R	A			
8.3866	12.4975	9	53	11	+14°	01'	17"	
23.0478	29.0176	10	00	58	16	10	51	
32.8556	19.1961	10	06	15	114	54	41	
64.29	60.71	29	59	84	44	65	109	
21.43	20.24	10	00	08	+15°	02'	16"	
-18	-22	-	1	46	+	13	41	
3.43	1.76	9	58	22	+15°	15'	57"	
31	46.62							
106°	821"							

Center of Plate $\begin{cases} A = 9^h 58^m 22^s \\ D = +15^\circ 15' 57'' \end{cases}$

$$\begin{array}{rclcl}
 2-3 & -8374 & -0.72 & +75 & \\
 +977 & -10465 & -69 & -6 & -75 \\
 +2369 & -2429 & -60 & -16 & -76 \\
 +1556 & -1607 & -51 & -23 & -74 \\
 143358 & -1685 & -14 & & = 19.1734
 \end{array}$$

$$\begin{array}{rclcl}
 4-7 & +852 & +1.54 & & -1486 \\
 +753 & +713 & +1466 & +19 & +1485 & : -1 \\
 -517 & +1959 & +1442 & +44 & +1486 & : 0 \\
 -1335 & +2793 & +1458 & +29 & +1487 & : +1 \\
 20.1282 & +1644 & +30 & & = 20.1470
 \end{array}$$

Tables $a = -0.2$ $c = -0.9$ $a - c = +0.7$ $b + c = -1.8$
 Dbs $a = +0.7$ $c = -1.5$ $a - c = +2.2$ $b + a = -1.3$

3023

Standard Coordinates

15

Cape No. 1360 m 98.7			Cape No. 1377 m 6.3			Cape No. 1390 m 98.8		
C	9 ^h 52 ^m	28.62	10 ^h 00 ^m	15.40		10 ^h 05 ^m	32.79	
L		56		39			79	
E		59		34			74	
Mean	9 52	28.59	10 00	15.38		10 05	32.77	
Proc	+	42.23	+	42.38		+	42.16	
X	9 53	10.82	10 00	57.76		10 06	149.3	
A	9 58	22	9 58	22		9 58	22	
x-A	-5	11.18	+	2 35.76		+	7 52.93	
tan(x-A)	-3	11.15	+	1 55.76		+	4 72.84	
log...	2.49297~		2.19246			2.67472		
cos	9.98686		9.98245			9.98512		
30	0.98707~		0.68215			1.16708		
30	-9.7066		+4.8100			+14.6920		
31	-	45	+	9		+	80	
32	8.2889		22.8109			32.7000		
2	8.3866		23.0478			32.8556		
2-3	+	977	+	2369		+	1556	
C	+14° 04' 58".6		+16° 14' 37".5			+14° 58' 30".3		
L		59.2		37.6			30.1	
E		58.4		36.9			29.2	
Mean	+14 04	58.7	+16 14	37.3		+14 58	29.9	
Proc	-	3 41.5	-	3 46.3		-	3 49.0	
S	+14 01	17.2	+16 10	51.0		+14 54	40.9	
D	+15 15	57	+15 15	57		+15 15	57	
S-D	-1 14	39.8	+	54 54.0		-	21 16.1	
tan(S-D)		-44.80.5		+32.94.3			-12.76.1	
log...	3.65132~		3.51776			3.10588~		
40	0.98247~		0.84891			0.43703~		
tan	9.3975		9.4626			9.4254		
32	19.741		13.643			23.342		
41	84.250		78.803			88.130		
40	-9.6044		+7.0617			-2.7354		
41	+	26.6	+	7.6		+	6.50	
42	12.4222		29.0693			19.3296		
43	12.4975		25.0176			19.1961		
4-4	+	753	-	517		-	1335	

3023 Standard Coordinates

15

Cap. W. 1360 ~ 987

Cap. W. 1377 ~ 963

Cap. W. 1390 ~ 988

C	9° 52' 28.62	10° 00' 15.40	10° 05' 32.79
L	56	39	79
E	59	34	74
mean	9 52 28.59	10 00 15.38	10 05 32.77
Proc	+ 42.23	+ 42.38	+ 42.16
X	9 53 10.82	10 00 57.76	10 06 14.93
A	9 58 22	9 58 22	9 58 22
X A	- 5 11.18	+ 2 35.76	+ 7 52.93
int(X-A)	- 3 11.15	+ 1 55.76	+ 4 72.84
log	2.49297~	2.19246	2.67472
log	9.98686	9.98245	9.98512
S ₀	09.8707~	06.8215	11.6708
S ₁	- 9.7066	+ 4.8100	+ 14.6920
S ₂	- 45	+ 9	+ 80
S ₃	8.2889	22.8109	32.7000
S ₄	8.3866	23.0478	32.8556
S ₅	+ 9.77	+ 2.369	+ 15.56

C	+ 14° 04' 58.6	+ 16° 14' 37.5	+ 14° 58' 30.3
L	592	376	501
E	584	369	292
mean	+ 14 04 58.7	+ 16 14 37.3	+ 14 58 29.9
Proc	- 3 41.5	- 3 46.3	- 3 49.0
X	+ 14 01 17.2	+ 16 10 51.0	+ 14 54 40.9
D	+ 15 15 57	+ 15 15 57	+ 15 15 57
S ₀	- 1 14 39.8	+ 54 54.0	- 21 16.1
int(D)	- 44.805	+ 3294.3	- 1276.4
log	3.65132~	3.51776	3.10588~
log	0.98247~	0.84891	0.43703~
log	9.3975	9.4626	9.4254
log	1.9741	1.3643	2.3342
log	8.4250	7.8803	8.8130
S ₀	- 9.6044	+ 7.0617	- 2.7354
S ₁	+ 266	+ 76	+ 650
S ₂	1.24222	29.0693	19.3296
S ₃	1.24975	25.0176	19.1961
S ₄	+ 753	- 517	- 1335

	p	$p-c$			Q	corr.	
1	1422	1232	-1.9	+2.2	-3.8	0.0	0
2	1214	1024	-2.2	+0.9	-2.8	-0.2	-1.8
3	1038	848	-2.2	-0.4	-1.5	+0.8	+7.4
4	900	710	-2.1	-1.3	-0.5	+0.6	+5.5
5	663	473	-1.6	-2.7	+1.4	-0.4	-3.7
6	379	189	-0.7	-3.8	+3.4	+0.3	+2.8
7	88	3498	+0.4	-4.0	+4.7	-0.2	-1.8
8	00	3410	+0.7	-3.8	+4.8	+0.6	+5.5
9	342.2	3232	+1.3	-3.2	+4.8	-0.1	-9

$$\lambda = -2.21$$

$$\beta = -4.03$$

$$C = 19.0$$

		corr.	old		new
Res.	Hayn	O-C	O-C	Hayn	O-C
-2.2	0	-2.2	-4.4	+4.6	-1.0
+4.8	-1.8	+6.6	-9.9	-6.4	-3.5
-3.1	+7.4	-10.5	-9	+4.3	-9.2
+6.9	+1.5	+1.4	-31.3	-6.4	-2.4
-21.6	-3.7	-17.9	-5.7	+2.8	-8.5
+1.7	+2.8	-1.1	-12.3	-7.4	-4.9
-7.8	-1.8	-6.0	+1.3	+1.5	-4.2
+4.6	+5.5	-9	+3.4	0	+3.4
+4.2	-9	+5.1			

	p	$p-c$	$\lambda \sin(p-c)$	$\beta \cos(p-c)$	Q	corr.	Hayn	O	$O-C$
1	217.8	198.8	+0.7	+3.8	-3.8	+0.5	+4.6	-2.2	-6.8
2	238.6	219.6	+1.4	+3.1	-1.4	0.0	0	+4.8	+4.8
3	256.2	237.2	+1.9	+2.2	0.0	-0.7	-4.4	-3.1	-3.3
4	270.0	251.0	+2.1	+1.3	+1.1	+0.9	+8.3	+6.9	-1.4
5	293.7	274.7	+2.2	-0.8	+2.8	-0.7	-6.4	-2.1	-1.5
6	322.1	303.1	+1.9	-2.2	+4.4	+0.3	+2.8	+1.7	-1.1
7	351.2	332.2	+1.0	-3.6	+4.9	-0.8	-7.4	-7.8	-4
8	360.0	341.0	+0.7	-3.8	+4.8	+0.6	+5.5	+4.6	-9
9	17.8	358.8	+0.1	-4.0	+4.4	0.0	0	+4.2	+4.2

3023

Luoou's Center

16

	x	$x - X_0$	Δx	$(x - X_0)^2$	$(x - X_0)^2 + (y - Y_0)^2$	$G - C$
1	18.0000	-1.3340	-3	1.7804	4.6881	-44
2	17.4855	-1.8485	-2	3.4177	4.6923	-2
3	17.2340	-2.1000	-1	4.4104	4.6826	-99
4	17.1680	-2.1660	0	4.6916	4.6916	-9
5	17.3583 ^v	-1.9757 ^v	+2	3.9026 ^v	4.6612 ^v	-313 ^{1/2}
6	18.0000	-1.3340	+3	1.7788	4.6868	-57
7	19.0000	0.3340	+4	0.1113	4.6802	-123
8	19.3340	0.0000	+4	0.0000	4.6938	+13
9	20.0000	+0.6660	+4	0.4441	4.6959	+34

Comp $R^2 = 4.6925$

	y	$y - Y_0$	Δy	$(y - Y_0)^2$
1	18.4239	-1.7051	-1	2.9077
2	19.0000	-1.1290	-0	1.2746
3	19.6073	-0.5217	-0	0.2722
4	20.1290	0.0000	0	0.0000
5	21.0000 ^v	+0.8710 ^v	+0	0.7586 ^v
6	21.8342	+1.7052	+1	2.9080
7	22.2664	+2.1374	+1	4.5689
8	22.2904	+2.1664	+1	4.6938
9	22.1909	+2.0619	+1	4.2518

Approx Center

$$x = 18.0 \quad y = 18.4239$$

$$21.8342$$

$$40.2581$$

$$Y_0 = 20.1290$$

$$y = \text{mean} = 22.2954$$

$$R = 2.1664$$

$$x = \text{min} = 17.1680$$

$$X_0 = 19.3344$$

$$\text{Center} \begin{cases} X_0 = 19.3340 \\ Y_0 = 20.1290 \end{cases}$$

3023

Lucas Center.

16

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$G - C$
1	180000	-13340	-3	17804	46881	-44
2	174855	-18485	-2	34177	46923	-2
3	172340	-21000	-1	44104	46826	-99
4	171680	-21660	0	46916	46916	-9
5	173543	-19757	+2	39026	46612	-313 ^{1/2} inch
6	180000	-13340	+3	17788	46869	-57
7	190000	03340	+4	01113	46802	-123
8	193340	00000	+4	00000	46938	+13
9	200000	06660	+4	04441	46959	+34

Comp $R^2 = 46925$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	184239	-17051	-1	29077
2	190000	-11290	-0	12746
3	196073	-05217	-0	02722
4	201290	00000	0	00000
5	210000	+08710	-0	07586
6	218342	+17052	+1	29080
7	222664	+21374	+1	45689
8	222954	+21664	+1	46938
9	221909	-20619	+1	42518

Approx Center.

$$x = 18000 \quad y = 184239$$

$$218342$$

$$402581$$

$$y_0 = 201290$$

$$y - \text{min} = 222954$$

$$R = 21664$$

$$x - \text{min} = 171680$$

$$x_0 = 193344$$

$$\text{Center} \left\{ \begin{array}{l} x_0 = 193340 \\ y_0 = 201290 \end{array} \right.$$

Formation of Komnals.

With Hayn's Correction

	ab	ac	bc	ab	ac
1	+ 2.28	+ 58.5	+ 75.3	+ 133.0	+ 171.0
2	+ 2.09	+ 3.7	+ 23	+ 3.7	+ 2.3
3	+ 1.09	+ 208.0	+ 51.5	+ 73.5	+ 18.2
4	- 0.00	+ 19.6	- 0.0	+ 199.2	- 0.0
5	- 0.43	+ 155.0	- 68.0	+ 493.0	- 216.5
6	- 2.28	+ 75.8	- 97.5	+ 113.0	- 145.2
7	- 0.71	+ 40.6	- 263.0	+ 16.2	- 105.0
8	+ 0.00	+ 0.0	+ 28.2	- 0.0	- 91.1
9	+ 1.38	+ 22.8	+ 70.0	+ 22.8	+ 70.0
	+ 3.42	+ 584.0	- 201.2	+ 1054.4	- 296.3
Group 5 full	- 1.29				
	+ 2.13				

O	C	O - C
1 -100	- 71 + 32 = - 39	- 61
2 -2	- 99 + 21 = - 78	+ 76
3 -35	- 113 + 10 = - 103	+ 68
4 -92	- 116 - 0 = - 116	+ 24
5 -249	- 106 - 16 = - 122	- 127
6 -85	- 71 - 32 = - 103	+ 18
7 -49	- 77 - 40 = - 117	+ 68
8 -42	+ 0 - 41 = - 41	- 1
9 +34	+ 36 - 39 = - 3	+ 37

+291 - 189
Average = 53

3023

Moon's Center

17

Conditional Equation

	a	b	c	0	c	0-c
1	-1.33	-1.71	-44	-48+26	-22	-22
2	-1.85	-1.13	-2	-67+17	-50	+48
3	-2.10	-0.52	-99	-76+8	-68	-31
4	-2.17	+0.00	-9	-78-0	-78	+69
5	-1.98	+0.87	-313	-36-12	-48	-108-216
6	-1.33	+1.71	-57	-48-26	-74	+17
7	-0.33	+2.14	-123	-12-33	-45	-78
8	+0.00	+2.17	+13	+0-33	-33	+46
9	+0.67	+2.06	+34	+24-32	-8	+42
						+222-239
						Average = 51

Normal Equations

$$\begin{aligned}
 +17.61 + 3.42 &= +58.9 \\
 +3.42 + 21.07 &= -20.1 \\
 -3.42 - 0.66 &= -11.3 \\
 +20.41 &= -31.4
 \end{aligned}$$

$$b = -15.4$$

$$+17.61 = +58.9 + 53 + 637$$

$$a = +36.2$$

With Hayn cor

$$+20.54 + 22.13 = +105.4$$

$$+21.3 + 21.64 = -29.6$$

$$-2.13 - 22.2 = -10.9$$

$$+21.42 = -40.5$$

$$b = -18.9$$

$$+20.54 = +105.4 + 40.5 + 109.4$$

$$a = +53.4$$

Arc measured = 160°

$$\text{Average } (0-c) = -2$$

$$\frac{0-c}{n} = 0.20$$

$$-\frac{2}{20} = -0.10 \quad \Delta c = -0.1$$

3023

Moon's Center

17

Conditional Equation

	a	b	0	c	0-c
1	-133	-171	-44	-48-26 = -22	-22
2	-185	-113	-2	-67-17 = -50	+48
3	-210	-052	-99	-76-8 = -68	-31
4	-217	+000	-9	-78-0 = -78	+69
5	-198	+087	-313	-36-12 = -48	-108
6	-133	+171	-57	-48-26 = -74	+17
7	-033	+214	-123	-12-33 = -45	-78
8	+000	+217	+13	-0-33 = -33	+46
9	+067	+206	+34	+24-32 = -8	+42
					+222-239
					Average = 51

Normal Equation

$$\begin{aligned}
 +1761 + 342 &= +584 \\
 +342 + 2107 &= -201 \\
 -342 - 066 &= -113 \\
 +2041 &= -314
 \end{aligned}$$

$$b = -15.4$$

$$+1761 = +584 + 53 + 637$$

$$a = +362$$

With Hagen's

$$\begin{aligned}
 +20.54 + 2213 &= +1054 \\
 +213 + 2164 &= -296 \\
 -213 - 22 &= -109 \\
 +2142 &= -405
 \end{aligned}$$

$$b = -18.9$$

$$+20.54 = +1054 + 40 + 1094$$

$$a = +534$$

Arc measured 160°

Average = -2

$$\frac{160}{n} = 0.20$$

$$-\frac{2}{20} = -0.10 \quad \Delta z = -0.1$$

3023 Moon's Mean Position (1913.0)

18

$$\begin{array}{r}
 X_0 = 19.3340^{\circ} \\
 - \frac{1}{2}a = -1.8^{\circ} \\
 \hline
 19.3358^{\circ} \\
 19.3367^{\circ}
 \end{array}$$

$$\begin{array}{r}
 Y_0 = 20.1290^{\circ} \\
 - \frac{1}{2}b = -0.8^{\circ} \\
 \hline
 20.1282^{\circ} \\
 20.1281^{\circ}
 \end{array}$$

From Plate Constants $X = 19.1734^{\circ}$ $Y = 20.1470^{\circ}$

$$\bar{s} = +1.1734^{\circ}$$

$$m = -1.8530^{\circ}$$

$$\begin{array}{r}
 \log 3 \quad 0.06978^{\circ} \\
 \log 5 \quad 0.00434^{\circ} \\
 \hline
 8.50724^{\circ}
 \end{array}$$

$$\begin{array}{r}
 \log \tan \delta \quad 9.4281^{\circ} \\
 - \frac{1}{2} \quad 0.1389^{\circ} \\
 \hline
 7.0534^{\circ} \\
 m_1 \quad 6.6204^{\circ}
 \end{array}$$

$$..(\alpha - A) \quad 1.57765^{\circ}$$

$$m_1 \quad + \quad 4^{\circ}$$

$$\alpha - A \quad +37.811^{\circ}$$

$$m_0 = -1.8530^{\circ}$$

$$A \quad 9 \quad 58 \quad 22^{\circ}$$

$$\begin{array}{r}
 \log m_0 \quad 0.26800^{\circ} \\
 7.33115^{\circ}
 \end{array}$$

$$\alpha_0 \quad 9 \quad 58 \quad 59.89^{\circ}$$

$$..(s - D) \quad 2.93683^{\circ}$$

$$Red = +1.93^{\circ}$$

$$s - D \quad -14 \quad 24.7^{\circ}$$

$$\alpha' = 9 \quad 59 \quad 01.74^{\circ}$$

$$D + 15 \quad 15 \quad 57^{\circ}$$

$$S_0 + 15 \quad 01 \quad 32.3^{\circ}$$

$$Red = -4.1^{\circ}$$

$$s' = +15 \quad 01 \quad 28.2^{\circ}$$

3023 Moon's Mean Position (1913.0)

18

$$X_0 = 19.3340$$

$$Y_0 = 20.1290$$

$$-w = -18$$

$$-8$$

$$19.3358$$

$$20.1282$$

$$19.3367$$

$$20.1281$$

From Plate Constants $X = 19.1734$ $Y = 20.1472$

$$z = +1.1734$$

$$m = -1.8530$$

$$\log S = 0.06978$$

$$\log \tan S = 9.4281$$

$$wss = 9.98459$$

$$z = 0.1389$$

$$8.50724$$

$$7.0534$$

$$(x-A) = 1.57765$$

$$y = 6.6204$$

$$x-A = -37.811$$

$$m_1 = 4$$

$$A = 9.5822$$

$$m_0 = -1.8535$$

$$Q_0 = 9.5859.815$$

$$\log m_0 = 0.26807$$

$$7.33115$$

$$Rad = +1.93$$

$$(d-D) = 2.93685$$

$$Q = 9.590174$$

$$\delta-D = -14.247$$

$$D = +1.51557$$

$$S_0 = +1.501323$$

$$Rad = -4.1$$

$$\delta' = +1.501282$$

3023

Red ad locum alp.

19

$$S = +15^{\circ} 01'$$

$$H + \alpha \quad 4^{\circ} 03' = 60^{\circ} 45' \\ H \quad 18 \quad 04' \\ \alpha \quad 9 \quad 59' \\ \delta \quad 19 \quad 30' \\ \delta + \alpha \quad 5 \quad 29' = 82^{\circ} 15'$$

$$\begin{array}{r} l \cos S \quad 99849 \\ i \quad 0.9109 \\ \hline (i) \quad 0.8988 \end{array}$$

$$\begin{array}{r} l \cos(H + \alpha) \quad 9.1298 \\ d \quad 1.0213 \\ \sin \quad 9.9960 \\ \tan S \quad 9.4286 \\ \frac{1}{\sin} \quad 8.8239 \\ \delta' \quad 0.1511 \\ (\delta) \quad 9.2698 \end{array}$$

$$\begin{array}{r} l \sin S \quad 9.4135 \\ \cos(H + \alpha) \quad 9.6890 \\ h \quad 1.2737 \\ \sin \quad 9.9408 \\ \sec \delta \quad 0.0151 \\ \frac{1}{\sin} \quad 8.8239 \\ h' \quad 0.3762 \\ (h) \quad 0.0535 \end{array}$$

$$\begin{array}{r} l \quad +0.61 \\ S \quad +0.19 \\ h \quad +1.13 \\ \hline +1.93 \end{array}$$

$$\begin{array}{r} \delta' \quad +1.42 \\ h \quad +2.38 \\ i \quad -7.87 \\ \hline -4.07 \end{array}$$

3023

Red ad locum ahp.

19

$$1+x \quad 4 \quad 03 = 60^{\circ} 45'$$

$$H \quad 18 \quad 04$$

$$x \quad 9 \quad 59$$

$$G \quad 19 \quad 30$$

$$1+x \quad 5 \quad 29 = 82^{\circ} 15'$$

$$1 \cos(H+x) \quad 9.1298^m$$

$$q \quad 1.0213^m$$

$$\sin \quad 9.9960$$

$$\cos S \quad 9.4286$$

$$\frac{1}{10} \quad 8.6239$$

$$(8') \quad 0.1521^m$$

$$(9') \quad 9.2698$$

$$f \quad +0.61$$

$$S \quad +0.19$$

$$c \quad +1.13$$

$$\quad +1.93$$

$$S = +1.5^{\circ} 01'$$

$$\cos S \quad 9.9849^m$$

$$i \quad 0.9109^m$$

$$(h) \quad 0.8958^m$$

$$1 \sin S \quad 9.4135^m$$

$$\cos(H+x) \quad 9.6890^m$$

$$h \quad 1.2737^m$$

$$\sin \quad 9.9408$$

$$\sec S \quad 0.0151$$

$$\frac{1}{10} \quad 8.8239$$

$$(h) \quad 0.3762$$

$$(h) \quad 0.0535$$

$$S' \quad +1.43$$

$$S \quad +2.38$$

$$c \quad -7.87$$

$$\quad -6.87$$

3023

Lunar parallax.

$$\begin{array}{r}
 \alpha' = 9^h 59^m 01.574^s \\
 \theta = 12 \quad 09 \quad 27.45^s \\
 \theta - \alpha = +2 \quad 10 \quad 25.73^s \\
 \quad \quad \quad - \quad \quad 32^s \quad 36' \quad 26''
 \end{array}$$

$$\begin{array}{r}
 \quad \quad \quad 12 \quad 36^s \\
 + \quad 32 \quad 23 \quad 50^s
 \end{array}$$

$$\begin{array}{r}
 9.95727^s \\
 0.00000 \\
 0.07348^s \\
 \hline
 0.03075^s
 \end{array}$$

$$\begin{array}{r}
 \delta = 47 \quad 01 \quad 36^s \\
 \quad \quad 15 \quad 01 \quad 28^s \\
 \quad \quad 32 \quad 00 \quad 08^s
 \end{array}$$

$$\begin{array}{r}
 9.82690^s \\
 8.24827^s \\
 9.72424^s \\
 0.13568^s \\
 \hline
 793459^s
 \end{array}$$

$$s - s' = +29 \quad 34.3^s$$

$$s = 15 \quad 31 \quad 02.5^s$$

$$\text{Nautical Almanac } s = +15 \quad 31 \quad 06.6^s$$

$$\theta - c = -4.4^s$$

$$s' = +15^{\circ} 01' 28.2''^{20}$$

$$\pi = 60' 53.6''$$

$$\begin{array}{r}
 9.86913^s \\
 8.24827^s \\
 9.73149^s \\
 0.01612^s \\
 \hline
 7.86501^s
 \end{array}$$

$$\alpha - \alpha' = +25' 11.61''$$

$$= +1'' 40.77''$$

$$10 \quad 00 \quad 42.51^s$$

$$x = 10 \quad 00 \quad 41.60^s$$

$$+0.91^s$$

Hays's corrections have been applied.

3023

Lunar paral. cov.

20

$$\begin{aligned} \alpha' &= 9^h 59^m 01^s 74 \\ \delta &= 12 \quad 09 \quad 27.45 \\ 0-\alpha &= +2 \quad 10 \quad 25.73 \\ &= - \quad 32 \quad 36 \quad 26'' \end{aligned}$$

$$\delta' = +15^\circ 01' 28'' 2$$

$$\pi = 60' 53'' 6$$

$$= 12 \quad 36$$

$$+ 32 \quad 23 \quad 50$$

$$\begin{array}{r} 995727 \\ 000000 \\ 007348 \\ \hline 003075 \end{array}$$

$$\begin{array}{r} 986913 \\ 824827 \\ 973149 \\ 001612 \\ \hline 786501 \end{array}$$

$$\alpha - \alpha' = +25' 11.61$$

$$= +1 \quad 40.77$$

$$\delta = 47 \quad 01 \quad 36$$

$$15 \quad 01 \quad 28$$

$$32 \quad 00 \quad 08$$

$$\begin{array}{r} 982640 \\ 824827 \\ 972424 \\ 013568 \\ \hline 793459 \end{array}$$

$$S - S' = +29 \quad 34.3$$

$$S = 15 \quad 31 \quad 02.5$$

$$\text{Haukfler } S = +15 \quad 31 \quad 06.6$$

$$0 - C = -44$$

$$10 \quad 00 \quad 42.57$$

$$X = 10 \quad 00 \quad 41.60$$

$$+0.91$$

Harpis corrections have been applied

1913 Mar 19

30 2 4

d

$\sqrt{}$ 19125
 72 1290906
 13.6 05
 20
13.6215

$\frac{2}{22.0}$ 12570
 22.0 12240
 20.0 3943

30.0329

$\frac{3}{31.8}$ 17058
 31.8 15706
 20.2 0100
 43
20.1353

Atlas - measures

y

n

18540
 1474182
 31
 00
6229

13259
 5556
 12911

.0346

16000
 7360
 6457
 00
1360

braces 3

1914 Mar 25

21

d

x

n

18490
 1086568
 69
 95
72373

1256162
 71
 12292

22.0273

16092
 1367781
 79
 79
31.7590

18857
 1647080
 81
 60
12381

13570
 13298
 8891

.0278

17855
 1023238
 3938
 40
7608

1913 Jan 15

30 2 4

 α

$\frac{1}{2}$ 19125
 72 1290906
 136 05
 20

13.6215

$\frac{2}{22.0}$ 12570
 30.0 12240
 3943

30.0329

$\frac{3}{31.8}$ 17058
 19.2 15706
 0100
 43
19.1353

Stars - measures

 γ

18540
 1474132
 31
 00

6229

13259
 5556
 12911

0346

16000
 7360
 6457
 00
1360

grade 3

1914 Mar 25

 α α

18490
 1086568
 69
 95

7.2373

12.56162
 71
 12292

22.0273

16092
 1367781
 79
 79
31.7590

 α

18857
 1647080
 81
 60

2381

13570
 13298
 8891

0278

17855
 1023238
 3938
 40
7608

21

3024

moon-measures

22

d

u

N

d

u

N

<u>1</u>	15-232	2005-5-
18.0	85-05	16780
18.7	17	7876
	29	40
	<u>18.6719</u>	<u>.6728</u>

2
17.7
19.0

15-127	145-19
1190806	77.0008
04	0108
21	20
<u>17.6781</u>	<u>.6817</u>

3
17.3
20.0

14098	14589
6495	1215179
9599	72
50	91
<u>17.2409</u>	<u>.2412</u>

4
17.2
20.4
min
u
N

20047	14955
1214035	1284650
5149	49
44	55
<u>17.2100</u>	<u>.2107</u>

5
17.4
21.0

19032	15002
12211	1181510
0511	19
29	92
<u>17.3179</u>	<u>.3184</u>

<u>6</u>	14198	958975-
18.0	14045-27	78
22.0+	2627	9419
	<u>22.0167</u>	<u>.0160</u>

3024

Moon measures

22

d a n d = w

$$\begin{array}{r}
 1 \\
 18.0 \quad 15-232 \quad 2005-5- \\
 18.7 \quad 85-05-15 \quad 16780 \\
 \quad 17 \quad 7876 \\
 \quad 29 \quad 40 \\
 \hline
 18.6719 \quad 6728
 \end{array}$$

$$\begin{array}{r}
 2 \\
 17.7 \\
 19.0
 \end{array}$$

$$\begin{array}{r}
 15127 \\
 1190806 \\
 \quad 04 \\
 \quad 21 \\
 \hline
 17.6781
 \end{array}$$

$$\begin{array}{r}
 14519 \\
 7700 \\
 \quad 0108 \\
 \quad 20 \\
 \hline
 6817
 \end{array}$$

$$\begin{array}{r}
 3 \\
 17.3 \\
 19.0
 \end{array}$$

$$\begin{array}{r}
 14098 \\
 6495-99 \\
 \quad 95-99 \\
 \quad 50 \\
 \hline
 17.2409
 \end{array}$$

$$\begin{array}{r}
 14589 \\
 1218179 \\
 \quad 72 \\
 \quad 91 \\
 \hline
 2412
 \end{array}$$

$$\begin{array}{r}
 4 \\
 17.2 \\
 W.F \\
 min \\
 n \\
 x
 \end{array}$$

$$\begin{array}{r}
 20047 \\
 1214035- \\
 \quad 5149 \\
 \quad 44 \\
 \hline
 17.2100
 \end{array}$$

$$\begin{array}{r}
 14955 \\
 1284650 \\
 \quad 45 \\
 \quad 55 \\
 \hline
 2107
 \end{array}$$

$$\begin{array}{r}
 5 \\
 17.4 \\
 21.0
 \end{array}$$

$$\begin{array}{r}
 19032 \\
 12211 \\
 \quad 0511 \\
 \quad 29 \\
 \hline
 17.3179
 \end{array}$$

$$\begin{array}{r}
 15002 \\
 1181110 \\
 \quad 19 \\
 \quad 92 \\
 \hline
 3184
 \end{array}$$

$$\begin{array}{r}
 6 \\
 18.0 \quad 14198 \quad 958975- \\
 22.0 \quad 14045-27 \quad 78 \\
 \quad 2627 \quad 9419 \\
 \hline
 22.0167 \quad 0160
 \end{array}$$

30 24

a

moon measures.

4

n

a n

23

7 17261

15709

19.0 12541

1045033

22.4 3189

2325

50

98

22.4718.4724

8 17259

17089

19.4 12126

1220508

22.5 29

12

max 49

76

w 22.5126

5126

9 16650

17125

w.0 12446

1130195

22.4 31

05

36

07

22.4207.4186

30 24

a

known measures

4

n

a

n

23

7 17261

15709

190 12541

104 ~~1033~~224 31 ~~39~~

2325

50

98

22.47184724

8 17219

17019

194 1212630

1220508

225 29

12

max 49

76

22.5126

5126

9 16650

17125

20 1244633

1130195

224 31

05

36

07

22.42074186

3024

Times etc.

24

Epistlan 1913 Mar 19, $12^h 26^m$ - $12^h 38^m$
 Moon $12 32 00.7 - 12 32 01.0$
 Clock fast $0 58.9$

W. L. T. $12 31 01.95$ $\theta - \alpha - + 2^m 30^m$
 Khong $4 44 31.05$
 G. L. T. $17 15 33.00$
 Sid. T. L. Moon $23 45 41.95$
 Internal $17 29 51.05$
 Reduction $2 51.99$
 G. L. T. $17 26 59.06$

From Kantaleu.

R.A. Decl.
 Moon $17^h 10^m 00^s 28.68$ $+ 15^\circ 32' 31.6''$
 Motion in $1^m 2.3616$ 15.567
 .. 26.9843 $+ 1 03.73$ $- 7 00.1$
 Tabular place $10 01 32.41$ $+ 15 25 31.5$

Moon's age 12 days

$934 = 11.65$
 $947 = 13.3$

parallax $60' 53.92$
 Semidiameter $16 37.1$
 R 997.1
 Augmentation $+ 13.3$
 Irradiation (3) $- 0.7$
 R 10097
 R 21644
 $a = + 2.6$ $(1 + 2) R$ 21649
 R^2 4.6868

3024

Times etc.

24

Station 1913 Mar 19	12"	26"		- 12"	35"	
Known	12	32	007	- 12	32	010
crossed out		0	589			

Light	12	31	0195	6-X-12"	30"
Khong	4	44	3105		
G. Light	17	15	3300		
Sid. T. in known	23	45	4195		
Intensified	17	29	5105		
Reduction		2	5199		
G. L. T.	17	26	5906		

From Kantaleu.

Known 17"	10"	00"	28.68	+ 15"	32'	31.1
Unknown 17" 2.3616				15.567		
26.9843	+	1	0373	-	7	00.
Tabular place	10	01	32.41	+ 15"	25	31.

Known age 12 days.

$9.24 = 11.61$
 $8.29 = 13.2$

parallax	60'	53.92
semimajor	16	37.1
R	997.1	
Augmentation	+ 1.33	
Immaturity (B)	- 0.7	
R	1009.7	
R	2.1644	
(1 + a) R	2.1649	
R ²	4.6865	

a = +2.6

3024

Plate constants

25

	1	2	3
x	72377	220276	317599
y	82889	224109	327000
$x-\bar{x}$	-1.0512	-7833	-9401

q	136222	300338	201356
η	124222	290693	193296
$q-\bar{q}$	+12000	+9645	+8060

$$\begin{aligned}
 x-\bar{x} & -1.614 & -2.6x & +1.2724 \\
 -1.0512 - 2193 & = -1.2705 & -19 & = -1.2724 = 0 \\
 -7833 - 4835 & = -1.2668 & -57 & = -1.2725 = -1 \\
 -9401 - 3240 & = -1.2641 & -83 & = -1.2724 = 0 \\
 193770^{\vee} - 3275^{\vee} & & -50^{\vee} & = 20.3169^{\vee}
 \end{aligned}$$

$$\begin{aligned}
 y-\bar{y} & +1.6112 & -1.6y & -1.3144 \\
 +1.2000 + 1166 & = +1.3166 & -22 & = +1.3144 = 0 \\
 +9645 + 3548 & = +1.3193 & -48 & = +1.3145 = +1 \\
 +8060 + 5116 & = +1.3176 & -32 & = +1.3144 = 0 \\
 20.3445^{\vee} + 3122^{\vee} & & -33^{\vee} & = 19.3396^{\vee}
 \end{aligned}$$

Tables $a = -0.4$ $e = -1.0$ $a - e = +0.6$ $b + a = -2.2$
 Obs $a = +2.6$ $e = +1.6$ $a - e = +1.0$ $b + a = -0.1$

3024

Plane Constants

25

	1	2	3
x	7.2377	22.0276	31.7599
y	8.2889	22.4109	32.7000
$z - \bar{z}$	-1.0512	-7.833	-9.401

q	13.6222	30.0338	20.1356
η	12.4222	29.0643	19.3296
$q - \eta$	+1.2000	+9.645	+8.060

$$\begin{array}{rcll}
 x - \bar{x} & -1.614 & -2.6x & +1.2724 \\
 -1.0512 - 2.193 & = & -1.2705 - 1.9 & = -1.2724 = 0 \\
 -7.833 - 4.835 & = & -1.2668 - 5.7 & = -1.2725 = -1 \\
 -9.401 - 3.240 & = & -1.2641 - 8.3 & = -1.2724 = 0 \\
 19.3770 - 32.75 & & -50 & = 20.3169
 \end{array}$$

$$\begin{array}{rcll}
 y - \eta & +1.6112 & -1.6y & +1.3144 \\
 +1.2000 + 1.166 & = & +1.3166 - 2.2 & = +1.3144 = 0 \\
 +9.645 + 3.548 & = & +1.3193 - 4.8 & = +1.3145 = +1 \\
 +8.060 + 5.116 & = & +1.3176 - 3.2 & = +1.3144 = 0 \\
 20.3445 + 3.122 & & -33 & = 19.3396
 \end{array}$$

2.19

$$\begin{array}{llll}
 \text{Tables } a = -0.4 & a = -1.0 & a - a = +0.6 & b + a = -2.2 \\
 \text{Obs } a = +2.6 & a = +1.6 & a - a = +1.0 & b + a = -0.1
 \end{array}$$

	p	$p-c$			λ	corr	Hayn	Obs.
1	140.6	121.6	-1.9	+2.1	-3.7	+0.4	+3.7	+6.0
2	128.3	109.3	-2.1	+1.3	-3.0	-2.4	-2.1	+2.0
3	99.2	80.2	-2.2	-0.7	-1.2	+0.5	+4.6	-4.3
4	90.0	71.0	-2.1	-1.3	0.5	+0.6	+5.5	+7.3
5	72.5	53.5	-1.8	-2.4	+0.9	-0.7	-6.4	-19.0
6	39.4	20.4	-0.8	-3.8	+2.7	+0.4	+5.7	+3.8
7	10.1	35.1	+0.3	-4.0	+4.6	-0.3	-2.8	-18.3
8	0.0	34.1	+0.7	-3.8	+4.8	+0.6	+5.5	+13.9
9	34.3	32.4	+1.3	-3.3	+4.9	-0.6	-5.5	+7.9

$$\lambda = -2.21$$

$$\beta = -4.03$$

$$\alpha = 1.9^{\circ}$$

		Old O-C	Corr Hayn	new O-C
0-C	1	+10.5	+5.3	+2.2
+2.3	2	+6.8	0	+6.8
+2.4	3	+3	-2.8	+3.1
-8.9	4	+11.7	+10.1	+1.6
+1.8	5	-15.4	-15.7	+3
-12.6	6	+4.9	+1.8	+3.1
+1	7	-19.7	-11.1	-8.6
-15.5	8	+11.7	+5.5	+6.2
+8.4	9	+4.6	+2.8	+1.8
+13.9				

	p	$p-c$	$\lambda_{pm}(p-c)$	$\beta_{pm}(p-c)$	β	corr from Hayn	α	O-C
1	219.4	200.4	+0.8	+3.8	-2.7	+0.9	+2.3	-2.3
2	231.7	212.7	+1.2	+3.4	-1.9	0.0	0	+2.0
3	240.8	241.8	+1.9	+1.9	+0.3	-0.3	-2.8	-1.5
4	270.0	251.0	+2.1	+1.3	+1.1	+1.1	+10.1	-2.8
5	287.5	268.5	+2.2	+0.2	+2.3	-1.7	-15.7	-3.3
6	320.6	301.6	+1.9	-2.1	+4.3	+0.2	+1.8	+2.0
7	349.9	330.9	+1.1	-3.5	+4.9	-1.2	-11.1	-7.2
8	0.0	341.0	+0.7	-3.8	+4.8	+0.6	+5.5	+8.4
9	16.7	357.7	+0.1	-4.0	+4.9	+0.3	+2.8	+5.1

3024

Lunar's Center

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	18.0000	-1.3780	-3	1.8997	4.6973	+105
2	17.6799	-1.6981	-3	2.8846	4.6936	+68
3	17.2408	-2.1372	-1	4.5681	4.6871	+3
4	17.2104	-2.1676	0	4.6985	4.6985	+117
5	17.3182	-2.0598	+1	4.2424	4.6714	-154
6	18.0000	-1.3780	+3	2.8981	4.6917	+49
7	19.0000	-0.3780	+4	0.1426	4.6671	-197
8	19.3780	0.0000	+5	0.0000	4.6985	+117
9	20.0000	+0.6220	+4	0.3874	4.6914	+46

Comp R^2 4.6868

	y	$y - y_0$	$(y - y_0)^2$
1	18.6724	-1.6726	2.7976
2	19.0000	-1.3450	1.8090
3	20.0000	-0.3450	0.1190
4	20.3450	0.0000	0.0000
5	21.0000	+0.6550	0.4290
6	22.0164	+1.6714	2.7936
7	22.4721	+2.1271	4.5245
8	22.5126	+2.1676	4.6985
9	22.4196	+2.0746	4.3040

Approx Center

$$x = 18.0 \quad y = 18.6724$$

$$22.0164$$

$$4.06888$$

$$y_0 = 20.3444$$

$$y_{\text{max}} = 22.5126$$

$$R = 2.1682$$

$$x_{\text{min}} = 17.2104$$

$$x_0 = 19.3786$$

$$\text{Center} \begin{cases} x_0 = 19.3780 \\ y_0 = 20.3450 \end{cases}$$

3029

Moon's Center

	x	$x - X_0$	Δx	$(x - X_0)^2$	$(x - X_0)^2 (y - Y_0)^2$	$O - C$
1	180000	-13780	-3	18997	46973	+105
2	176799	-16981	-3	28846	46936	+68
3	172408	-21372	-1	45681	46871	+3
4	172104	-21676	0	46985	46985	+117
5	173182	-20598	+1	42424	46714	-154
6	180000	-13780	+3	28981	46917	+49
7	190000	-03780	+4	01426	46671	-197
8	193780	00000	+5	00000	46985	+117
9	200000	+06220	+4	03874	46914	+46

Comp R 46868

	y	$y - Y_0$	$(y - Y_0)^2$
1	186724	-16726	27976
2	190000	-13450	18090
3	200000	-03450	01190
4	203450	00000	00000
5	210000	+06550	04290
6	220164	+16714	27936
7	224721	+21271	45245
8	225126	+21676	46985
9	224196	+20746	43040

Approx Center

 $x = 180$ $y = 186724$ 220164

406888

 $Y_0 = 203444$ $y_{\text{max}} = 225126$ $R = 21682$ $x_{\text{max}} = 172104$ $X_0 = 193786$

Center } $X_0 = 193780$
 } $Y_0 = 203450$

Formation of Hourals.

With Hay's correct.

	ab	de	bu	au	
1	+ 2.30	- 145.0	- 175.2	- 306	- 371
2	+ 2.28	- 115.8	- 91.2	- 115.5	- 911
3	+ 0.73	- 6.4	- 1.0	- 66.4	- 105
4	- 0.00	- 254.0	+ 0.0	- 347	+ 00
5	- 0.34	+ 79.4	- 254	- 6.2	+ 20
6	- 2.30	- 67.6	+ 81.8	- 42.8	+ 51.8
7	- 0.81	+ 74.8	- 420.0	+ 32.6	- 183.0
8	+ 0.00	+ 0.0	+ 254.0	+ 0.0	+ 134.5
9	+ 1.28	+ 28.5	+ 95.2	+ 11.2	+ 373
	+ 3.14	- 406.1	- 281.8	- 252.4	- 961
(5) fullent.	- 1.02				
	+ 2.12				

	O	C	O - C
1	+ 22	+ 16 + 5 = + 21	+ 1
2	+ 68	+ 19 + 4 = + 23	+ 45
3	+ 31	+ 24 + 1 = + 25	+ 6
4	+ 16	+ 25 - 0 = + 25	- 9
5	+ 3	+ 23 - 2 = + 21	- 18
6	+ 31	+ 16 - 5 = + 11	+ 20
7	- 86	+ 4 - 7 = - 3	- 83
8	+ 62	+ 0 - 7 = - 7	+ 69
9	+ 18	- 7 - 7 = - 14	+ 32
			+ 173 - 110
			Average = 31

3024

Moon's Center

Conditional Equations

	a	b	0	c	0-c
1	-1.38	-1.67	= +105	+28+17 = +45	+60
2	-170	-1.34	= +68	+34+14 = +48	+20
3	-2.14	-0.34	= +3	+43+3 = +46	-43
4	-2.17	+0.00	= +117	+44-0 = +44	+73
5	-2.06	+0.66	= -154	+21-3 = +18	(-95)-190
6	-1.38	+1.67	= +49	+28-17 = +11	+38
7	-0.38	+2.13	= -197	+8-22 = -14	-183
8	+0.00	+2.17	= +117	-0-22 = -22	+139
9	+0.62	+2.07	= +46	-12-21 = -33	+79
					+409-321
					Average = 86

Normal Equations

$$\begin{aligned}
 +18.54 + 3.14 &= -406 \\
 +3.14 + 21.15 &= -282 \\
 -3.14 - 0.53 &= +69 \\
 +20.62 &= -213
 \end{aligned}$$

$$b = -10.3$$

$$+18.54 = -406 + 32 = -374$$

$$a = -20.2$$

With Hayn's correction giving (5) full wt.

$$+21.72 + 2.12 = -252$$

$$+2.12 + 21.48 = -96$$

$$-2.12 - 0.21 = +25$$

$$+21.27 = -71$$

$$b = -3.3$$

$$+21.72 = -252 + 7 = -245$$

$$a = -11.3$$

Obs. measured: 154

Average (0-c) = +10.3

$$\frac{rc}{n} = 0.19$$

$$\frac{+10.3}{19} = +0.54 \quad \Delta a = +0.6$$

3029

Moon's Center

Conditional Equations

	a	b	0	c	0-c
1	-138-167	=	+105	+28+17	=+45+60
2	-170-134	=	+68	+34+14	=+48+20
3	-214-034	=	+3	+43+3	=+46-43
4	-217+000	=	+117	+44-0	=+44+73
5	-206+066	=	-154	+21-3	=+18-95
6	-138+167	=	+49	+28-17	=+11+38
7	-038+213	=	-197	+8-22	=-14-183
8	+000+217	=	+117	-0-22	=-22+139
9	+062+207	=	+46	-12-21	=-33+79

+409-321

Average = 86

Normal Equations

$$+18.54 + 314 = -406$$

$$+314 + 2115 = -282$$

$$-314 - 053 = +69$$

$$+20.62 = -213$$

$$b = -10.3$$

$$+18.54 - 406 + 32 = -374$$

$$a = -20.2$$

with Hayn's correction giving (5) full wt.

$$+21.72 + 212 = -252$$

$$+212 + 2148 = -96$$

$$-212 - 021 = +25$$

$$+21.27 = -71$$

$$b = -3.3$$

$$+21.72 = -252 + 7 = -245$$

$$a = -11.3$$

Are measured: 158

Average (0-c) = +10.3

$$\frac{rc}{m} = 0.19$$

$$+ \frac{10.3}{19} = +0.54 \quad \Delta z = +0.6$$

3024 Moon Mean Position (1913.0)

$$X_0 = 19.3780^\circ$$

$$Y_0 = 20.3450^\circ$$

$$\Delta \alpha = -1.0$$

$$\Delta \delta = -5^\circ$$

$$19.3770^\circ$$

$$20.3445^\circ$$

$$\text{Hayn } 19.3774$$

$$20.3448^\circ$$

$$\text{From Plate Constants } X = 20.3167^\circ \quad Y = 19.3390^\circ$$

$$\xi = +231.67^\circ$$

$$\eta = -266.07^\circ$$

$$\log 3 \quad 0.36498^\circ$$

$$-\cos 5 \quad 9.98510^\circ$$

$$8.50724$$

$$\log \tan 8 \quad 9.4280^\circ$$

$$\xi^2 \quad 0.7298^\circ$$

$$7.0534^\circ$$

$$\dots (K-A) \quad 1.87254^\circ$$

$$\dots (M_1) \quad 7.2112^\circ$$

$$\eta_1 + \quad 1.6^\circ$$

$$\eta_0 - 2.6623^\circ$$

$$K-A \quad +1 \quad 14.58^\circ$$

$$A \quad 9 \quad 58 \quad 22^\circ$$

$$X_0 \quad 9 \quad 59 \quad 36.58^\circ$$

$$\log \eta_0 \quad 0.42526^\circ$$

$$7.83115$$

$$\text{Red} - \quad + \quad 1.93^\circ$$

$$\dots (K-D) \quad 3094.16^\circ$$

$$K-D \quad - \quad 20 \quad 42.0^\circ$$

$$D + 15 \quad 15 \quad 57^\circ$$

$$\delta_0 + 14 \quad 55 \quad 15.0^\circ$$

$$\text{Red} = \quad - \quad 4.2^\circ$$

$$\delta = +14 \quad 55 \quad 10.8^\circ$$

3024 Moon Mean Position (1713.0)

$$X_0 = 19.3780 \quad Y_0 = 20.3450$$

$$\Delta \alpha = -10 \quad \Delta \delta = -5$$

$$19.3770$$

$$20.3445$$

$$\text{Hagen } 19.3774$$

$$20.3448$$

$$\text{From Plate Constants } X = 20.3167 \quad Y = 19.3390$$

$$\xi = +2.3167$$

$$\eta = -2.6610$$

$$\log 3 \quad 0.36998$$

$$\log 5 \quad 0.69897$$

$$8.50724$$

$$(X-A) \quad 1.87264$$

$$X-A \quad +1.1458$$

$$A \quad 9.5822$$

$$X_0 \quad 9.593658$$

$$\text{Red} \quad +1.93$$

$$X \quad 9.593851$$

$$\log 1000 \quad 9.4280$$

$$\log 2 \quad 0.7298$$

$$\log 3 \quad 0.70534$$

$$\log 10 \quad 7.2112$$

$$\eta_1 \quad +1.6$$

$$\eta_0 \quad -2.6623$$

$$\log \eta_0 \quad 0.425260$$

$$7.33115$$

$$(X-D) \quad 3.09416$$

$$X-D \quad -20.4210$$

$$D+15 \quad 15.57$$

$$D_0+14 \quad 55.150$$

$$\text{Red} \quad -4.2$$

$$S+14 \quad 55.108$$

3024

Red ad locum app.

$$S = +14^{\circ} 55'$$

$$H + \alpha \quad 4 \quad 04 = 61^{\circ}$$

$$H \quad 18 \quad 04$$

$$K \quad 19 \quad 00$$

$$G \quad 19 \quad 30$$

$$G + \alpha \quad 5 \quad 30 = 82^{\circ} 30'$$

$$l \cos(G + \alpha) \quad 9 \quad 11 \quad 57$$

$$g \quad 1 \quad 02 \quad 14$$

$$\sin \quad 9 \quad 99 \quad 63$$

$$\tan S \quad 9 \quad 42 \quad 55$$

$$\frac{1}{\tan} \quad 5 \quad 82 \quad 39$$

$$(8') \quad 0 \quad 1 \quad 37 \quad 1$$

$$(8') \quad 9 \quad 26 \quad 78$$

$$h \quad +0.61$$

$$S \quad +0.19$$

$$Z \quad +1.13$$

$$\hline +1.93 \checkmark$$

$$\log \cos S \quad 1.9851$$

$$l \quad 0.9109$$

$$(i) \quad 0.8960$$

$$l \sin S \quad 9.4106$$

$$\cos(H + \alpha) \quad 9.6856$$

$$h \quad 1.2737$$

$$\sin \quad 9.9418$$

$$\sec S \quad 0.0149$$

$$\frac{1}{\tan} \quad 5.8239$$

$$(h') \quad 0.3699$$

$$(h') \quad 0.0543$$

$$8' \quad +137$$

$$2' \quad +239$$

$$l \quad -7.87$$

$$\hline -4.16$$

3024

Red ad locum = h/p

$$S = +14^{\circ} 55'$$

$$H + \alpha \quad 4 \quad 04 = 61^{\circ}$$

$$H \quad 18 \quad 04$$

$$K \quad 19 \quad 00$$

$$G \quad 19 \quad 30$$

$$G + \alpha \quad 5 \quad 30 = 82^{\circ} 30'$$

$$l \cos(G + \alpha) \quad 9 \quad 71157$$

$$q \quad 10214$$

$$\sin \quad 99963$$

$$\tan S \quad 9.4255$$

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

$$\begin{pmatrix} 8' \\ 5' \end{pmatrix} \quad 0.1371$$

$$\begin{pmatrix} 8' \\ 5' \end{pmatrix} \quad 92671$$

$$h \quad +0.61$$

$$S \quad +0.19$$

$$l \quad +1.13$$

$$\hline +1.93$$

$$l \cos S \quad 9.9851$$

$$l \quad 0.9109$$

$$(l) \quad 0.8960$$

$$l \sin S \quad 9.4106$$

$$\cos(H + \alpha) \quad 9.6856$$

$$h \quad 1.2737$$

$$\sin \quad 9.9418$$

$$\sec S \quad 0.0149$$

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

$$l(h) \quad 0.3699$$

$$(h) \quad 0.0543$$

$$8' \quad +1.37$$

$$h' \quad +2.34$$

$$l \quad -7.87$$

$$\hline -4.16$$

3024 Lunar Parallax

$$\begin{array}{r} \alpha' = 9^h 59^m 38.5^s \\ \delta = 12^\circ 31' 02'' \\ G - \alpha = +2^\circ 31' 23.5'' \\ = +37^\circ 50' 52'' \end{array}$$

$$+ 14' 20''$$

$$+ 37' 36' 32''$$

$$\begin{array}{r} 995727 \\ 000000 \\ \hline 010117 \\ 0.05844 \end{array}$$

$$\delta = 48^\circ 50' 36''$$

$$1.4' 55'' 11''$$

$$33' 55' 25''$$

$$\begin{array}{r} 982640 \\ 824831 \\ 974620 \\ \hline 012325 \\ 794466 \end{array}$$

$$\delta - \delta' = +30' 15.9''$$

$$\delta = +15^\circ 25' 26.7'' \quad \alpha = 10^\circ 01' 33.24''$$

$$\text{Hankle's } \delta = +15^\circ 25' 31.5'' \quad \alpha = 10^\circ 01' 32.41''$$

$$\angle O - C = 4.8'' \quad +0.80''$$

$$\delta = +14^\circ 55' 10.8''$$

$$\pi = 60' 53.92''$$

$$\begin{array}{r} 986913 \\ 824831 \\ 978786 \\ \hline 001593 \\ 792123 \end{array}$$

$$\alpha - \alpha' = +28' 40.52''$$

$$= +1' 54.70''$$

Hayn's corrections have been applied

3024 Lunar Parallax.

$$\alpha = 9^{\circ} 59' 38.5''$$

$$\delta = 12^{\circ} 31' 02''$$

$$-\alpha = +2^{\circ} 34' 23.5''$$

$$= +37^{\circ} 50' 52''$$

$$+14.20$$

$$+37.36.32$$

$$9.90727$$

$$0.00000$$

$$0.10117$$

$$0.05844$$

$$\delta = 48.59.36$$

$$14.55.11$$

$$33.55.25$$

$$9.82690$$

$$8.24831$$

$$9.74670$$

$$0.12325$$

$$7.94966$$

$$\delta - \delta' = +30.15.9$$

$$\delta = +15.25.26.7 \quad \alpha = 10.01.32.26$$

$$\text{Hankle's } \delta = +15.25.31.5 \quad \alpha = 10.01.32.41$$

$$O-C = -9.8 \quad +0.80$$

Hayn's corrections have been applied.

$$\delta = +14^{\circ} 55' 10.9''$$

$$\pi = 60' 53.9''$$

$$9.86913$$

$$8.24831$$

$$9.78786$$

$$0.01593$$

$$7.92123$$

$$\alpha - \alpha' = +28' 49.52''$$

$$= +1' 54.74''$$

