

KG

11366

v.923

XLVII

Plates

~~185~~

1930

1931

1956

Harvard Lunar Plates.

Measurements and Reductions

Mary Fowler

Volume XLVII

Plate No.	Date	Page
1930	1912 Aug. 5	1
1931	1912 Aug 5	12
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1
7.8
15.8

2
25.
33.

3
24.
13.0

1930

Star-measures.

1913 Nov. 24.

1

	d	N	d	N
1	14900	19796	17118	15503
7.8	686050	1783540	1496869	762930
15.8	52	39	69	30
	00	70	10	83
	<u>158046</u>	<u>5047</u>	<u>77853</u>	<u>7857</u>
2				
15.5	19389	19150	19940	18490
33.9	1016064	1836060	1415060	1421822
	59	60	50	20
	81	40	20	80
	<u>33.9221</u>	<u>9211</u>	<u>25.4229</u>	<u>4266</u>
3				
	18232	18070	18258	19200
24.8	1493040	1133044	1560003	1181011
13.4	39	40	99	1011
	20	40	30	75
	<u>13.3292</u>	<u>3289</u>	<u>29.7350</u>	<u>7372</u>

Grade 5 or 6.

remeasure direct (2) 30
 = 25.4234

1930

Stars - Measures

1913 Nov 24.

1

	d	N	d	N
1	14900	19796	17118	15503
78	686050	1783540	1496869	762930
158	52	39	69	30
	00	70	10	83
	<u>15.8046</u>	<u>5047</u>	<u>7.7853</u>	<u>7.857</u>
2				
255	19389	19150	19940	18490
339	1016069	1836060	1415060	1421822
	59	60	60	20
	81	40	20	80
	<u>33.9221</u>	<u>9211</u>	<u>25.4229</u>	<u>4266</u>
3				
248	18232	18070	18258	19200
139	1493040	1133049	1160003	11810
	39	40	99	10
	20	40	30	75
	<u>13.3292</u>	<u>3289</u>	<u>29.7350</u>	<u>7372</u>

Grade 5 or 6.

Remeasure direct (2/30)
 = 25.4239.

1930. leucous - leucosines

2

$$\begin{array}{r} 1 \\ 18.4 \\ 17.0 \end{array}$$

cl	N
18109	16730
12925	11902
30	1400
94	98
<u>18,4826</u>	<u>.4809</u>

$$\begin{array}{r} 2 \\ 19.0 \quad 19.502 \quad 15880 \\ 17.8 \quad 11.73545 \quad 13630 \\ \quad 22 \quad 1518 \\ \quad 95 \quad 70 \\ \hline 17.7762 \quad .7743 \end{array}$$

very oblique

$$\begin{array}{r} 3 \\ 19.1 \\ 18.0 \end{array}$$

14324	9590
22	8868
13619	69
<u>19.0706</u>	<u>.0724</u>

$$\begin{array}{r} 4 \\ 19.1 \\ 18.5 \\ \text{map} \\ 50 \end{array}$$

19750	15320
11053	13999
59	00
45	04
<u>19.1309</u>	<u>.1319</u>

$$\begin{array}{r} 5 \\ 19.1 \\ 19.0 \end{array}$$

18678	15391
9375	14680
73	70
68	80
<u>19.0709</u>	<u>.0714</u>

$$\begin{array}{r} 6 \\ 19.0 \quad 18295 \quad 20050 \\ 19.2 \quad 16135 \quad 1220033 \\ \quad 20 \quad 20 \\ \quad 85 \quad 50 \\ \hline 19.2174 \quad .2168 \end{array}$$

very oblique

1930.

leagues - measures

2

$$\begin{array}{r} 1 \\ 184 \\ 170 \end{array}$$

d	N
18109	16730
12925	11902
30	1400
94	98
<u>18.4826</u>	<u>4509</u>

d	N
19019502	11580
17811735	13630
22	1118
95	70
<u>17.7762</u>	<u>7743</u>

very oblique

$$\begin{array}{r} 3 \\ 191 \\ 180 \end{array}$$

14324	9590
22	8868
13619	60
<u>19.0706</u>	<u>0724</u>

$$\begin{array}{r} 4 \\ 191 \\ 185 \\ \text{net} \\ 70 \end{array}$$

19750	15320
11053	13999
59	00
45	04
<u>19.1309</u>	<u>1319</u>

$$\begin{array}{r} 5 \\ 191 \\ 190 \end{array}$$

18678	15391
9375	14680
73	70
68	80
<u>19.0709</u>	<u>0714</u>

d	N
19018295	20050
19216135	1220033
20	20
85	50
<u>19.2174</u>	<u>2168</u>

very oblique

1930

moon - measures.

3

7
18.4
20.0

17620

18610

1220922

1399703

13

02

00

00

18.46054604

8
18.0 17335-

18860

20.4 1414345-

1197580

50

78

30

54

21.31873122✓

remeasure direct gives .3170

9 16440

17740

17.8 1123639

1293035-

20.5 37

47

new 38

48

in 21.5202

15195

Very faint image of moon.

1930

Moon - measures

3

2
18.4
W.U

17620

18610

1.220922

1.399703

13

02

00

00

1846054604

8
18.0 17335-

18860

W.9 1414345-

11975

50

7880

30

54

20.31873122

remeasure direct gives .3170

9 16440

17740

17.8 11236

1293035-

W.5 37

47

new 38

48

4 21.5202

15195

Very faint image of Moon.

1930

Inimes etc.

Expt. 1912 Aug. 5	23	11	-23	23
... known	23	17	12.0	-23 17 12.4
clockslow		1	13.5	
W. sid. t.	23	18	25.7	
H. hong	4	44	31.05	
P. sid. t.	28	02	56.75	
Sig. T. known	8	54	40.29	
Interval	19	08	164.6	
Reduction		3	08.12	
A. M. T.	19	05	0834	$\theta - \alpha = -3^h 28^m$

From Kant Allen	R. A.	Decl.
known 19 ^h	2 ^h 46 ^m 06.17 ^s	+18° 45' 17.3"
motion in 1 ^h = 2.1608 ^h		12236 ^h
" " 5.139 ^h	+ 11.50 ^h	+ 1 02.9 ^h
Tabular place	2 46 17.27 ^h	+18 46 20.2 ^h

Moon's age. 22.8 days

" parallel

57' 18.1^h ✓

" semi-diam.

15 38.5^h

934 = 10.2

R =

938.5^h

938.5 = 10.9

Augmentation

+ 10.4

- irradiation (J)

- 1.0

R

947.9^h

R

2.0319^h

a = -2.7

(1+a) R

2.0314^hR²:

4.1266

1930

Times etc.

Exp. time 1912 Aug. 5th 23^h 11^m - 23^h 23^m
 known 23 17 12.0 - 23 17 12.4
 clock slow 1 13.5

H. Sid. 23 18 25.7
 H. long 9 44 31.05
 G. Sid. 28 02 56.75
 Sid. in known 8 54 40.29
 Interval 19 08 16.46
 Reduction 3 08.12
 G. in T. 19 05 08.34 $G-X = -3^h 28^m$

From Kant Alm. R.A. Mech.
 known 19^h 2^m 46^s 06.17 + 18^m 45^s 17.3
 motion in 2.1608 12.236
 5.139 + 11.10 + 1 02.9
 Tabular place 2 46 17.27 + 18 46 20.2

known age 22.8 days

parallel 57' 18"

semi diam 15 38.5"

R = 938.5"

Augmentation + 10.4

Transit (17) - 10

R 947.9

R 2031.9

-2.7

(1 + a) 18 2031.4

R' 4126.6

Plate constant

x	y	R.A.	Decl.
7.7855	15.8046	2 43 36	+17 55 04
25.4249	33.9216	53 03	+20 18 59
29.7361	13.3290	55 34	+17 39 22
3 62.95	63.06	151 73	24 112 85
20.98	21.02	2 50 44	18 37 48
-18	-22	- 1 32	+ 7 37
2.98	0.98	2 49 12	+18 45 25
31	465		
92 ^s	457 ["]		
1 ^m 32 ^s	7' 37 ["]		

$$A = 2^h 49^m 12^s$$

$$D = +18 45 25$$

$$\begin{aligned}
 x - \bar{x} &= -217.94 & + 2.7x & & + 2699 \\
 + 723 - 2444 &= -2721 & + 21 &= -2700 & = -1 \\
 + 4624 - 7392 &= -2768 & + 69 &= -2699 & = 0 \\
 + 126 - 2904 &= -2778 & + 80 &= -2698 & = +1 \\
 17.1013^v - 4029^v & & + 46^v & & = 16.9729^v
 \end{aligned}$$

$$\begin{aligned}
 y - \bar{y} &= +213.2 & + 1.94 & & - 4115 \\
 + 2427 + 1658 &= +4085 & + 30 &= +4115 & = 0 \\
 - 1365 + 5416 &= +4051 & + 64 &= +4115 & = 0 \\
 - 2244 + 6334 &= +4090 & + 25 &= +4115 & = 0 \\
 18.4914^v + 3643^v & & + 35^v & & = 18.4477^v
 \end{aligned}$$

Tables $a = -3.2$ $e = -3.0$ $a - e = -0.2$ $b + d = +4.0$
 Obs $a = -2.7$ $e = -1.9$ $a - e = -0.8$ $b + a = +4.9$
 $\sigma = 0$ -0.5 -1.1 $+0.6$ -0.9

hca d

$$A = \begin{pmatrix} 2 & 4 & 9 \\ 4 & 5 & 25 \end{pmatrix}$$

$$\begin{array}{r}
 4 - 21 \quad + 21326 \quad + 194 \quad - 4115 \\
 + 2427 + 1648 = + 4085 + 30 = + 4115 = 0 \\
 - 1365 + 416 = + 4051 + 64 = + 4115 = 0 \\
 - 2244 + 6334 + 4090 + 25 = + 4115 = 0 \\
 184914 + 3643 + 35 = 184472
 \end{array}$$

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1930

Standard Coordinates

6

Cape W 410 mg 6.0				Cape W 431 mg 5.8				Cape W 440 mg 6.9			
C	2	42	55.62	2	52	21.74		2	54	54.10	
L			59			73				14	
B			60			63				12	
Mean	2	42	55.60	2	52	21.70		2	54	54.12	
Prec	+		40.27	+		41.10		+		40.36	
S	2	43	35.87	2	53	02.80		2	55	34.48	
A	2	49	12	2	49	12		2	49	12	
d-A	-	5	36.13	+	3	50.80		+	6	22.48	
sin(d-A)			-336.10			+230.79				+382.43	
log "			2.52647m			2.36322				2.58255	
cos S			9.97841			9.97210				9.97905	
3.			1.01212m			0.84256				1.06884	
3.	-		10.2830	+		6.9592		+		11.7176	
3.	-		38	+		33		+		59	
3			7.7132			24.9625				29.7235	
3			7.7855			25.4249				29.7361	
2-3			+723			+4624				+126	
C	+17°	52'	02.0	+20°	16'	03.45		+17°	36'	28.4	
L			02.2			04.0				29.1	
B			01.6			03.85				28.1	
Mean	+17	52	01.9	+20	16	03.8		+17	36	28.5	
Prec	+	3	01.8	+	2	55.4		+	2	53.6	
S	+17	55	03.7	+20	18	59.2		+17	39	22.1	
D	+18	45	25	+18	45	25		+18	45	25	
d-D	-	50	21.3	+	1	33	34.2	-	1	06	02.9
tan(d-D)			-3021.4			+5615.6				-3963.4	
log "			3.48021m			3.74940				3.59806m	
log "			0.81136m			1.08055				0.92921m	
tan S			9.5096			9.5685				9.5028	
3			20242			16851				21377	
3			8.5872			8.3070				8.6939	
3			-6.4768	+		12.0378				-8.4960	
3	+		387	+		203		+		494	
3			15.5619			34.0581				13.5534	
4			15.8046			33.9216				13.3290	
4-3			+2427			-1365				-2244	

1930

Standard Coordinates

6

Cape W 410 mag 6.0	Cape W 431 mag 5.8	Cape W 440 mag 4.9
C 2 42 55.62	2 52 21.74	2 54 54.10
L 59	73	14
B 60	63	12
mean 2 42 55.60	2 52 21.70	2 54 54.12
sec + 40.27	+ 41.10	+ 40.36
A 2 43 35.87	2 52 02.80	2 55 34.48
A 2 49 12	2 49 12	2 49 12
(A-A) - 5 36.13	+ 3 50.80	+ 6 22.48
(A-A) - 3 36.10	+ 2 30.79	+ 3 82.43
mag 2.52647m	2.36322	2.58215m
WVS 9.97841	9.97210	9.97905
T. 1.01212m	0.84256	1.06884
T. - 10.2830	+ 6.9592	+ 11.7176
T. - 38	+ 33	+ 19
T. 7.7132	24.9625	29.7235
T. 7.7855	25.4249	29.7361
T. + 723	+ 4624	+ 126
C + 17° 52' 02.0	+ 20° 16' 03.4	+ 17° 36' 28.4
L 02.2	04.0	29.1
B 01.6	03.8	28.1
mean + 17 52 01.9	+ 20 16 03.8	+ 17 36 28.5
Prece + 3 01.8	+ 2 55.4	+ 2 53.6
S + 17 55 03.7	+ 20 18 59.2	+ 17 39 22.1
D + 18 45 25	+ 18 45 25	+ 18 45 25
(D) - 50 21.3	+ 1 33 34.2	- 1 06 02.9
(A-A) - 3 02.14	+ 56.156	- 39.634
mag 3.48021m	3.74940	3.59806m
mag 0.81136m	1.08055	0.92921m
WVS 9.5096	9.5685	9.5028
T. 20242	16851	21377
T. 8.5872	8.3070	8.6939
T. - 6.4768	+ 12.0378	- 8.4960
T. + 387	+ 203	+ 494
T. 15.5619	39.0581	13.5534
T. 15.8046	33.9216	13.3290
T. + 2427	- 1365	- 2244

pt	pos. c.	resid.
1	137.2	+44
2	110.9	-77
3	104.2	-28
4	90.0	-53
5	75.5	+117
6	69.1	+28
7	42.0	-54
8	26.2	+52
9	0.0	-129

1930

Moon's Center

	x	y	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$0 - c$
1	18.4818	+1.3740	+6	1.8895	4.1278	+12	
2	19.0000	+1.8922	+3	3.5816	4.1013	-253	
3	19.0715	+1.9637	+2	3.8569	4.1031	-235	
4	19.1314	+2.0236	0	4.0950	4.0950	-316	
5	19.0712	+1.9634	-2	3.8542	4.1080	-186	
6	19.0000	+1.8922	-3	3.5793	4.0988	-278	
7	18.4604	+1.3526	-6	1.8279	4.0890	-376	
8	18.0000	+0.8922	-7	0.7948	4.0025	-241	
9	17.1078	0.0000	-8	0.0000	4.0941	-325	

Comp $R^2 = 4.1266$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.0000	-1.4962	+1	2.2383
2	17.7752	-0.7210	+1	0.5197
3	18.0000	-0.9962	0	0.2462
4	18.4962	0.0000	0	0.0000
5	19.0000	+0.5038	-0	0.2538
6	19.2171	+0.7209	-1	0.5195
7	20.0000	+1.5038	-1	2.2611
8	20.3150	+1.8188	-1	3.3077
9	20.5198	+2.0236	-2	4.0941

Approximate Center

$$x = 19.0 \quad y = 17.7752$$

$$19.2171$$

$$3.69923$$

$$y_0 = 18.4962$$

$$y_{\text{max}} = 20.5198$$

$$R = 2.0236$$

$$x_{\text{max}} = 19.1314$$

$$x_0 = 17.1078$$

$$\text{Center } \begin{cases} x_0 = 17.1078 \\ y_0 = 18.4962 \end{cases}$$

1930

Lunar Center

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 (y - y_0)^2$	$0 - c$
1	18.4818	+1.3740	+6	1.8891	4.1278	+ 12
2	19.0000	+1.8922	+3	3.5816	4.1013	- 253
3	19.0715	+1.9637	+2	3.8569	4.1031	- 235
4	19.1314	+2.0236	0	4.0950	4.0950	- 316
5	19.0712	+1.9634	-2	3.8542	4.1080	- 186
6	19.0000	+1.8922	-3	3.5793	4.0988	- 278
7	18.4604	+1.3526	-6	1.8279	4.0888	- 378
8	18.0000	+0.8922	-7	0.7948	4.0025	- 241
9	17.1078	0.0000	-8	0.0000	4.0941	- 325

Comp R^2 4.1266

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.0000	-1.4962	+1	2.2383
2	17.7752	-0.7210	+1	0.5197
3	18.0000	-0.9962	+0	0.2462
4	18.4962	0.0000	0	0.0000
5	19.0000	+0.5038	-0	0.2538
6	19.2171	+0.7209	-1	0.5195
7	20.0000	+1.5038	-1	2.2611
8	20.3150	+1.8188	-1	3.3077
9	20.5198	+2.0236	-2	4.0941

Approximate Center

$$x = 19.0 \quad y = 17.7752$$

$$19.2171$$

$$3.69923$$

$$y_0 = 18.4962$$

$$y - \text{max} = 20.5198$$

$$R = 2.0236$$

$$x - \text{max} = 19.1314$$

$$x_0 = 17.1078$$

$$\text{Center } \begin{cases} x_0 = 17.1078 \\ y_0 = 18.4962 \end{cases}$$

Formation of Normals

ab

ab

1	-0.51	+ 4.1	- 4.5
2	-1.36	-478.2	+182.2
3	-0.98	-460.6	+157.5
4	+0.00	-638.3	- 0.0
5	+0.24	- 91.1	-46.5 (-23.2)
6	+1.36	-525.4	-202.9
7	+2.02	-507.6	-564.0
8	+1.62	-214.5	-438.6
9	+0.00	- 0.0	-656.5
	+2.39	-2911.6	-1613.3
	-1.54	+12.3	- 13.5
	+0.85	-2899.3	-1603.6

giving (1) full wt.

O

C

O - C

1	+12	-187 + 168 =	- 19	+31
2	-253	-258 + 81 =	-177	-76
3	-235	-268 + 56 =	-212	-23
4	-316	-276 - 0 =	-276	-40
5	-186	-268 - 56 =	-324	+138 (+69)
6	-278	-258 - 81 =	-339	+61
7	-376	-185 - 168 =	-353	-23
8	-241	-122 - 204 =	-326	+85
9	-325	- 0 - 226 =	-226	-99

+246 - 261

Average = 60

1930

Moon's Center Conditional Equations

8

	a	b	0	c	0-c
1	+1.37	-1.50	= +12	-178 + 146 = -	32 + 44
2	+1.89	-0.72	= -253	-246 + 70 = -	176 - 77
3	+1.96	-0.50	= -235	-255 + 48 = -	207 - 28
4	+2.02	+0.00	= -316	-263 - 0 = -	263 - 53
5	+1.96	+0.50	= -186	-255 - 48 = -	303 + 117
6	+1.89	+0.72	= -278	-246 - 70 = -	316 + 28
7	+1.35	+1.50	= -376	-176 - 146 = -	322 - 54
8	+0.89	+1.82	= -241	-116 - 177 = -	293 + 52
9	+0.00	+2.02	= -325	- 0 - 196 = -	196 - 129

Normal Equations

Average - 65

$$\begin{aligned}
 &+ 20.61 + 2.39 = -2912 \\
 &+ 2.39 + 13.44 = -1613 \\
 &- 2.39 - 0.28 = + 337 \\
 &\quad + 13.16 = -1276 \\
 &- 0.42 - 2.39 = + 287 \\
 &+ 20.19 = -2625
 \end{aligned}$$

$$b = -97.0$$

$$a = -130.0$$

Normals giving (1) full wt.

$$\begin{aligned}
 &+ 20.59 + 0.85 = -2912 \\
 &+ 0.85 + 13.25 = -1604 \\
 &- 0.85 - 0.04 = + 121 \\
 &\quad + 13.21 = -1483 \\
 &+ 20.59 = -2912 + 95 = -2817
 \end{aligned}$$

$$b = -112$$

$$a = -136.8$$

1930

Moon's Center Conventional Equations

8

	a	b	0	c	0-c
1	+1.37	-1.50	+1.2	-178 + 146 = -32	+44
2	+1.89	-0.72	-2.53	-246 + 70 = -176	-77
3	+1.96	-0.50	-2.35	-255 + 48 = -207	-28
4	+2.02	+0.00	-3.16	-263 - 0 = -263	-53
5	+1.96	+0.50	-1.86	-255 - 48 = -303	+117
6	+1.89	+0.72	-2.78	-246 - 70 = -316	+28
7	+1.35	+1.50	-3.76	-176 - 146 = -322	-54
8	+0.89	+1.82	-2.41	-116 - 177 = -293	+52
9	+0.00	+2.02	-3.25	-0 - 196 = -196	-129

Normal Equations

Average - 65

$$\begin{aligned}
 +20.61 + 2.39 &= -29.12 \\
 +2.39 + 13.44 &= -16.13
 \end{aligned}$$

$$\begin{aligned}
 -2.39 - 0.28 &= +3.37 \\
 +13.16 &= -12.76
 \end{aligned}$$

$$b = -97.0$$

$$\begin{aligned}
 -0.42 - 2.39 &= +2.87 \\
 +20.19 &= -26.25
 \end{aligned}$$

$$a = -130.0$$

Normals giving (1) full wt

$$\begin{aligned}
 +20.59 + 0.85 &= -29.12 \\
 +0.85 + 13.25 &= -16.04
 \end{aligned}$$

$$\begin{aligned}
 -0.85 - 0.04 &= +1.21 \\
 +13.21 &= -19.85
 \end{aligned}$$

$$b = -112$$

$$+20.59 = -29.12 + 95 = -28.17$$

$$a = -136.8$$

1930 known mean Position (1912⁰) 9

$X_0 = 17.1078^{\circ}$	$Y_0 = 18.4962^{\circ}$	17.1078°	18.4962°
$\frac{1}{2}a = \quad \quad 65^{\circ}$	$\frac{1}{2}b = \quad \quad 48^{\circ}$	$\quad \quad 65^{\circ}$	$\quad \quad 48^{\circ}$
<u>17.1013[✓]</u>	<u>18.4914[✓]</u>	<u>17.1010</u>	<u>18.4906</u>

from Rate constants $X = 16.9729^{\circ}$ $Y = 18.4477^{\circ}$
 giving (1) full wt. (16.9726) (18.4469)

$\xi = -1.0271^{\circ}$ (-1.0274) $\eta = -3.5523^{\circ}$ (-3.5531)
 $\log \xi = 0.01161^{\circ}$ (0.01174) $\log \tan \delta = 9.5203^{\circ}$
 $\cos \delta = 9.97747^{\circ}$ $\log \xi^2 = 0.0232^{\circ}$
 $\cos \delta = 8.50724^{\circ}$ $\log \eta_1 = 6.5969^{\circ}$

" (A-A) 1.52690[✓] (1.52703)

A-A = 33.64[✓] (33.65)

A = 2 49 12[✓]

$X_0 = 2^{\circ} 48' 38.36^{\circ}$ (38.35)

Red = +1.60

$X' = 2 48 39.96^{\circ}$ (39.95)

constant radius = -0.2

$\eta_1 = +4^{\circ}$

$\eta_0 = -3.5527^{\circ}$ (-3.5535)

$\log \eta_0 = 0.55056^{\circ}$ (55.066)

$\cos \delta = 7.3311^{\circ}$

" (S-D) = 3.21941[✓] (3.21951)

S-D = -27' 37.3[✓] (37.7)

D = +18 45 25[✓]

$S_0 = +18 17 47.7^{\circ}$ (47.3)

Red = +12.8

$S' = +18 18 00.5^{\circ}$ (00.1)

constant radius = -0.2

1930

Reductum ad locum apparentum

10

Aug 5. 23^h

$$H + \alpha_0 = 181^\circ 15'$$

$$H + \alpha_0 = 12^\circ 05'$$

$$H = 9^\circ 16'$$

$$\alpha_0 = 2^\circ 48' 38.36''$$

$$g = 21^\circ 20'$$

$$G + \alpha_0 = 0^\circ 09'$$

$$= 2^\circ 15'$$

$$S_0 = +18^\circ 17' 47.7''$$

$$\log i = 0.7466$$

$$\cos S_0 = 9.9775$$

$$(i) = 0.7241$$

$$\log \cos(G + \alpha_0) = 9.9997 \quad \log \sin S_0 = 9.4968$$

$$\log g = 1.1358 \quad \cos(H + \alpha_0) = 9.9999$$

$$\sin(G + \alpha_0) = 8.5939 \quad h = 1.2943$$

$$\tan S_0 = 9.5194 \quad \sin(H + \alpha_0) = 9.3387$$

$$\frac{1}{\tan} = 8.8239 \quad \sec S_0 = 0.0225$$

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

$$\log(s) = 8.0725 \quad \log(h) = 8.4794$$

$$(s') = 1.1350 \quad (h') = 0.7910$$

$$f = +1.62$$

$$(s) = +0.01$$

$$(h) = -0.03$$

$$\text{Red in } \alpha = +1.60$$

$$g' = +13.65$$

$$(h) = +6.18$$

$$(i) = +5.30$$

$$\text{Red in } S = +12.77$$

$$\alpha' = 2^\circ 48' 39.96''$$

$$S' = +18^\circ 18' 00.5''$$

1930. Reduction ad locum apparentum

α_0 :

Aug 5. 23^h

$$H + \alpha_0 = 18^{\circ} 15'$$

$$H + \alpha_0 = 12^{\circ} 05'$$

$$H = 9^{\circ} 16'$$

$$\alpha_0 = 2^{\circ} 48' 38.36''$$

$$\delta = 21^{\circ} 20'$$

$$G + \alpha_0 = 0^{\circ} 09'$$

$$= 2^{\circ} 15'$$

$$S_0 = +18^{\circ} 17' 47.7''$$

$$\log i = 0.7466$$

$$\log S_0 = 9.9775$$

$$(u) = 0.7241$$

$$\log \cos(G + \alpha) = 9.9997 \quad \log \sin S_0 = 9.4968$$

$$\log g = 1.1355 \quad \cos(H + \alpha_0) = 9.9999$$

$$\sin(G + \alpha_0) = 8.5939 \quad h = 1.2943$$

$$\sin S_0 = 9.5194 \quad \sin(H + \alpha_0) = 9.3387$$

$$\frac{1}{h} = 8.8239 \quad \sec S_0 = 0.0225$$

$$\log(g) = 8.0725 \quad \log(h) = 8.4794$$

$$(g') = 1.1350 \quad (h') = 0.7910$$

$$f = +1.62$$

$$(g) = +0.01$$

$$(h) = +0.03$$

$$\text{Red in } \alpha = +1.60$$

$$b' = +1.365$$

$$a' = +6.18$$

$$(u) = +5.30$$

$$\text{Red in } S = +1.77$$

$$\alpha = 2^{\circ} 48' 39.96''$$

$$S = +18^{\circ} 18' 00.5''$$

1930 Lunar Parallax

$$\begin{array}{rcl} \alpha' = 2 & 48 & 39.96 \checkmark (39.95) \quad S' + 18 \quad 18 \quad 00.5 \checkmark (00.1) \\ \theta = 23 & 18 & 25.7 \checkmark \\ \delta - \alpha' = -3 & 30 & 14.3 \checkmark \\ & = & -52^\circ 33' 30'' \checkmark \end{array}$$

$$\frac{1}{2}(\alpha - \alpha') = -17 \quad 46 \checkmark$$

$$t - \frac{1}{2}(\alpha - \alpha') = -52 \quad 15 \quad 44 \checkmark$$

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

$$\log \sin(\alpha - \alpha') = 9.99999 \checkmark$$

$$\log \cos(\delta - \frac{1}{2}(\alpha - \alpha')) = 9.78679 \checkmark$$

$$\log \tan \gamma = 0.17047 \checkmark$$

$$\gamma = 55^\circ 58' 00'' \checkmark$$

$$\delta = 18 \quad 18 \quad 00 \checkmark$$

$$\gamma - \delta = 37 \quad 40 \checkmark$$

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

$$\log \sin \pi = 9.22187 \checkmark$$

$$\log \sin(\gamma - \delta') = 9.78609 \checkmark$$

$$\log \sin \gamma = 9.91840 \checkmark$$

$$\log \sin(\delta - \delta') = 7.91596 \checkmark$$

$$\delta - \delta' = +28 \quad 19.8 \checkmark$$

$$\delta = +18 \quad 46 \quad 20.3 \checkmark (19.9)$$

$$\text{Am Eph } \delta = +18 \quad 46 \quad 20.2 \checkmark$$

$$O-C + 0.1 \checkmark$$

$$\text{giving } (t) \text{ full mt} = (-0.3) \checkmark$$

$$\text{cor to chan } \approx -0.2 \checkmark$$

$$(O-C) = -0.5 \checkmark$$

$$\log \sec \phi' = 9.86913 \checkmark$$

$$\log \sin \pi = 9.22187 \checkmark$$

$$\log \sin \gamma = 9.89981 \checkmark$$

$$\log \cos \delta = 9.97626 \checkmark$$

$$\log \sin(\delta - \alpha') = 8.01455 \checkmark$$

$$\alpha - \alpha' = -35' 32.95 \checkmark$$

$$= -2^\circ 22.20 \checkmark$$

$$K = 2 \quad 46 \quad 17.76 \checkmark (17.75)$$

$$\alpha = 2 \quad 46 \quad 17.27 \checkmark$$

$$+ 0.49 \checkmark$$

$$(+0.48) \checkmark$$

$$-0.2 \checkmark$$

$$+0.46 \checkmark$$

1930

Lunar Parallax

11

$$\begin{aligned}
 \alpha' &= 2 \quad 48 \quad 39 \quad 96 \quad (39.91) & S' &+ 18 \quad 18 \quad 00.5 \quad (00.1) \\
 \theta &= 23 \quad 18 \quad 25.7 \\
 \alpha - \alpha' &= -3 \quad 30 \quad 14. \\
 &= -52^\circ \quad 33' \quad 30''
 \end{aligned}$$

$$\pi \quad 57' \quad 18.1$$

$$\frac{1}{2}(\alpha - \alpha') = -17 \quad 46$$

$$t = \frac{1}{2}(\alpha - \alpha') = -52 \quad 15 \quad 44$$

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

$$\cos(\alpha - \alpha') = 9.99999$$

$$- \cos(\theta - \frac{1}{2}(\alpha - \alpha')) = 9.78679$$

$$\sin \gamma = 0.17047$$

$$\gamma = 55^\circ \quad 58' \quad 00''$$

$$\delta = 18 \quad 18 \quad 00$$

$$\gamma - \delta = 37 \quad 40$$

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

$$\sin \pi = 9.22187$$

$$\sin(\gamma - \delta) = 9.78609$$

$$- \sin \gamma = 9.91840$$

$$\sin(\theta - \delta) = 7.91596$$

$$\delta - \delta' = +28 \quad 198$$

$$S = +18 \quad 46 \quad 20.3$$

$$\lambda = 2 \quad 46 \quad 17.76$$

$$\text{Sun Eph } \delta = +18 \quad 46 \quad 20.2$$

$$\lambda = 2 \quad 46 \quad 17.27$$

$$O - C = +0.1$$

$$+0.49$$

$$\text{Gravity (1) full int} = (-0.3)$$

$$(+0.48)$$

1101931

stars measures

1913 Nov. 25.

12

d	N	d	N
1 16992	17546	1 6478	19035
6.1 9152	15398	7 70812	17790
15.7 4041	9791	18	8885
92	29	70	15
<u>15.7848</u>	<u>7852</u>	<u>6.1242</u>	<u>1245</u>
2		14981	17389
23.6 8960	10283	10860	11500
34.1 8150	8489	50	0000
7075	9398	68	87
<u>340785</u>	<u>0787</u>	<u>23.5878</u>	<u>15888</u>
3 19230	16742	19673	16990
24.1 13959	12000	10700	15950
13.5 6560	9901	98	5253
20	30	53	72
<u>13.5264</u>	<u>5264</u>	<u>28.1041</u>	<u>1036</u>

Grade 5 or 6

1101931

Stars measured

1913 Nov. 25

12

	d	N	d	N
1	16992	17546	16478	19035
61	9152	15398	7708 ¹²	17790
157	4041	9791	18	8885
	92	29	70	15
	<u>157848</u>	<u>7852</u>	<u>6.1242</u>	<u>1245</u>
2			14981	17389
236	8960	10683	10860	11500
341	8180	8489	50 ⁵⁰	0000
	7075	9398	68	87
	<u>340785</u>	<u>0787</u>	<u>23.5878</u>	<u>15888</u>
3	19230	16742	19673	16990
241	13959	12000	10700 ⁹⁰	15950
125	6560	9901	98	52
	20	30	53	72
	<u>135264</u>	<u>5264</u>	<u>28.1041</u>	<u>1036</u>

Grade 5 or 6

1931

moon measures

13

	d	u	d	u
1 scratch				
17.5	18366	15811	18765	15431
17.5	1222320	1198090	1535540	888061
	20	89	55	8161
	73	03	48	11
	<u>17.6149</u>	<u>.6168</u>	<u>17.6591</u>	<u>.6544</u>

2				
18.0-			12709	10481
18.0			1229810	6462
			10	10050

<u>17.9597</u>	<u>.9581</u>
----------------	--------------

	d	u	d	u
3 scratch				
18.2				
18.5	16935	19845	18172	14682
	1115055	1560510	1016660	1266661
	54	16	70	6061
	27	30	66	51
	<u>18.5778</u>	<u>.5772</u>	<u>18.1998</u>	<u>.2014</u>

4				
18.2			17080	17818
19.0+			964041	1524950
max			40	3550
u			60	90
x			<u>18.2575</u>	<u>.2566</u>

5				
18.0+			9387	15712
20.0			9981	15430
			9091	3540

<u>18.0298</u>	<u>.0277</u>
----------------	--------------

	d	u	d	u
6				
17.5 scratch			15589	19119
20.5	19381	17780	1202231	1268550
	1424741	1288099	27	7880
	40	95	70	00
	71	70	<u>17.6445</u>	<u>.6426</u>
	<u>20.5143</u>	<u>.5116</u>		

1931

known measures

13

1 scratch

175 18366

15811

18765

15431

175 1222320

1198070

1535540

888061

20

77

55

81

73

03

48

11

17.6149.616817.65916544

2

180-

189

12709

10481

1229810

6462

10

10050

17.95979581

3 scratch

182

185 16935

19845

18172

14682

1115015

1560510

1016660

1266661

54

16

70

60

27

30

66

51

18.5778.577218.19982014

4

182

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978

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990

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1006

1010

1014

1018

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1038

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1078

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1090

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1098

1102

1106

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1114

1118

1122

1126

1130

1134

1138

1142

1146

1150

1154

1158

1162

1166

1170

1174

1178

1182

1186

1190

1194

1198

1202

1206

1210

1214

1218

1222

1226

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1234

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1394

1
7
17
20
8
16
21
14
11
10

1931

Hydrogen-measurements.

14

	α	ν	α	ν
7	1450910	13128		
17.0	1010	1250310		
209	13920	09		
	<u>20.9410</u>	<u>.9379</u>		
8				
16.2	12965	12990		
21.1	12045	9598		
max	4940	12020		
in				
7	<u>21.0920</u>	<u>.0929</u>		

Faint image of Moon.

1931

Hygon - measurements

14

d

n

d²

n

3	141509/0	13128
17.0	10/0	12503/0
209	13920	09

20.9410.9379

8

162	12965	12990
211	12045	9158
49	40	12070

7 21.0920.0924

Faint image of Moon.

1931	Times etc.							
Exhibition	1912 Aug 5	23 ^h	27 ^m	✓	- 23 ^h	39 ^m	✓	
.. .. known		23	32	✓	52.4	✓	23	32 52.7
Clockslow			1	✓	13.5	✓		
H. Sid T.		23	34	✓	06.05	✓		
H. hour		4	44	✓	31.05	✓		
G. Sid T.		28	18	✓	37.10	✓		
S. T. known		8	54	✓	40.29	✓		
Interval		19	23	✓	56.81	✓		
Reduction			3	✓	10.69	✓		
G. M. T.		19	20	✓	46.12	✓	0-X = -3 ^h	43 ^m

From bank alim.			RA		Decl.		
known 19 ^h	2 ^h	46 ^m	06.17	✓	+ 18°	45'	17.3
Motion = 2.1619	✓				12.226	✓	
.. .. w. 7687			+ 44.90	✓	+ 4	13.9	✓
Tabular place	2	46	51.07	✓	+ 18	49	31.2

Moon's age	43 days			
parallel	57'	18.7	✓	
Tamudian	15	38.6	✓	
	R	938.6	✓	
924 = 10.85		+ 11.0	✓	
938.6 = 11.0		- 1.0	✓	
Augmentation		948.6	✓	
Inradiation		2.0334	✓	
	R	2.0330	✓	
a = -1.8	(1+a) R	4.1331	✓	
	R ²			

1931 Times etc.
 Exhibition 1912 Aug 5, 23^h 27^m - 23^h 39^m
 ... known 23 32 52.4 - 23 32 52.7
 Clockflow 1 13.5

H. L. I. 23 34 06.05
 H. H. I. 4 44 31.05
 G. L. I. 28 18 37.10
 S. T. H. I. 8 54 40.29
 + internal 19 23 56.81
 Reduction 3 10.69
 G. H. T. 19 20 46.12 6-X-3^h 09^m

From East Alman. R.A. Decl.
 known 19^h 2^m 46^s 06^s 17 + 18^h 45^m 17^s 3
 motion 2.1619 12.226
 W. 7687 + 44.90 + 4 13.9
 Tabular place 2 46 51.07 + 18 49.312

Known age 23 days.
 parallax 57' 18.7
 Translucian 15 38.6
 924-10.55 R 938.6
 9386-11.0 Augmentation + 11.0
 Imagination - 1.0
 R 948.6
 R 20334
 6--1.8 (1+a) R 20330
 R² 4.1331

1931

Plate Constants

16

1

2

3

2	6.1244	23.5883	28.1038
3	7.7132	24.9625	29.7235
2-3	-1.5888	-1.3742	-1.6197

γ	15.7850	34.0786	13.5264
η	15.5619	34.0581	13.5534
γ-η	+2231	+205	-270

$$\begin{array}{rclcl}
 2-3 & -1194 & & +1.8x & +1.7755 \\
 -1.5888 - 1.878 & = & -1.7766 + 11 & = & -1.7755 = 0 \\
 -1.3742 - 4055 & = & -1.7797 + 42 & = & -1.7755 = 0 \\
 -1.6197 - 1610 & = & -1.7807 + 51 & = & -1.7756 = -1 \\
 6.2245 - 2268 & & +29 & = & 1.77763
 \end{array}$$

$$\begin{array}{rclcl}
 \gamma-\eta & +114x & +24 & & -2961 \\
 +2231 + 698 & = & +2929 + 32 & = & +2961 = 0 \\
 +205 + 2689 & = & +2894 + 68 & = & +2962 = +1 \\
 -270 + 3204 & = & +2934 + 27 & = & +2961 = 0 \\
 19.0591 + 1850 & & +38 & = & 18.9518
 \end{array}$$

Tables $a = -2.7$ $e = -2.7$ $a - e = 0.0$ $b + a = +3.0$
 Obs $a = -1.8$ $e = -2.0$ $a - e = +0.2$ $b + a = +5.0$

1931

Plate Constants

16

	1	2	3
2	6.1244	23.5883	28.1038
3	7.7132	24.9625	29.7235
2-3	-1.5888	-1.3742	-1.6197

η	15.7850	34.0786	13.5264
μ	15.5619	34.0581	13.5534
$\eta - \mu$	+2231	+205	-270

2-3	-1194		+1.82		+1.7755
-1.5888	-1.878	-1.7766	+11	-1.7755	= 0
-1.3742	-4.055	-1.7797	+42	-1.7755	= 0
-1.6197	-1.610	-1.7807	+51	-1.7756	= -1
16.2247	-2268		+29		= 1.77763

$\eta - \mu$	+ 1 1 4 2	+ 2 4	- 2 9 6 1
+ 2 2 3 1	+ 6 9 8	+ 2 9 2 9 + 3 2	+ 2 9 6 1 = 0
+ 2 0 5	+ 2 6 8 9	+ 2 8 9 4 - 6 8	+ 2 9 6 2 = + 1
- 2 7 0	+ 3 2 0 4	+ 2 9 3 4 + 2 7	+ 2 9 6 1 = 0
1 9 . 0 5 - 9 1	+ 1 8 5 0	+ 3 8	= 1 8 . 9 5 - 1 8

Tables. $a = -2.7$ $a = -2.7$ $a - c = 0.0$ $b + a = +3.0$
 else $a = -1.8$ $c = -2.0$ $a - c = +0.2$ $b + a = +5.0$

pt.	mag. L	resid.
1	135.0	+22
2	121.5	-29
3	103.7	+37
4	90.0	-29
5	62.3	+58
6	44.9	-78
7	22.5	+21
8	0.0	-1

1931

brooks Center

17

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	17.6568	+1.4328	+5	2.0544	4.1375	+44
2	17.9589	+1.7349	+3	3.0109	4.1328	-3
3	18.2006	+1.9766	+2	3.9077	4.1397	+66
4	18.2570	+2.0330	0	4.1331	4.1331	0
5	18.0288	+1.8048	-3	3.2562	4.1413	+82
6	17.6436	+1.4196	-5	2.0139	4.1271	-60
7	17.0000	+0.7760	-6	0.6012	4.1360	+29
8	16.2240	0.0000	-7	0.0000	4.1327	-4
9						
				Comp $R^2 =$	4.1331	

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.6158	-1.4434	+1	2.0831
2	18.0000	-1.0592	+0	1.1219
3	18.5775	-0.4817	+0	0.2320
4	19.0592	0.0000	0	0.0000
5	20.0000	+0.9408	-0	0.8851
6	20.5130	+1.4538	-1	2.1132
7	20.9394	+1.8802	-1	3.5348
8	21.0922	+2.0330	-1	4.1327

$x = \text{max} = 18.2570$ $y = \text{max} = 21.0922$
 Comp $R = 2.0330$ $R = 2.0330$
 $x_0 = 16.2240$ $y_0 = 19.0592$

Center $\begin{cases} x_0 = 16.2240 \\ y_0 = 19.0592 \end{cases}$

1931

Lagoon Center

17

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0) + (y - y_0)$	$0 - c$
1	17.65684	1.4328	+5	20544	4.1375	+44
2	17.9589	1.7349	+3	30109	4.1328	-3
3	18.2006	1.9766	+2	39077	4.1397	+66
4	18.2570	2.0330	0	41331	4.1331	0
5	18.0288	1.8048	-3	32562	4.1413	+82
6	17.6436	1.4196	-5	20139	4.1271	-60
7	17.0000	0.7760	-6	06012	4.1360	+29
8	16.2240	0.0000	-7	00000	4.1327	-4

Comp $R^2 = 4.1331$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.6158	-1.4434	+1	20831
2	18.0000	-1.0592	+0	11219
3	18.5775	-0.4817	+0	02320
4	19.0592	0.0000	0	00000
5	20.0000	+0.9408	-0	08851
6	20.5130	+1.4538	-1	2.1132
7	20.9394	+1.8802	-1	3.5348
8	21.0922	+2.0330	-1	4.1327

 $x - \text{max} = 18.2570$ $y - \text{max} = 21.0922$ Comp $R^2 = 2.0330$ $R = 2.0330$ $x_0 = 16.2240$ $y_0 = 19.0592$

Center $\begin{cases} x_0 = 16.2240 \\ y_0 = 19.0592 \end{cases}$

1931

Moon's Center Conditional Equations

18

	a	b	c		c	0-c
1	+1.43	-1.44	= +44	+20 + 2 = +22	+22	
2	+1.73	-1.06	= -3	+24 + 2 = +26	-29	
3	+1.98	-0.48	= +66	+28 + 1 = +29	+37	
4	+2.03	+0.00	= 0	+29 - 0 = +29	-29	
5	+1.80	+0.94	= +82	+26 - 2 = +24	+58	
6	+1.42	+1.45	= -60	+20 - 2 = +18	-78	
7	+0.78	+1.88	= +29	+11 - 3 = +8	+21	
8	0.00	+2.03	= -4	+0 - 3 = -3	-1	

Average = 34

Mean Equations

$$+ 7.17 - 29.8 = +10.7$$

$$+ 4.00 + 6.30 = +10.3$$

$$- 4.00 + 1.66 = -2.34$$

$$+ 7.96 = -1.63$$

$$b = -1.63$$

$$+ 7.17 = +10.7 - 5 = +10.2$$

$$a = +14.2$$

1931

Moon's Center Conditional Equations

18

	a	b	c	d	e	f
1	+1.43	-1.44	+4.4	+2.0	+2.2	+2.2
2	+1.73	-1.06	-3	+2.4	+2.6	-2.9
3	+1.98	-0.48	+6.6	+2.8	+1	+3.7
4	+2.03	+0.00	0	+2.9	-0	-2.9
5	+1.80	+0.94	+8.2	+2.6	-2	+5.8
6	+1.42	+1.45	-6.0	+2.0	-2	-7.8
7	+0.78	+1.88	+2.9	+1.1	-3	+2.1
8	0.00	+2.03	-4	+0	-3	-1

Average = 3.4

Mean Equations

$$+ 7.17 - 2.98 = + 4.19$$

$$+ 4.00 + 6.30 = + 10.30$$

$$- 4.00 + 1.66 = - 2.34$$

$$+ 7.96 = + 5.62$$

$$b = - 1.6$$

$$+ 7.17 = + 10.7 - 5. = + 5.7$$

$$a = + 14.2$$

Reduction to app place.

$$H + \alpha_0 12 \quad 05 = 181^\circ 15'$$

$$H \quad 9 \quad 16$$

$$\alpha_0 \quad 2^m \quad 49^m$$

$$G \quad 21 \quad 20$$

$$G + \alpha_0 24 \quad 09 = 2^\circ 15'$$

$$S_0 = +18 \quad 22$$

$$\begin{aligned} \text{Red in } \alpha \quad & \left. \begin{aligned} f &= +1.62 \\ (g) &= +0.01 \\ (h) &= -0.03 \end{aligned} \right\} = +1.60 \end{aligned}$$

$$\begin{aligned} \text{Red in } \delta \quad & \left. \begin{aligned} (g) &= +13.65 \\ (h) &= -6.20 \\ (i) &= +5.32 \end{aligned} \right\} = +1.277 \end{aligned}$$

$$\begin{aligned} l \cos(G+\alpha) & 9.9997 \\ g & 1.1355 \\ \sin & 8.5990 \\ \tan S & 9.5212 \\ \frac{1}{\sin} & 8.8239 \\ & \dots \\ g' & 1.1352 \\ g & 8.0746 \end{aligned}$$

$$\begin{aligned} l \sin S & 9.4984 \\ \cos(H+\alpha) & 9.9999 m \\ h & 1.2941 \\ \sin & 8.3388 m \\ \sec S & 0.0227 \\ \frac{1}{\cos} & 8.8239 \\ & \dots \\ h' & 0.7924 m \\ h & 8.4795 m \end{aligned}$$

$$\begin{aligned} l \cos S & 9.9773 \\ i & 0.7486 \\ (i) & 0.7259 \end{aligned}$$

1931 Moon's Mean Position (1912.0)

19

$$\begin{aligned} X_0 &= 16.2240^\circ \\ \Delta a &= +7^\circ \\ \hline &16.2247^\circ \end{aligned}$$

$$\begin{aligned} Y_0 &= 19.0592^\circ \\ \Delta b &= -1^\circ \\ \hline &19.0591^\circ \end{aligned}$$

From Plate Constants $X = 17.7763^\circ$ $Y = 18.9518^\circ$

$$\bar{z} = -0.2237^\circ$$

$$\eta = -3.0482^\circ$$

$$\log 3 = 9.34967^\circ$$

$$\log \cos 9.97730^\circ$$

$$\log \cos 8.50724^\circ$$

$$\log (d-A) = 0.86513^\circ$$

$$X-A = 7.33^\circ$$

$$A = 2^\circ 49' 12''$$

$$\alpha_0 = 2^\circ 49' 04.67''$$

Red to app place +1.60

$$\alpha' = 2^\circ 49' 06.27''$$

$$\log \tan S = 9.5203^\circ$$

$$\log \cos^2 = 8.6993^\circ$$

$$\log \eta_1 = 5.2730^\circ$$

$$\log \eta_0 = 0.48404^\circ$$

$$\log \cos 7.33115^\circ$$

$$\log (d-D) = 3.15289^\circ$$

$$S-D = 23^\circ 42.0'$$

$$D = +18^\circ 45' 25''$$

$$S_0 = +18^\circ 21' 43.0''$$

Red to app place +12.8

$$S' = +18^\circ 21' 55.8''$$

1931 moons mean Position (1912.0)

19

$$\begin{array}{r} X_0 = 16.2240 \\ \Delta a = \quad + 7 \\ \hline 16.2247 \end{array}$$

$$\begin{array}{r} Y_0 = 19.0592 \\ \Delta b = \quad - 1 \\ \hline 19.0591 \end{array}$$

Transit Plate Constants $X = 17.7763$ $Y = 18.9518$

$$\bar{z} = -0.2237$$

$$\eta = -3.0482$$

$$\log \bar{z} = 9.34967$$

$$\dots \cos \bar{z} = 9.97730$$

$$\dots \sin \bar{z} = 8.50724$$

$$(a-A) = 0.86513$$

$$\log \tan S = 9.5203$$

$$\dots \cos^2 S = 8.6993$$

$$\dots \eta_1 = 5.2730$$

$$A - A = 7.33$$

$$\log \eta_0 = 0.48404$$

$$\dots \sin \eta_0 = 7.33115$$

$$A = 2^h 49^m 12^s$$

$$(d-D) = 3.15289$$

$$d_0 = 2^h 49^m 04.67^s$$

$$S-D = 23.42.0$$

$$\text{Rectified place} + 1.60$$

$$D = +18.45.25$$

$$d' = 2^h 49^m 06.27^s$$

$$S_0 = +18.21.43.0$$

$$\text{Rectified place} + 12.8$$

$$S' = +18^{\circ} 21' 55.8''$$

1931

Linear Parallax

20

$$\alpha' = 2^h 49^m 06.27^s$$

$$\delta = 23^{\circ} 34' 06.05''$$

$$- 3' 15''$$

$$- 48^{\circ} 45'$$

$$- 16' 50''$$

$$- 48^{\circ} 28' 10''$$

$$9.95727$$

$$999999$$

$$017847$$

$$0.13573$$

$$53^{\circ} 48' 40''$$

$$18^{\circ} 21' 56''$$

$$35^{\circ} 26' 44''$$

$$9.82640$$

$$822195$$

$$976337$$

$$009309$$

$$\sin(\delta - \delta') 7.90481$$

$$S - S' = + 27^{\circ} 36.7'$$

$$S = + 18^{\circ} 49' 32.5''$$

$$\text{Am Elphid} + 18^{\circ} 49' 31.2''$$

$$O - C + 1.3''$$

$$\delta' = + 18^{\circ} 21' 55.8''$$

$$57' 18.7''$$

$$9.86913$$

$$822195$$

$$9.87613$$

$$0.02388$$

$$\sin(\delta - \delta') 7.99109$$

$$\alpha - \alpha' = - 33^{\circ} 40.80''$$

$$= - 2^h 14.72^m$$

$$\alpha = 2^h 46^m 51.55^s$$

$$\alpha = 2^h 46^m 51.07^s$$

$$+ 0.48''$$

1931

Linear Parallax

20

$$\begin{array}{r} \alpha' = 2^h 49^m 06.27^s \\ 0 - 23 \quad 34 \quad 06.05 \\ - 3 \quad 15 \\ - \quad 48 \quad 45 \end{array}$$

$$\begin{array}{r} \delta = +18^\circ 21' 55''.8 \\ 57' 18.7 \end{array}$$

$$\begin{array}{r} - \quad 16 \quad 16 \quad 50 \\ - \quad 48 \quad 28 \quad 10 \end{array}$$

$$\begin{array}{r} 9.86913 \\ 8.22195 \\ 9.87613 \\ \hline 0.02388 \end{array}$$

$$\sin(\alpha - \alpha') 7.99109$$

$$\begin{array}{r} 9.95727 \\ 9.99999 \\ 0.17847 \\ \hline 0.13573 \end{array}$$

$$\alpha - \alpha' = -33' 40.80''$$

$$= -2^m 14.72^s$$

$$53 \quad 48 \quad 40$$

$$18 \quad 21 \quad 56$$

$$35 \quad 26 \quad 44$$

$$9.86640$$

$$8.22195$$

$$9.76337$$

$$0.09309$$

$$\sin \delta \cdot \sin \delta' 7.90481$$

$$S - \delta' = +27 \quad 36.7$$

$$S = 18 \quad 49 \quad 32.5$$

$$\alpha = 2 \quad 46 \quad 51.55$$

$$\text{in Eph} \quad +18^\circ 49' 31''.2$$

$$2^h 46^m 51.57^s$$

$$O - C \quad + 1.3$$

$$+ 0.98$$

1956

Star - measures

1913 Nov. 26

21

	d	4	v
1	15906	17149	
9.5	10195	13280	79
10.5	9196	73	
	22	60	
	<u>20.5728</u>	<u>.5723</u>	
2			
21.8	9820		
29.0	9820		
	22		
	<u>29.0000</u>	<u>29.0000</u>	

	d	2	v
	17206	18243	
	11690	13770	71
	8990	75	
	20	56	
	<u>9.4476</u>	<u>.4477</u>	
	14731	17012	
	13400	83	50
	98	48	
	36	30	
	<u>21.8664</u>	<u>.8678</u>	
	13869	11600	
	643819	1304038	
	3025	39	
	66	08	
	<u>24.2561</u>	<u>.2563</u>	

Grade 3 or 2

1956

Stars - lucas

1913 mod. 26

21

	d	y	z
1	15906	17149	
95	10195	13280	
W5	9176	7379	
	22	60	
	<u>205728</u>	<u>5723</u>	

21.8	9820
29.0	982020
	22
	<u>290000</u>

243	19629	15389
125	1423936	1079090
	3536	90
	41	07
	<u>125398</u>	<u>5392</u>

	d	z	N
	17206		18243
	11690		13770
	8970		7571
	20		56
	<u>94476</u>		<u>4477</u>
	14731		17012
	1340091		835050
	9891		48
	36		30
	<u>218664</u>		<u>8678</u>

13869	15600
643819	1304038
3025	39
66	08
<u>242561</u>	<u>2163</u>

Grade 3 or 2

1956

Moon - measures

22

	α	δ	μ	σ	ω
1	18402	20021			
17.1	109900	17440			
17.8	0.100	3032			
min	15	37			
in	17.7415	7409			
8					

18.0	12285	15080
179	7880	1483030
	12020	40

17.97399753

3
18.8
19.0

12721
1162020
13

1443929
30
13304

18.88978871

1273142
12700

14603
1456846
55

19.0041.0046

11680
1146155
60

1384131
30
13630

18.97799796

16045
1077079
51
51

18260
1355060
40
64

18.47294712

A
19.0+
19.6
max
in
x

J
19.0-
20.0

B
18.5
21.0

1950

Moon - measures

22

	α	δ	α	δ	α	δ
1	1 54 02		20 0 21			
17.1	109 90		174 40			
17.8	0.1 00		30 32			
min	15		37			
Σ	17.7415		7409			

18.0	122 85		150 80			
179	78 80		148 30		30	
	120 20		40			

Σ	17.9739		197.53			
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18.8			127 71		144 39	29
19.0			116 20	20	30	
			13		133 04	

Σ			18.8897		1871	
19.0			127 31		146 03	
19.6			10 42		145 68	
min			127 00		5-5 48	

Σ			19.0041		10046	
19.0			116 80		1384 131	
20.0			114 61	55	30	
			60		136 30	

Σ			18.9779		9796	
18.5			160 45		182 60	
21.0			107 70	79	135 50	60
			51		40	
			51		64	
			184 72		4712	

1956

moon-measures

23

	d		n
2	19888		19.600
18.0	16229.50		13196.80
21.4	32		90
	00		10
	<u>21.3655</u>		<u>.3589</u>

	d		n
8	17.1 18906		18570
21.6	12982.82		14480.84
max	89		80
	15		80
8	<u>21.5927</u>		<u>.5907</u>

Moon's limb a little fuzzy.

Remembrance (7)

	d		n
	18005		17937
	14380		11520.30
	7777		20
	19		45
	<u>21.3632</u>		<u>.3581</u>

1956

moon - measures

23

	α	δ	α	δ
2	19888		19600	
180	16229.50		13196.00	
214	32		90	
	00		10	
	<u>21.3655</u>		<u>3589</u>	
2				
171	18906		18570	
216	12982.82		14480.84	
max	89		80	
-	15		80	
5	<u>21.5927</u>		<u>1907</u>	

moon limb a little fuzzy.

1956 Times etc

Eph. to star	1912 Aug 27,	22 ^h 38 ^m	✓	- 22 ^h 50 ^m	✓
... moon		22 44	23.7	- 22 44	24.0
Clock slow		1	04.3	✓	
H. Sid. T.		22 45	28.15	✓	
H. long		4 44	31.05	✓	
G. Sid. T.		27 29	59.20	✓	
S. T. M. M.		10 21	24.51	✓	
Interval		17 08	34.69	✓	
Reduction		2	48.51	✓	
G. M. T.		17 05	46.18	0 - 0 - 0	0 ^m 13 ^s

From East Alman		R.A.		Decl	
Moon 17	22 ^h 45 ^m	30.58	- 11° 01'	40.11	✓
Motion in 1 ^m = 1.8277			13.39		✓
... 5.7697		+ 10.55	+ 1	17.3	✓
Tabular place	22 45	41.13	- 11 00	22.8	✓

Moon's age	15+ days.	9 ^h past full.
Parallax	54'	22.9
Secularian	14	50.7
R =		890.7
Augmentation		+ 8.5
Paradiation		- 0.6
R =		898.6
R =		1.9263
(a+1)/R =		1.9262
R ² =		37103

$939 = 9.3$
 $891 = 8.5$
 $a = -0.5$

1956 Times etc

Exultation 1912 Aug 27	22 ^m	38 ^m	-22 ^m	50 ^m	
moon	22	44	237	-22	44 290
clock slow		1	043		
H. 1st T.	22	45	28.15		
H. 2nd T.	4	44	31.05		
Q. 1st T.	2.7	29	59.20		
S. T. 1st T.	10	21	24.51		
Interval	17	08	34.69		
Residual		2	48.51		
E. 1st T.	17	05	46.18	0 - 1 - - 0 ^m 0 ^m 13 ^m	

Ironheart Celest	R. G.	Real		
moon 17	22 ^m 45 ^m	30 ^m 58 ^m	- 11 ^m 01 ^m	40 ^m 1
moon 17	1.8277	13.371		
5.7697		+ 10.55	+ 1	173
Tabular place	22 45	41.13	- 11 00	228

moon's age	15+ days	9 ^m past full.
parallax	54' 22.9	
semidiameter	14' 50.7	
IK	890.7	
Augmentation	+ 8.5	
True semidiameter	- 0.6	
IK	898.6	
R	1.9263	
Q + 11 IK	1.9262	
IK	37103	

Q = -0.5

956 Plate Constant

$$\begin{array}{rcll} x = 3 & - 66.64 & + 5x & + 1232 \\ + 133 - 1370 & = -1237 & + 5 & = -1232 = 0 \\ + 688 - 1931 & = -1243 & + 11 & = -1232 = 0 \\ + 408 - 835 & = -1243 & + 12 & = -1231 = +1 \\ 17.0813 & - 1310 & + 9 & = 17.0744 \end{array}$$

$$\begin{array}{r}
 4 - 4 + 6.9,5x + 7.34 - 1615 \\
 + 508 + 65.7 = + 1465 + 150 = + 1615 = 0 \\
 - 118 + 1520 = + 1402 + 212 = + 1614 = - 1 \\
 - 162 + 1686 = + 1524 + 92 = + 1616 = + 1 \\
 19.6674 + 1187 + 144 = 19.6390
 \end{array}$$

1956

Plate Constant

x	y							
94476	205722	22	41	36	-11	37	44	
21.8671	290000		48	08	-10	35	36	
292562	125395		49	29	-12	39	28	
5557	16211		18	73		17	108	
18.52	2070	22	46	24	-11	36	16	
-18	-22		-	16		+10	08	
x^2	1.30	22	46	08	-11	26	08	
31	465							
162	608							
	-10' 08"							

$$A = 22^h 46^m 08^s$$

$$D = -11^\circ 26' 08''$$

$$\begin{aligned}
 x-3 & -60.64 & +.5x & & +1232 \\
 +133 & -1370 & = -1237 & + 5 & = -1232 & = 0 \\
 +688 & -1931 & = -1243 & + 11 & = -1232 & = 0 \\
 -408 & -835 & = -1243 & + 12 & = -1231 & = +1 \\
 170813 & -1310 & = & + 9 & & = 17.0744
 \end{aligned}$$

$$\begin{aligned}
 y-4 & +69.5x & +7.3y & & -1615 \\
 +508 & +657 & = +1465 & +150 & = +1615 & = 0 \\
 -118 & +1520 & = +1402 & +212 & = +1614 & = -1 \\
 -162 & +1686 & = +1524 & +92 & = +1616 & = +1 \\
 19.6674 & +7187 & & +144 & & = 19.6390
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables } a &= 0.0 & b &= -5.44 & a-b &= +5.44 & b+a &= 0.0 \\
 a &= -0.5 & c &= -7.3 & a-c &= +6.8 & c+a &= -2.9
 \end{aligned}$$

1956 Standard Coordinates-Comparison Stars

	Cape No. 3155 mag 6.7			Cape No. 3170 mag 6.7			Cape No. 3175 mag 7.2		
C	22° 40' 58.06			22° 47' 30.11			22° 48' 50.68		
L		12			19			70	
B		05			17			65	
mean	22 40 58.08			22 47 30.16			22 48 50.68		
Pre		+ 37.98			+ 37.97			+ 37.98	
A	22 41 36.06			22 48 08.13			22 49 28.66		
A	22 46 08			22 46 08			22 46 08		
A-A	- 4 31.94			+ 2 00.13			+ 3 20.66		
Sm(A-A)	- 271.92			+ 120.13			+ 200.65		
log _e	2.43444m			2.07965m			2.30244		
~~log_e~~	9.99100			9.99263			9.98932		
~~log_e~~	0.93268m			0.57952			0.79900		
~~log_e~~	- 8.5640			+ 3.7977			+ 6.2950		
~~log_e~~	-	17		+ 6			+ 20		
~~log_e~~	9.4343			21.7983			24.2970		
~~log_e~~	9.4476			21.8671			24.2562		
~~log_e~~	+ 133			+ 688			- 408		
C	- 11° 41' 29.9			- 10° 35' 24.9			- 12° 43' 16.8		
L		30.4			24.7			17.4	
B		30.5			25.1			17.1	
mean	- 11 41 30.3			- 10 35 24.9			- 12 43 17.1		
Pre		+ 3 46.5			+ 3 49.0			+ 3 48.7	
S	- 11 37 43.8			- 10 31 35.9			- 12 39 28.4		
D	- 11 26 08			- 11 26 08			- 11 26 08		
D-D	- 11 35.8			+ 54 32.1			- 1 13 20.4		
Sm(D-D)	- 695.8			+ 3272.4			- 4401.1		
log _e	2.84248m			3.51487			3.64356m		
~~log_e~~	0.17363m			0.84602			0.97471m		
~~log_e~~	9.3134m			9.2691m			9.3514m		
~~log_e~~	1.8654			1.1590			1.5980		
~~log_e~~	8.2322m			7.4815m			8.0028m		
~~log_e~~	- 1.4915			+ 70148			- 9.4342		
~~log_e~~	- 171			- 30			- 101		
~~log_e~~	204914			29.0118			12.5557		
~~log_e~~	20.5722			29.0000			12.5395		
~~log_e~~	+ 808			- 118			- 162		

1970 Standard Coordinates - Comparison Stars

Cape No. 3155 mag 6.7				Cape No. 3170 mag 6.7				Cape No. 3175 mag 7.2			
C	22°	40'	58.06	22°	47'	30.11		22°	48'	50.68	
L			12			19				70	
E			05			17				65	
mean	22	40	58.08	22	47	30.16		22	48	50.68	
Proc			+ 37.98			+ 37.97				+ 37.98	
A	22	41	36.06	22	48	08.13		22	49	28.66	
A	22	46	08	22	46	08		22	46	08	
x-A	-	4	31.94	+ 2	00.13			+ 3	20.66		
m(A-A)			-271.92	+ 120.13				+ 200.65			
log u	2.43444	m		2.07965	m			2.30244	m		
log v	9.99100			9.99263				9.98932			
log w	0.93268	m		0.57952	m			0.79900	m		
log x	-8.5640			+ 3.7977				+ 6.2950			
log y	-	17		+ 6				+ 20			
log z	9.4343			21.7983				24.2970			
log t	9.4476			21.8671				24.2562			
log s	+ 133			+ 688				- 908			
C	-11°	41'	29.9	-10°	35'	24.9		-12°	43'	16.8	
L			30.9			24.7				17.4	
E			30.5			25.1				17.1	
mean	-11	41	30.3	-10	35	24.9		-12	43	17.1	
Proc			+ 3 46.5			+ 3 49.0				+ 3 48.7	
S	-11	37	43.8	-10	31	35.9		-12	39	28.4	
D	-11	26	08	-11	26	08		-11	26	08	
S-D	-	11	35.8	+ 54	32.1			- 1	13	20.4	
z(A-B)			- 695.8	+ 3272.4				- 4401.1			
log u	2.84248	m		3.51487	m			3.64356	m		
log v	0.17363	m		0.84602	m			0.97471	m		
log w	9.3134	m		9.2691	m			9.3514	m		
log x	1.8654			11.590				15.980			
log y	8.2322	m		7.4815	m			8.0028	m		
log z	-1.4915			+ 701.48				- 9.4342			
log t	-	171		- 30				- 101			
log s	20.4914			29.0118				12.5557			
log t	20.5722			29.0000				12.5395			
log s	+ 808			- 118				- 162			

ph	mag. L	residual
1	180.0	+38 +30
2	151.5	+19 +5
3	110.3	+0 -5
~~4~~ 4	91.0	-122 -134
5	80.1	+10 -2
6	46.3	+14 +10
7	28.5	+59 +61
~~8~~ 8	0.0	-36 -27

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Moon's Center

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	x	y	$x-x_0$	$(x-x_0)^2$	$(x-x_0)^2 + (y-y_0)^2$	$O-C$
1	17.0776	+0.0000	0.0000	0.0000	3.7164	+61
2	18.0000	+0.9224	0.9224	0.8508	3.7211	+108
3	18.8884	+1.8108	1.8108	3.2790	3.7256	+153
4	19.0044	+1.9268	1.9268	3.7125	3.7125	+22
5	18.9788	+1.9012	1.9012	3.6146	3.7250	+147
6	18.9720	+1.3944	1.3944	1.9443	3.7204	+101
7	18.0000	+0.9224	0.9224	0.8508	3.7211	+108
8	17.0776	0.0000	0.0000	0.0000	3.7045	-58
Comp $R^2 = 3.7103$						

	y	$y-y_0$	Δy	$(y-y_0)^2$
1	17.7412	-1.9268	-10	3.7164
2	17.9746	-1.6934	-8	2.8703
3	19.0000	-0.6680	-3	0.4466
4	19.6680	0.0000	0	0.0000
5	20.0000	+0.3320	+2	0.1104
6	21.0000	+1.3320	+7	1.7761
7	21.3614	+1.6934	+8	2.8703
8	21.5917	+1.9237	+10	3.7045

Approximate Center.

$$x = 18.0 \quad y = 17.9746$$

$$21.3614$$

$$39.3360$$

$$\text{mean } y = 19.6680$$

$$y = \text{min} = 17.7412$$

$$R = 1.9268$$

$$x = \text{max} = 19.0044$$

$$x_0 = 17.0776$$

$$y_0 = 19.6680$$

$$y = \text{max} = 21.5917$$

$$R = 2.9237$$

$$\text{Center } \begin{cases} x_0 = 17.0776 \\ y_0 = 19.6680 \end{cases}$$

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Miron's Center

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	x	y	N	$x - x_0$	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	$y - y_0$
1	17.0776	17.0000	0	0.0000	0.0000	3.7164	+61
2	18.0000	18.0000	0	0.9224	0.8508	3.7211	+108
3	18.8884	18.8884	0	1.8104	3.2790	3.7256	+153
4	19.0044	19.0044	0	1.9268	3.7125	3.7125	+22
5	18.9788	18.9788	0	1.9012	3.6146	3.7250	+147
6	18.4720	18.4720	0	1.3944	1.9443	3.7204	+101
7	18.0000	18.0000	0	0.9224	0.8508	3.7211	+108
8	17.0776	17.0776	0	0.0000	0.0000	3.7045	-58

Comp $K = 3.7103$

	x	y	N	$x - x_0$	$(x - x_0)^2$
-1	17.7412	17.7412	0	-1.9268	3.7164
2	17.9746	17.9746	0	-1.6934	2.8703
3	19.0000	19.0000	0	-0.6680	0.4466
4	19.6680	19.6680	0	0.0000	0.0000
5	20.0000	20.0000	0	0.3320	0.1104
6	21.0000	21.0000	0	1.3320	1.7761
7	21.3614	21.3614	0	1.6934	2.8703
8	21.5917	21.5917	0	1.9237	3.7045

Approximate Center

$$x = 18.0 \quad y = 17.9746$$

$$21.3614$$

$$39.3360$$

$$\text{mean } y = 19.6680$$

$$y - \text{min} = 17.7412$$

$$R = 1.9268$$

$$x - \text{max} = 19.0044$$

$$x_0 = 17.0776$$

$$19.6680$$

$$y - \text{max} = 21.5917$$

$$R = 2.9237$$

$$\text{Center } \begin{cases} x_0 = 17.0776 \\ y_0 = 19.6680 \end{cases}$$

Formation of Normals

	ab	an	bn
1	- 0.00	+ 0.0	- 117.7
2	- 1.55	+ 99.4	- 182.5
3	- 1.21	+ 276.9	- 102.5
4	+ 0.00	+ 21.5	+ 0.0
5	+ 0.63	+ 279.3	+ 98.5
6	+ 1.85	+ 140.4	+ 134.3
7	+ 1.55	+ 99.4	+ 182.5
8	+ 0.00	- 0.0	- 27.8
	+ 1.27	+ 906.9	- 65.2
			- 83.4
			- 148.6

giving 8) full int.

Residuals

	O		C	O - C
1	+61	+ 10 + 31 =	+31	+30
2	+108	+ 75 + 28 =	+103	+5
3	+153	+ 147 + 11 =	+158	-5
4	+22	+ 15 - 6 - 0 =	+156	-134
5	+147	+ 154 - 5 =	+149	-2
6	+101	+ 113 - 22 =	+91	+10
7	+108	+ 75 - 28 =	+47	+61
8	-58	+ 0 - 31 =	-31	-27
				+106 - 168
				difference = 36.

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Moon's Center

Conditional Equations.

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	a	b	0		c	0-c
1	+0.00	-1.93	= +61	+	0 + 23 = +23	+38
2	+0.92	-1.69	= +108	+	69 + 20 = +89	+19
3	+1.81	-0.67	= +153	+	135 + 8 = +143	+10
4	+1.93	+0.00	= +22	+	144 - 0 = +144	-122
5	+1.90	+0.33	= +147	+	141 - 4 = +137	+10
6	+1.39	+1.33	= +101	+	103 - 16 = +87	+14
7	+0.92	+1.69	= +108	+	69 - 20 = +49	+59
8	+0.00	+1.92	= -58	+	0 - 22 = -22	-36

Average = 36

Normal Equation

~~$$+12.40 + 1.27 = +907$$~~

~~$$+ 1.27 + 13.64 = -65$$~~

~~$$- 1.27 - 0.13 = -93$$~~

~~$$+ 13.51 = -158$$~~

~~$$b = -11.7$$~~

~~$$- 0.12 - 1.27 = +6$$~~

~~$$+ 12.28 = +913$$~~

~~$$a = +74.4$$~~

Giving (8) full wt.

$$+11.47 + 1.27 = +907$$

$$+ 1.27 + 15.49 = -149$$

$$- 1.27 - 0.14 = -101$$

$$+ 15.35 = -250$$

$$b = -16.3$$

$$+11.47 = +907 + 21 = +928$$

$$a = +80.9$$

Ave measured: 180 Average (0-c) = -8

$$\frac{180}{n} = 0.33$$

$$-\frac{8}{33} = -0.24 \quad \Delta n = -0.3$$

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Moon's Center

Conditional Equation

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	x	y	z		u	v	w
1	+0.00	-1.93	+0.1	+	0+23	+23	+38
2	+0.92	-1.69	+1.04	+	69+20	+89	+19
3	+1.81	-0.67	+1.53	+	135+8	+143	+10
4	+1.93	+0.00	+2.2	+	144+0	+144	+122
5	+1.90	+0.33	+1.47	+	141+4	+137	+10
6	+1.39	+1.33	+1.01	+	103+16	+87	+14
7	+0.92	+1.69	+1.04	+	69+20	+49	+59
8	+0.00	+1.92	-5.8	+	0+22	-22	-36

Average $a = 30$

Normal Equation

$$+12.40 + 1.27 = +90.7$$

$$+12.7 + 13.64 = -6.5$$

$$-12.7 - 0.13 = -9.3$$

$$+13.51 = -15.8$$

$$b = -11.7$$

$$-0.12 - 1.27 = +6$$

$$+12.28 = +9.13$$

$$c = +74.4$$

Giving (8) full wt.

$$+11.47 + 1.27 = +90.7$$

$$+12.7 + 15.49 = -1.49$$

$$-12.7 - 0.14 = -10.1$$

$$+15.35 = -20.0$$

$$b = -16.3$$

$$+11.47 = +90.7 + 21 = +92.8$$

$$a = +80.9$$

Arc measured 1.80 Average $(a-c) = -8$

$$\frac{B}{a} = 0.33$$

$$-\frac{8}{33} = -24$$

$$\Delta p = -0.3$$

Aug. 27 23^h

Reduction table, alt.

$$\begin{array}{rcl}
 H + \alpha_0 & = & 6^h 36^m = 99^\circ 00' \quad S_0 = -11 \quad 44 \quad 29.3 \\
 H & = & 7 \quad 50 \\
 \alpha_0 & = & 22 \quad 46 \\
 \delta & = & 21 \quad 28 \\
 \delta + \alpha_0 & = & 20^h 14^m = 303^\circ 30' \\
 \log L & = & 0.8665 \\
 \log S & = & 9.9908 \\
 \log(i) & = & 0.8573
 \end{array}$$

$$\begin{array}{rcl}
 \log \cos(G + \alpha_0) & = & 9.7419 \\
 \log \sin(G + \alpha_0) & = & 9.9211 \\
 \log \tan S_0 & = & 9.3177 \\
 \log \frac{1}{\sin} & = & 8.8239 \\
 \log \sin S_0 & = & 9.3086 \\
 \log(H + \alpha_0) & = & 9.1943 \\
 \log \sin(H + \alpha_0) & = & 9.9946 \\
 \log \sec S_0 & = & 0.0092 \\
 \log \frac{1}{\sin} & = & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 \log(g') & = & 0.9196 \\
 \log(g) & = & 9.2404 \\
 \log(h') & = & 9.7840 \\
 \log(h) & = & 0.1088
 \end{array}$$

$$\begin{array}{rcl}
 f & + & 1.81 \\
 (g) & + & 0.17 \\
 (h) & + & 1.28 \\
 \text{Red in } \alpha & = & 3.26 \checkmark
 \end{array}$$

$$\begin{array}{rcl}
 (g') & + & 8.31 \\
 (h') & + & 0.61 \\
 (i) & + & 7.20 \\
 \text{Red in } \delta & = & 16.12
 \end{array}$$

190-6 Moon's Mean Position (1912.0)

29

$$\begin{array}{rcl}
 X_0 = 17.0776 & Y_0 = 19.6680 & 17.0776 \quad 19.6680 \\
 + 37 & + 6 & + 40 \quad - 8 \\
 \hline
 17.0813 & 19.6674 & 17.0816 \quad 19.6672
 \end{array}$$

$$\begin{array}{rcl}
 \text{From Plate Constants } X = 17.0744 & Y = 19.6390 & \\
 17.0747 & 19.6388 &
 \end{array}$$

$$\xi = -0.9253$$

$$\eta = -2.3618$$

$$\log \xi = 9.9664$$

$$\log \eta = 9.9908$$

$$\log \tan \delta = 8.5072$$

$$\log \tan \delta = 9.2953$$

$$\xi^2 = 9.9328$$

$$\eta^2 = 8.2815$$

$$\log (1-A) = 1.4683$$

$$\eta_1 = -2$$

$$X-A = -29.39$$

$$\eta_0 = -2.3608$$

$$A = 22.4608$$

$$\log \eta_0 = 0.3730$$

$$\log \tan \delta = 7.3311$$

$$\alpha_0 = 22.4538.6$$

$$\log (1-U) = 3.0419$$

$$\text{Red. adl. app.} = +3.26$$

$$\delta - D = -18.21.8$$

$$\alpha' = 22.45.41.8$$

$$D = -11.26.08$$

$$\delta_0 = -11.44.29.8$$

$$\text{constant } n = .03$$

$$\text{Red. adl. app.} = +16.1$$

$$\delta' = -11.44.13.2$$

$$\text{constant } n = -0.2$$

1912-6 Moons Mean Position (1912.0)

29

$$\begin{array}{r}
 X_0 = 170776 \quad Y_0 = 196680 \quad 170776 \quad 196680 \\
 + 37 \quad + 6 \quad + 40 \quad - 8 \\
 \hline
 170813 \quad 196674 \quad 170816 \quad 196672
 \end{array}$$

$$\begin{array}{r}
 \text{True Place constant } X = 170744 \quad Y = 196390 \\
 170747 \quad 196388
 \end{array}$$

$$\delta = -0.9256^{\circ}$$

$$\eta = -2.361^{\circ}$$

$$\log \delta = 9.9667^{\circ}$$

$$\log \tan \delta = 9.2953^{\circ}$$

$$\cos \delta = 9.9908^{\circ}$$

$$\eta_2 = 9.9328^{\circ}$$

$$\sin \delta = 8.5072^{\circ}$$

$$\eta_1 = 8.2815^{\circ}$$

$$(A-A) = 1.4683^{\circ}$$

$$\eta_1 = -2$$

$$A-A = -29.4^{\circ}$$

$$\eta_0 = -23.6^{\circ}$$

$$A = 22^{\circ} 46' 08''$$

$$\log \eta_0 = 0.3730^{\circ}$$

$$A = 22^{\circ} 45' 38.6^{\circ}$$

$$\sin \eta_0 = 7.3311^{\circ}$$

$$\text{Red ant. app.} = 3.26$$

$$(A-U) = 30419^{\circ}$$

$$A' = 22^{\circ} 45' 41.8^{\circ}$$

$$S-U = 18^{\circ} 21.8^{\circ}$$

$$\text{on constant } = 0.3$$

$$D = -11^{\circ} 26' 08''$$

$$S_0 = -11^{\circ} 44' 29.8''$$

$$\text{Red ant. app.} = 1.61$$

$$S = -11^{\circ} 44' 13.2''$$

$$\text{on constant } = -0.2$$

1956 Lunar Parallax

$$\begin{aligned} \alpha' &= 22^{\text{h}} 45^{\text{m}} 41.83^{\text{s}} \\ \delta &= 22^{\circ} 45' 28.15'' \\ &\quad - 0'' 13.71'' \\ &\quad - 0'' 03' 25.5'' \end{aligned}$$

$$\begin{aligned} &\quad - 0 \quad 0 \quad 1.2'' \\ &\quad - 0 \quad 03 \quad 24'' \end{aligned}$$

$$\begin{aligned} &9.95727 \\ &0.00000 \\ &0.00000 \end{aligned}$$

$$\begin{aligned} &42^{\circ} 11' 09.5'' \\ &- 11 \quad 44 \quad 13.2'' \\ &0-3 \quad 55 \quad 22.7'' \end{aligned}$$

$$\begin{aligned} &9.82640 \\ &8.19916 \\ &9.90758 \\ &0.17293 \\ &\hline &8.00602 \end{aligned}$$

$$+ 43 \quad 53.1''$$

$$S - 11 \quad 00 \quad 20.7'' \quad \alpha = 22 \quad 45 \quad 41.69''$$

$$\text{Ann Eph. } S = -11 \quad 00 \quad 22.8'' \quad \alpha = 22^{\text{h}} 45^{\text{m}} 41.13''$$

$$O-C \quad + \quad 2.7'' \quad + \quad 0.57''$$

$$\text{Cor to standard} = - \quad 0.2'' \quad - \quad 0.03''$$

$$O-C = + \quad 2.4'' \quad + \quad 0.54''$$

$$S' = -11 \quad 44 \quad 13.2''$$

$$\pi = 54' 22.9''$$

$$\begin{aligned} &9.86913 \\ &8.19916 \\ &6.99839 \\ &0.00806 \\ &\hline &5.07474 \end{aligned}$$

$$\begin{aligned} \alpha - \alpha' &= - \quad 0' \quad 02.50'' \\ &= \quad - \quad 0.17'' \end{aligned}$$

