

KG

11366

v.935

U2. LIX



Plate

2374.

2375

2377



Harvard Lunar Plates

Measures and Reductions

Henry Fowler

Volume LIX

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2375	1912 Dec. 20	12
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2

✓

7.5

30.

2

11.

13.

3

26

23

0

2374 Stars & measures.

1914, January 26

1

	d	N
✓	19.565	15045
7.3	1566065	895050
30.4	62	5050
	81	39
	<u>30.3909</u>	<u>3909</u>

	d	N
	17200	15567
	1002425	1271020
	20	1015
	97	52
	<u>7.2825</u>	<u>2846</u>

	d	N
2	16983	16955
11.3	1438081	957070
13.3	80	60
	90	70
	<u>13.2605</u>	<u>2605</u>

	d	N
	17746	16130
	1090102	1297071
	05	74
	54	46
	<u>11.3151</u>	<u>3163</u>

	d	N
3	17746	18500
26.1	1023030	1604030
23.7	30	32
	58	14
	<u>23.7525</u>	<u>7530</u>

	d	N
	981610	17155
	1010	1638090
	9044	87
	<u>16.0768</u>	<u>0769</u>

Grade 4.

2374 Stars - measures.

1914 January 26

	d	n
V	19565	15045
73	15660.65	8950.50
30.4	62	50
	81	39
	<u>30.3909</u>	<u>3909</u>

<u>2</u>	16983	16955
11.3	14380.81	9570.70
13.3	80	60
	90	70
	<u>13.2605</u>	<u>2601</u>

<u>3</u>	17746	18500
26.1	10230.30	16040.30
23.7	30	32
	58	14
	<u>23.7525</u>	<u>7530</u>

Grade 4.

	d	n
	17200	15567
	10024.25	12710.20
	20	10.11
	97	52
	<u>72825</u>	<u>2846</u>
	17746	16130
	10901.02	12970.71
	05	74
	54	46
	<u>11.3151</u>	<u>3163</u>

	9816.10	17155
	10.10	16380.90
	9044	87
	<u>260768</u>	<u>0769</u>

2374

Moon Measures

2

1
 14.2 14920
 19.5 9670
 min 19.5250

point on terminator - not the
 used in reduction.

1 scratch

18.5 19952	10249	18839	19260
19.8 1380095	1641093	1450006	13546
95	90	02	4542
60	59	49	95
<u>19.6160</u>	<u>.6145</u>	<u>18.5660</u>	<u>.5653</u>

2 20041	20200
18.0 1120190	1903022
19.8 98	20
49	10
<u>19.8850</u>	<u>.8823</u>

3 179	17760	14490
20.0	1617080	602220
	70	2020
	60	80
	<u>17.8413</u>	<u>.8457</u>

4 17.2	17627	15555
21.0	945060	13732
	50	3843
	32	75
	<u>17.1822</u>	<u>.1821</u>

5 17.1	16550	15610
21.5	749090	1468070
min	90	6570
x	60	21
	<u>17.0931</u>	<u>.0939</u>

2374

Moon measures

2

$$\begin{array}{r}
 1 \\
 192 \\
 195 \\
 \hline
 19.5-25.0
 \end{array}$$

point on terminator - not the
used in reduction.

1 scratch

$ \begin{array}{r} 185 \\ 198 \\ \hline 19.6160 \end{array} $	$ \begin{array}{r} 19952 \\ 1380095- \\ 95- \\ 60 \\ \hline 19.6160 \end{array} $	$ \begin{array}{r} 10249 \\ 1641093 \\ 90 \\ 59 \\ \hline 6145 \end{array} $	$ \begin{array}{r} 18839 \\ 1450006 \\ 02 \\ 49 \\ \hline 18.5660 \end{array} $	$ \begin{array}{r} 19200 \\ 13546 \\ 4542 \\ 91- \\ \hline 15653 \end{array} $
--	--	---	--	---

$ \begin{array}{r} 2 \\ 180 \\ 198 \\ \hline 19.885-0 \end{array} $	$ \begin{array}{r} 20041 \\ 1120195- \\ 98 \\ 49 \\ \hline 19.885-0 \end{array} $	$ \begin{array}{r} 20200 \\ 1903022 \\ 20 \\ 10 \\ \hline 18823 \end{array} $
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$ \begin{array}{r} 3 \\ 179 \\ 200 \\ \hline \end{array} $	$ \begin{array}{r} 17760 \\ 1617080 \\ 70 \\ 60 \\ \hline 17.8413 \end{array} $	$ \begin{array}{r} 14490 \\ 602220 \\ 20 \\ 80 \\ \hline 8457 \end{array} $
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$ \begin{array}{r} 4 \\ 172 \\ 210 \\ \hline \end{array} $	$ \begin{array}{r} 17627 \\ 945060 \\ 50 \\ 32 \\ \hline 17.1822 \end{array} $	$ \begin{array}{r} 15555- \\ 13732 \\ 3843 \\ 75- \\ \hline 1821 \end{array} $
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$ \begin{array}{r} 5- \\ 17.1 \\ 21.5 \\ \hline \end{array} $	$ \begin{array}{r} 16550 \\ 749090 \\ 90 \\ 60 \\ \hline 17.0931 \end{array} $	$ \begin{array}{r} 15610 \\ 1468070 \\ 65-70 \\ 21 \\ \hline 10939 \end{array} $
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2374

moon-measures

d

4

n

d x

n

6
17.2
22.0

16502
7880
8080
16

16651
15300
9092
61

17.1365.1358

7
17.6
23.0

15396
1201928
9748
10

16781
1015046
4546
78

17.6623.6632

8

18.0
23.4

15344

17140

1241406

10073

28

60

54

50

23.29312920

9

18.6
23.5

scratch

20290

19025

18600

17694

1486054

1445070

13780

12570

50

6060

74

6860

00

37

10

00

23.5440542918.8173.5131

2374

moon measures

d

y

v

d_{7c}

v

6
17.2
220

16502
7880
8080
16

16651
15300
9092
61

17.13651358

7
17.6
23.0

15396
1201928
9748
10
17.6625

16781
10150
4546
78
6632

8
180 15344 17140
23.9 1241406 1007368
28
54
23.2931
2920

9
18.6 scratch
23.5 20290 19025 18600 17699
1486054 1445070 13780 1257060
50 6060 74
00 37 10
23.5440 5429 18.5173 5131

2374	Times etc.					
Expt stars 1912 Dec 20, 4 ^h 21 ^m				- 4 ^h 33 ^m		
" " moon	4	26	55.2	- 4	26	55.6
Clock fast		0	22.4			
H Sid T.	4	26	33.0		0 - 2 - + 1 ^m 25 ^m	
Whony	4	44	31.05			
G Sid T.	9	11	04.05			
Sid T. in moon	17	54	48.42			
Interval	15	16	15.63			
Reduction		2	30.11			
G. in T.	15	13	45.52			

from Hunt, Allen	R.A.		Decl.		
moon 15 ^h	3 ^h 01 ^m	07.503	+ 20° 28'	53.4	
Motion in R.A.	225.61		11.618		
" " 13.7587		+ 31.04	+ 2	39.8	
Tabular place	3 01 ^m	38.07	+ 20	31	33.2

moon's age	12	days	
" parallax	57'	47.1	
" semidiameter	15'	46.3	
R =	946.3		
Augmentation	+ 14.2		
Irradiation (A)	- 0.8		
R =	959.7		
R =	2057.2		
(1+a) R =	2057.9		
R =	4.2329		
a = + 0.8			

2374

Times etc.

Expt star	1912 Dec 20, 9 ^h 21 ^m	- 4 ^h 33 ^m
.. known	4 26 55.2	- 4 26 55.6
Clock fast	0 22.4	
H. Sid T.	4 26 33.0	0 - 8 - + 1 ^m 25 ^m
.. known	4 44 31.05	
G. Sid T.	9 11 04.05	
Sid T. in known	17 54 48.42	
Interval	15 16 15.63	
Reduction	2 30.11	
G. in T.	15 13 45.52	

from known Alt.	R.A.	Decl.
known 15 ^h	3 ^h 01 ^m 07 ^s 03	+ 20° 28' 53.4
known in 22561		11.618
13.7587	+ 31.04	+ 2 39.8
Tabular place	3 01 ^m 38 ^s 07	+ 20 31 33.2

known age 12 days

parallax 5.7' 47.1

semidiam. 15' 46.3

939 = 13.85

946 = 19.2

R = 946.3

Amplitude + 14.2

Irradiation (4) - 0.8.

R = 959.7

R = 2057.2

a = +0.8

(1+a) R = 2057.9

R = 4232.9

2374

5

Plate Constants

x	y
7 28 36	30.3909
11.3157	13.2603
<u>26.0768</u>	<u>23.7528</u>
3 4468	6740
14.89	2247
-18	-22
311	47
31	465
96 ^s	219"
= 1 ^m 36 ^s	= 3' 39"

$R.A.$	Decl.
2 ^h 53 ^m 50 ^s	+21 15 58
2 56 12	+19 03 18
3 04 17	+20 25 31
<u>7 113 79</u>	<u>-60 43 107</u>
2 58 06	+20 14 56
+ 1 36	- 3 39
2 59 42	+20 11 17

$A = 2^h 59^m 42^s$
 $D = +20^\circ 11' 17''$

} Center of plate

$x - 3$	-67.24	$-0.8x$	$+3772$
$-1724 - 2042$	$= -3766$	$-6 = -3772$	$= 0$
$-2872 - 891$	$= -3763$	$-9 = -3772$	$= 0$
$-2157 - 1596$	$= -3753$	$-20 = -3773$	$= -1$
$19.1523 - 1451$	-15		$= 193829$

$y - 7$	$+67.5x$	$+2.7y$	$+2x$	-625
$+213 + 492$	$= +705$	$-82 = +623$	$+1 = +624$	$= -1$
$-105 + 764$	$= +659$	$-36 = +623$	$+2 = +625$	$= 0$
$-1076 + 1760$	$= +684$	$-64 = +620$	$+5 = +625$	$= 0$
$215875 + 1293$	-58	$+4$		$= 216489$

Tables $a = +0.6$ $c = 0.0$ $a - c = +0.6$ $b + a = -0.8$
 Obs $a = +0.8$ $c = +2.7$ $a - c = -1.9$ $b + a = -0.5$

2374

5

Plate Constants

x	y
7 28 36	30 39 09
11 31 57	13 26 03
<u>26 07 68</u>	<u>23 75 28</u>
3 44.68	67.40
14.89	22.47
- 18	- 22
311	47
31	465
96 ^s	219 ^s
= 1 ^m 36 ^s	= 3' 39"

$R.A.$	$Decl.$
2 ^h 53 ^m 50 ^s	+ 21 15 58
2 56 12	+ 19 03 18
3 04 17	+ 20 25 31
<u>7 11 37.9</u>	<u>60 43 10.7</u>
2 58 06	- 20 14 56
+ 1 36	- 3 39
2 59 42	+ 20 11 17

A = 2^h 59^m 42^s
 D = + 20° 11' 17" } Center of Plate

2-3	- 67.24	- 0.82	+ 3772
- 1724	- 2042	- 6	- 3772 = 0
- 2872	- 891	- 4	- 3772 = 0
- 2157	- 1596	- 20	- 3773 = - 1
19.1523	- 1451	- 15	= 193829

4-7	+ 6752	- 274	+ 22	- 621
+ 213	+ 492	= + 705 - 82	: + 62371	: + 624 : - 1
- 1057	704	= + 659 - 39	: + 623 + 2	: + 625 : 0
- 1076	+ 1760	+ 684 - 64	+ 620 + 5	+ 625 = 0
21.5875	+ 1293	- 58	+ 4	= 21.6489

Tables $a = +0.6$ $a = 0.0$ $a - c = +0.6$ $b + a = -0.8$
 Obs $a = +0.8$ $c = +2.7$ $a - c = -1.9$ $b + c = -0.5$

2374 Standard Coordinates

Cape W. 434 mg 6.7				Cape W. 443 mg 8.4				Cape W. 459 mg 6.7			
C	2	53	09.07	2	55	30.84		3	03	35.94	
L			02			91				602	
B			04			82				602	
mean	2	53	09.04	2	55	30.86		3	03	35.99	
Prece			+41.19			+40.71				+41.18	
α	2	53	50.23	2	56	11.57		3	04	17.17	
A	2	59	42.	2	59	42		2	59	42	
$\alpha - A$	-	5	51.77	-	3	30.43		-	4	35.17	
$\sin(\alpha - A)$			-351.73			-210.42				+275.15	
$\rho \sin \mu$			254621m			232309m				242957	
$\tan S$			9.96937			9.97553				9.97180	
Σ			102282m			080586m				091861	
Σ_0			-10.5395			-6.3953				+8.2910	
Σ_1			-45			-18				-15	
Σ			7.4560			11.6029				26.2925	
Σ			7.2836			11.3157				26.0768	
$\Sigma - \Sigma$			-1724			-2872				-2157	
C	+21°	13'	03.6	+19°	00'	24.7		+20°	22'	44.0	
L			03.6			24.7				+4.0	
B			03.2			24.9				43.6	
mean	+21	13	03.5	+19	00	24.8		+20	22	43.9	
Prece	+2	54.6		+2	53.1			+2	47.5		
δ	+21	15	58.2	+19	03	17.9		+20	25	31.4	
D	+20	11	17	+20	11	17		+20	11	17	
$\delta - D$	+104	41.1		-1	07	59.1		+14	14.4		
$\tan(\delta - D)$			+3881.6			-4079.6				+854.4	
ρ			3.58901			3.61062m				2.93166	
η_0			092016			0.94177m				0.26281	
$\tan S$			9.5902			9.5383				9.5710	
Σ			2.0456			1.6117				1.8372	
η_1			86892			82034				84616	
η_0	+8.3207			-8.7452				+1.8315			
η_1	+489			+160				+289			
η	30.3696			13.2708				23.8604			
η	30.3909			13.2603				23.7528			
η	+21.3			-105				-1076			

2374 Standard Cordiales

Cape W. 434 mg 67

Cape W. 443 mg 84

Cape W. 459 mg 67

C 2 53 09.07

C 2 55 30.84

C 3 03 35.94

L 08

91

602

E 04

82

602

mean 2 53 09.04

2 55 30.86

3 03 35.99

Proc + 41.19

+ 40.71

+ 41.18

X 2 53 50.23

2 56 11.57

3 04 17.17

A 2 59 42.

2 59 42.

2 59 42.

X-A - 5 51.77

- 3 30.43

+ 4 35.17

-(X-A) - 351.73

- 210.42

+ 275.15

mean 2 54 6.21

2 56 30.9

2 56 30.9

Proc 9.96937

9.97553

9.97180

Σ 102282

080586

091861

Σ₀ - 10.5395

- 6.3953

+ 8.2910

Σ₁ - 45

- 18

- 15

Σ₂ 7.4560

11.6029

26.2925

Σ₃ 7.2836

11.3157

26.0768

Σ₄ - 1724

- 2872

- 2157

C + 21° 13' 03.6

+ 19° 00' 24.7

+ 20° 22' 44.0

L 03.6

24.7

44.0

E 03.2

24.9

43.6

mean + 21 13 03.5

+ 19 00 24.8

+ 20 22 43.9

Proc + 2 54.6

+ 2 53.1

+ 2 47.5

S + 21 15 58.8

+ 19 03 17.9

+ 20 25 31.4

D + 20 11 17

+ 20 11 17

+ 20 11 17

S-D + 1 04 41.1

- 1 07 59.1

+ 14 14.4

-(S-D) + 3881.6

- 4079.6

+ 854.4

L 3.58901

3.61062

2.93166

Σ₀ 0.92016

0.94177

0.26281

Σ₁ 9.5902

9.5383

9.5710

Σ₂ 2.0456

1.6117

1.8372

Σ₃ 8.6892

8.2034

8.4616

Σ₄ + 8.3207

- 8.7452

+ 1.8315

Σ₅ + 489

+ 160

+ 289

Σ₆ 30.3696

13.2708

23.8604

Σ₇ 30.3909

13.2603

23.7528

Σ₈ + 21.3

- 10.5

- 10.76

pt.	pos. c	resid
1	196.6	+14
2	214.4	-17
3	219.5	+4
4	253.5	-66
5	270.0	+55
6	281.5	+16
8	313.1	+17
9	341.9	-36

2374

Known Center

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	18.5656	-0.5894	-1	0.3474	4.2393	+64
2	18.0000	-1.1550	-1	1.3342	4.2392	+63
3	17.8435	-1.3115	-1	1.7203	4.2420	+91
4	17.1822	-1.9728	-0	3.8919	4.2376	+47
5	17.0935	-2.0615	-0	4.2497	4.2497	+168
6	17.1362	-2.0188	+0	4.0755	4.2452	+123
7	17.6628	-1.4922	+1	2.2264	4.2201	reject
8	18.0000	-1.1550	+1	1.3338	4.2394	+65
9	18.5152	-0.6398	+1	0.4090	4.2310	-19

Comp 4.2329

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	19.6152	-1.9728	3.8919	
2	19.8836	-1.7044	2.9050	
3	20.0000	-1.5880	2.5217	
4	21.0000	-0.5880	0.3457	
5	21.5880	0.0000	0.0000	
6	22.0000	+0.4120	0.1697	
7	23.0000	+1.4120	1.9937	
8	23.2926	+1.7046	2.9056	
9	23.5430	+1.9550	3.8220	

Approx. Center $x = 18.0$ $y = 19.8836$ 23.2926

43.1762

 $y_0 = 21.5881$ $y - \text{min} = 19.5250$ $R = 20631$ $x - \text{min} = 17.0935$ $x_0 = 19.1566$ Center $\begin{cases} x_0 = 19.1550 \\ y_0 = 21.5880 \end{cases}$

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Mean Center

7

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	$O - C$
1	18.55656	-0.5894	-1	0.3474	4.2393	+64
2	18.0000	-1.1550	-1	1.3342	4.2392	+63
3	17.8435	-1.3115	-1	1.7203	4.2420	+91
4	17.1822	-1.9728	-0	3.8919	4.2376	+97
-5	17.0935	-2.0615	-0	4.2497	4.2497	+168
6	17.1362	-2.0188	+0	4.0755	4.2452	+123
7	17.6628	-1.4922	+1	2.2264	4.2201	neg. ch.
8	18.0000	-1.1550	+1	1.3338	4.2394	+65
9	18.5152	-0.6398	+1	0.4090	4.2310	-19

Compd 4.2329

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	19.6152	-1.9728		3.8919
2	19.8836	-1.7044		2.9050
3	20.0000	-1.5880		2.5217
4	21.0000	-0.5880		0.3457
5	21.5880	0.0000		0.0000
6	22.0000	+0.4120		0.1697
7	23.0000	+1.4120		1.9937
8	23.2926	+1.7046		2.9056
9	23.5430	+1.9550		3.8220

Appr. Center $x = 18.09 = 19.8836$ 23.2926

43.1762

 $y_0 = 21.5881$ $y - \text{min} = 19.52150$ $R = 20631$ $x - \text{min} = 17.0935$ $x_0 = 19.1566$ Center $\left\{ \begin{array}{l} x_0 = 19.1550 \\ y_0 = 21.5880 \end{array} \right.$

Formation of Normals

	ab	an	bn
1	+ 1.1 6	- 37.8	- 126.0
2	+ 19.7	- 73.0	- 107.0
3	+ 2.0 8	- 119.2	- 144.9
4	+ 1.1 6	- 92.6	- 27.7
5	- 0.0 0	- 338.0	+ 0.0
6	- 0.8 3	- 248.5	+ 50.5
7			
8	- 1.9 7	- 75.4	+ 11.2 0
9	- 1.2 5	+ 12.2	- 37.3
	+ 232	- 974.3	- 280.4

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Known's Center

8

Conditional Equations

	a	b	c		c	0 - c
1	-0.59	-1.97	+ 64	+ 32 + 18 =	+ 50	+ 14
2	-1.16	-1.70	+ 63	+ 64 + 16 =	+ 80	- 17
3	-1.31	-1.59	+ 91	+ 72 + 15 =	+ 87	+ 4
4	-1.97	-0.59	+ 47	+ 108 + 5 =	+ 113	- 66
5	-2.06	+ 0.00	+ 168	+ 113 - 0 =	+ 113	+ 55
6	-2.02	+ 0.41	+ 123	+ 111 - 4 =	+ 107	+ 16
7						
8	-1.16	+ 1.70	+ 65	+ 64 - 16 =	+ 48	+ 17
9	-0.64	+ 1.96	- 19	+ 35 - 18 =	+ 17	- 36

Average = 28

Normal Equations

$$\begin{aligned}
 + 17.36 + 232 &= -972 \\
 + 232 + 16.56 &= -280 \\
 - 232 - 0.31 &= +130 \\
 + 16.25 &= -150 \\
 + 17.36 &= -972 + 21 = -951
 \end{aligned}$$

$$b = -9.2$$

$$a = -54.8$$

2374

Innovis Center

8

Conditional Equations

	a	b	c	d	e	f	g	h
1	-0.59	-1.97	+ 64	+ 32	+ 18	= + 50	+ 14	
2	-1.16	-1.70	+ 63	+ 64	+ 16	= + 80	- 17	
3	-1.31	-1.59	+ 91	+ 72	+ 15	= + 87	+ 4	
4	-1.97	-0.59	+ 47	+ 108	+ 5	= + 113	- 66	
5	-2.06	+ 0.00	+ 168	+ 113	- 0	= + 113	+ 55	
6	-2.02	+ 0.41	+ 123	+ 111	- 4	= + 107	+ 16	
7								
8	-1.16	+ 1.70	+ 65	+ 64	- 16	= + 48	+ 17	
9	-0.64	+ 1.96	- 19	+ 35	- 18	= + 17	- 36	
								Average = 28

Normal Equations

$$\begin{aligned}
 + 17.36 + 232 &= -972 \\
 + 232 + 16.56 &= -280 \\
 - 232 - 0.31 &= +130 \\
 + 16.25 &= -150 \\
 + 17.36 &= -972 + 21 = -951
 \end{aligned}$$

$b = -9.2$
 $a = -54.8$

X_0

2374

Moon's Mean Position (1912.0)

$$\begin{array}{r}
 X_0 = 19.1550 \\
 \text{---} -27 \\
 \hline
 19.1523
 \end{array}
 \quad
 \begin{array}{r}
 Y_0 = 21.5880 \\
 \text{---} -5 \\
 \hline
 21.5875
 \end{array}$$

From Plate Constants $X = 19.3829$ $Y = 21.6489$

$$\xi = +1.3829$$

$$\eta = -0.3511$$

$$\log \xi = 0.14079$$

$$\cos S = 9.97219$$

$$\text{const} = 8.50724$$

$$(\alpha - A) = 1.66096$$

$$\alpha - A = +45.81$$

$$A = 259.42$$

$$\alpha_0 = 300.2781$$

$$\text{Par} = +4.05$$

$$X' = 300.3186$$

$$\log \tan S = 9.55650$$

$$0.2816$$

$$7.0534$$

$$6.9000$$

$$\eta_1 = +8$$

$$\eta_0 = -0.3519$$

$$\log \eta_1 = 9.54642$$

$$7.33115$$

$$(\delta - D) = 22.1527$$

$$S - D = -2.442$$

$$D = +20.1117$$

$$S = +20.08328$$

$$\text{Rad} = +23.9$$

$$\delta' = +20.08567$$

X_0

2374

Moon's Mean Position (1912.0)

$$\begin{array}{r} X_0 = 19.1550 \\ - a = -27 \\ \hline 19.1523 \end{array}$$

$$\begin{array}{r} Y_0 = 21.5880 \\ - b = -5 \\ \hline 21.5875 \end{array}$$

From Plate Constant $X = 19.3829$ $Y = 21.6489$

$$\xi = +1.3829$$

$$\eta = -0.3511$$

$$\begin{array}{r} \log \xi = 0.14079 \\ - \log 5 = 9.97259 \\ \text{const} = 8.50724 \end{array}$$

$$\begin{array}{r} \log 1 \mu = 5.95650 \\ 02816 \\ 70534 \\ 69000 \end{array}$$

$$(\alpha - A) = 1.66096$$

$$\gamma_1 = +8$$

$$\alpha - A = +4581$$

$$\gamma_0 = -0.3519$$

$$A = 25942$$

$$\begin{array}{r} \log \eta_1 = 9.54642 \\ 7.33115 \end{array}$$

$$\alpha_0 = 3002781$$

$$(\delta - 1) = 221527$$

$$\text{Par} = +4.05$$

$$S - D = -2442$$

$$\alpha' = 3003186$$

$$D = +201117$$

$$S = +20.08328$$

$$\text{Red} = +23.9$$

$$\delta' = +2008567$$

2374

Red. ad locum aph.

10

$$\delta_0 + 20^\circ 09'$$

$$H + \alpha \quad 3^h \quad 04^m = 46^\circ$$

$$H \quad 0 \quad 04$$

$$\alpha_0 \quad 3 \quad 00$$

$$G \quad 22 \quad 21$$

$$G + \alpha \quad 1 \quad 21 = 20^\circ 15'$$

$$l \cos S \quad 99726$$

$$.. \quad \underline{91640}$$

$$.. \quad 91366$$

$$l \sin \delta \quad 9.5372$$

$$.. \cos(H + \alpha) \quad 9.8418$$

$$.. \quad 13111$$

$$\sin .. \quad 9.8569$$

$$\sec S \quad 0.0274$$

$$.. \quad 8.8239$$

$$l \cos(G + \alpha) \quad 9.9723$$

$$.. \quad 13052$$

$$\sin .. \quad 9.5392$$

$$\tan S \quad 9.5646$$

$$.. \quad 8.8239$$

$$g' \quad 1.2775$$

$$g \quad 9.2329$$

$$h' \quad 0.6901$$

$$h \quad 0.0193$$

$$\begin{array}{r} + 283 \\ + 0.17 \\ + 1.05 \\ \hline + 4.05 \end{array}$$

$$\begin{array}{r} \delta' + 1895 \\ h' + 4.79 \\ .. + 0.14 \\ \hline + 2388 \end{array}$$

2374

Red. ad. Coeun. - 1912.

10

$$H + \alpha \quad 3^{\circ} \quad 04' = 46^{\circ}$$

$$H \quad 0 \quad 04$$

$$\alpha_0 \quad 3 \quad 00$$

$$G \quad 22 \quad 21$$

$$G + \alpha \quad 1 \quad 21 = 20^{\circ} 15'$$

$$l \cos(G + \alpha) \quad 99723$$

$$q \quad 1.3052$$

$$\sin \dots \quad 9.5392$$

$$\tan \dots \quad 9.5646$$

$$\dots \quad 8.8239$$

$$g' \quad 1.2775$$

$$g \quad 9.2329$$

$$\begin{array}{r} + 2.83 \\ + 0.17 \\ + 1.05 \\ \hline + 4.05 \end{array}$$

$$S_0 \quad + 20^{\circ} 09'$$

$$l \cos S \quad 99726$$

$$\dots \quad 9.1640$$

$$(i) \quad 9.1366$$

$$l \sin S \quad 9.5372$$

$$\cos(H + \alpha) \quad 9.8418$$

$$h \quad 1.3111$$

$$\sin \dots \quad 9.8569$$

$$\sec S \quad 0.0274$$

$$\dots \quad 8.8239$$

$$h' \quad 0.6901$$

$$h \quad 0.0193$$

$$\begin{array}{r} g' \quad + 1.895 \\ h' \quad + 4.79 \\ \dots \quad + 0.14 \\ \hline + 23.88 \end{array}$$

2374 Lunar Parallel,

$$\begin{array}{r} \delta' = 3 \quad 00 \quad 31.86 \\ \theta = 4 \quad 26 \quad 33.0 \\ + 1 \quad 26 \quad 01.1 \\ = + 21 \quad 30 \quad 16 \end{array}$$

$$+ \quad \quad \quad 8 \quad 22$$

$$+ 21 \quad 21 \quad 54$$

$$9.95727$$

$$0.00000$$

$$003093$$

$$\hline 998820$$

$$\delta = 44 \quad 13 \quad 16$$

$$20 \quad 08 \quad 57$$

$$24 \quad 04 \quad 19$$

$$9.82640$$

$$8.22152$$

$$9.61054$$

$$0.15650$$

$$\hline 7.81896$$

$$\delta - \delta' = + 22 \quad 39.5$$

$$\delta = + 20 \quad 31 \quad 36.2$$

$$\text{Naut Alm } \delta = + 20 \quad 31 \quad 33.2$$

$$0 - C \quad + \quad 3.0$$

$$\delta' = + 20^\circ \quad 08' \quad 56.7''$$

$$\Pi = 57' \quad 47.1''$$

$$9.86913$$

$$8.22552$$

$$9.56417$$

$$\hline 002849$$

$$768731$$

$$\alpha - \alpha' = + 16' \quad 44.08$$

$$= + 1^m \quad 06.93$$

$$\alpha = 3 \quad 01 \quad 38.79$$

$$\alpha = 3 \quad 01 \quad 38.07$$

$$+ 0.72$$

$$\begin{array}{r}
 2374 \\
 \alpha' = 3 \quad 00 \quad 31.86 \\
 \delta = 4 \quad 26 \quad 33.0 \\
 + 1 \quad 26 \quad 01.1 \\
 = + 21 \quad 30 \quad 16
 \end{array}$$

$$+ \quad \quad \quad 8 \quad 22$$

$$+ 21 \quad 21 \quad 54$$

$$995727$$

$$000000$$

$$003093$$

$$\hline 998820$$

$$\alpha = 44 \quad 13 \quad 16$$

$$20 \quad 08 \quad 57$$

$$24 \quad 04 \quad 19$$

$$982640$$

$$822152$$

$$961054$$

$$015650$$

$$\hline 781896$$

$$\delta - \delta' = + 22 \quad 39.5$$

$$\delta = + 20 \quad 31 \quad 36.2$$

$$\text{Nant Alm } \delta = + 20 \quad 31 \quad 33.2$$

$$0 - C \quad \quad \quad + \quad 30$$

$$\delta = + 20^\circ \quad 08' \quad 56.7''$$

$$\delta = \quad \quad \quad 57' \quad 47.1''$$

$$9.86913$$

$$822552$$

$$956417$$

$$\hline 002849$$

$$768731$$

$$\alpha - \alpha' = + 16' \quad 44.8''$$

$$= + 1 \quad 0.6593$$

$$\alpha = 3 \quad 01 \quad 38.79$$

$$\alpha = 3 \quad 01 \quad 38.07$$

$$+ 0.72$$

2
1
6
29
2
10.1
2
3
25.5
22

2375

Stars - Measures

1914 January 27.

12

α
 $\sqrt{19630}$
 $6.7 \sqrt{1472717}$
 $295 \sqrt{2023}$
 30
29.4908

α
 $\sqrt{17944}$
 1285658
 5558
 34
4917

α
 $\sqrt{15024}$
 123.3340
 40
 10
6.7318

α
 $\sqrt{19630}$
 1228078
 78
 01
7330

α
 $\sqrt{18381}$
 $10.6 \sqrt{1498140}$
 $24 \sqrt{90}$
 79
17.3393

α
 $\sqrt{16150}$
 $95-4850$
 43
 45
3400

α
 $\sqrt{18310}$
 1490089
 $95-98$
 95
10.6590

α
 $\sqrt{17890}$
 1129095
 90
 80
6591

α
 $\sqrt{18177}$
 $27 \sqrt{1079591}$
 01
 73
22.7378

α
 $\sqrt{16079}$
 13465
 68
 91
7385

α
 $\sqrt{16615}$
 1145050
 56
 09
25.4840

α
 $\sqrt{17560}$
 12720510
 $05-20$
 60
4848

bracket

2375

Stars Measures

1914 January 27.

12

$\frac{1}{2}$ 19630
 67 1472717
 295 2023
 30
29.4908

$\frac{1}{4}$ 17944
 128565-8
 55
 34
4917

$\frac{1}{2}$ 15024
 1233340
 40
 10
6.7318

$\frac{1}{2}$ 19630
 1228018
 78
 01
7330

$\frac{2}{10.6}$ 18381
 124 1498140
 90
 79
12.3393

$\frac{1}{4}$ 16150
 95-4850
 43
 45
3400

$\frac{1}{2}$ 18310
 1490089
 95-98
 95
106590

$\frac{1}{2}$ 17890
 11290
 9095
 80
6591

$\frac{3}{25}$ 18177
 227 1079591
 01
 73
22.7378

$\frac{1}{4}$ 16079
 13465
 68
 91
7385

$\frac{1}{2}$ 16615
 1145050
 56
 09
25.4840

$\frac{1}{2}$ 17560
 1278510
 05-20
 60
4848

4.0000
 4.0000

2375-

lyon - measures -

13

d 4 n d 7c n

min in y = about 18.87901 scratch.

18.5 13050

15103

15960

20058

19.1 12530

0500

10390.11

1558092

2528

14579

0010

7077

45

45

19.0522.052418.4451.44722

18.0 15463

20105

19.4 1222950

1334720

4250

1529

67

15

19.3221.32083

17.5

20.0

14460

16276

877065-

11930

33

50

38

47

60

17.4319.43354

17.3

21.0

min

7c

19568

17349

11420

15251

70

2020

77

60

40

17.2058.20815 scratch.

17.4 19396

16379

21.5 13869

11898

7168

9791

96

70

21.5527.5521

19562

18996

12545

15980

3940

8989

56

90

17.2983.3008

2375- brown - measures -

13

min in y = about 18.87901 scratch

18.5 13050

15103

15960

20058

19.1 12530

0500

10390.11

1558092

2528

14579

0010

7077

45

45

19.0522052418.945144722

18.0 15463

20105

19.4 1222950

1334720

4250

1529

67

15

19.322132083

17.5

20.0

14460

16276

877065-

11930

50

33

47

38

60

17.431943354

17.3

21.0

min

20

19368

17349

11420

1525170

2020

77

60

40

17.205820815

scratch

17.4 19396

16379

21.0 13869

11898

71

97

96

70

21.55275521

19562

18996

12545

15980

39

89

56

90

17.29833008

2375- known-measures

d	h	d	h	N
6		18480		19070
17.5		13460.50		14065
220		59		6470
		60		50
		<u>17.4986</u>		<u>.4994</u>

2	180	18002	18740
225	12285	9090	1447182
	90	71	
	05	40	
	<u>22.5716</u>	<u>.5735</u>	

8 Scratch.

184	17450	19748	15608	19580
22.7	885062	18360.50	1068378	1452022
	62	52	79	30
	56	52	90	70
	<u>22.8597</u>	<u>.8605</u>	<u>18.5079</u>	<u>.5051</u>

2375-

known - measures.

d

q

r

ck

N

$$\begin{array}{r} 6 \\ 175 \\ 220 \end{array}$$

$$\begin{array}{r} 18480 \\ 1346050 \\ 59 \\ 60 \\ 174986 \end{array}$$

$$\begin{array}{r} 19070 \\ 14065 \\ 6470 \\ 50 \\ 4994 \end{array}$$

$$\begin{array}{r} 2 \\ 180 \\ 22.1 \\ 18002 \\ 12285 \\ 9090 \\ 05 \\ 22.5716 \end{array}$$

$$\begin{array}{r} 18740 \\ 1447182 \\ 71 \\ 40 \\ 5735 \end{array}$$

$$\begin{array}{r} 8 \\ 184 \\ 22.7 \\ 17450 \\ 885062 \\ 62 \\ 56 \\ 22.8597 \end{array}$$

$$\begin{array}{r} 19748 \\ 1836050 \\ 52 \\ 52 \\ 8605 \end{array}$$

$$\begin{array}{r} 15608 \\ 1068378 \\ 79 \\ 90 \\ 18.5079 \end{array}$$

$$\begin{array}{r} 19580 \\ 1452022 \\ 30 \\ 79 \\ 5051 \end{array}$$

2375 Times etc.

exp. station	1912 Dec 20,	4 ^h 36 ^m	- 4 ^h 48 ^m
moon	4	42	16.0 ^v - 4 42 16.4 ^v
clock fast		0	224 ^v
H sid T	4	41	53.8 ^v 6-4-+1 ^h 40 ^m
H long	4	44	31.0 ^v
G sid T	9	26	24.8 ^v
Sid T. in moon	17	54	48.42 ^v
Interval	15	31	36.43 ^v
Reduction		2	32.62 ^v
G. M. T.	15	29	03.81 ^v

from Nautical Almanac

moon 15 ^h	R. A.	Decd.
motion 1 ^h = 2.2573 ^v	3 ^h 01 ^m 07.303 ^v	+ 20° 28' 53.4 ^v
" " 29.0635 ^v	+ 1 05.61 ^v	11.606 ^v
Tabular place.	3 02 12.64 ^v	+ 20 34 30.7 ^v

moon's age 12 days

934 = 13.55 ^v	parallel	57' 47.7 ^v
946.5 = 13.9	semidiam	15 46.5 ^v
	R	946.5 ^v
	Augmentation	+ 13.9 ^v
	Irradiation	- 0.8 ^v
	R	959.6 ^v
	(1+a) R	2057.0 ^v
a = +1.3	(1+a) R ²	2057.3 ^v
	R ²	4.2325 ^v

2375 Times etc.
Exp Titan 1912 Dec 20, 4^h 36^m - 4^h 48^m
Moon 4 42 16.0 - 4 42 16.4
clock fast 0 22.4

H Sid T 4 41 53.8 6-X-+1^h 40^m
H long 4 44 31.05
G Sid T. 9 26 24.85
Sid T in Moon 17 54 48.42
Interval 15 31 36.43
Reduction 2 32.62
G in T. 15 29 03.81

from Nantuxen.
Moon 15^m R. C. Reed
3^h 01^m 07.503 + 20° 28' 53.4
Moon in 22.573 11.606
29.0635 + 1 05.61 + 5 37.3
Tabular place. 3 02 12.64 + 20 34 30.7

Moon's age 12 days

penallay 57' 47.7
sundean 15 46.5
R 946.5
Augmentation + 1.39
Irradiation - 0.8
R 959.6
(total) R 2057.0
(1+a) R 2057.3
R² 4232.5

939 : 13.55
946.5 : 13.9
a = +1.3

2375

Plate Constants

	1	2	
x	6.7324	10.6590	25.4844
y	7.4560	11.6029	26.2925
$x-y$	- .7236	- .9439	- .8081
u	29.4912	12.3396	22.7382
v	30.3696	13.2708	23.8604
$u-v$	- .8784	- .9312	-1.1222

$$\begin{aligned}
 x-3 &= 128.74 & -1.32 & +1.1040 \\
 -7236 - 3795 &= -1.1031 & -9 &= -1.1040 = 0 \\
 -9439 - 1588 &= -1.1027 & -14 &= -1.1041 = -1 \\
 -8081 - 2926 &= -1.1007 & -33 &= -1.1040 = 0 \\
 19.2625 - 2696 & & -25 &= 20.0944
 \end{aligned}$$

$$\begin{aligned}
 y-u &+ 129.62 & -9 & -14 & +7944 \\
 -8784 + 873 &= -7911 & +29 &= -7940 & -3 &= -7943 = +1 \\
 -9312 + 1381 &= -7931 & -12 &= -7943 & -1 &= -7944 = 0 \\
 -1.1222 + 3303 &= -7919 & -23 &= -7942 & -2 &= -7944 = 0 \\
 20.9442 + 2496 & & -21 & & -2 &= 21.9859
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables} \quad a &= +0.6 & e &= 0.0 & a-e &= +0.6 & b+a &= -1.0 \\
 \text{Obs} \quad a &= +1.3 & e &= +1.1 & a-e &= +0.2 & b+a &= -0.9
 \end{aligned}$$

2375

Plate Constants

1 2

x	6.7324	10.6590	25.4844
y	7.4560	11.6029	26.2925
$x-3$	-7236	-9439	-8081
y	294912	123396	22.7382
y	30.3696	13.2708	23.8604
$y-m$	-8784	-9312	-1.1222

$$\begin{aligned}
 x-3 &= 12874 & -1.32 & +1.1040 \\
 -7236 & -3795 & -1.1031 & -9 & -1.1040 & = 0 \\
 -9439 & -1588 & -1.1027 & -14 & -1.1041 & = -1 \\
 -8081 & -2926 & -1.1007 & -33 & -1.1040 & = 0 \\
 192625 & -2696 & -25 & & & = 30.0944
 \end{aligned}$$

$$\begin{aligned}
 y-m &+129.62 & -9 & -17 & +7944 \\
 -8784 & +873 & -7911 & -29 & -7940 & -3 & -7943 & = +1 \\
 -9312 & +1381 & -7931 & -12 & -7943 & -1 & -7944 & = 0 \\
 -11222 & +3303 & -7919 & -23 & -7942 & -2 & -7944 & = 0 \\
 209442 & +2496 & -21 & & -2 & +2 & +19859
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables. } a &= +0.6 & e &= 0.0 & a-e &= +0.6 & b+a &= -1.0 \\
 \text{Obs. } a &= +1.3 & e &= +1.1 & a-e &= +0.2 & b+a &= -0.9
 \end{aligned}$$

pt.	pos. L	resid.
1	2035	+134
2	2180	-48
3	2428	+75
4	2715	-42
5	2870	-98
6	3007	-80
7	3220	+128
8	3387	+96

2375

Linear Center

17

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 (y - y_0)^2$	$o - c$
1	18.4462	-0.8238	-2	0.6790	4.2689	+364
2	18.0000	-1.2700	-2	1.6134	4.2560	+235
3	17.4327	-1.8373	-1	3.3760	4.2728	+403
4	17.2070	-2.0630	0	4.2560	4.2588	+263
5	17.2996	-1.9704	+1	3.8821	4.2486	+161
6	17.4990	-1.7710	+1	3.1361	4.2449	+124
7	18.0000	-1.2700	+2	1.6124	4.2550	+225
8	18.5065	-0.7635	+2	0.5826	4.2426	+101

Comp $R^2 = 4.2325$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	19.0523	-1.8947		3.5899
2	19.3219	-1.6256		2.6426
3	20.0000	-0.9470		0.8968
4	21.0000	+0.0530		0.0028
5	21.5524	+0.6054		0.3665
6	22.0000	+1.0530		1.1088
7	22.5726	+1.6256		2.6426
8	22.8601	+1.9131		3.6600

Approx Center

$$x = 18.0 \quad y = 19.3214$$

$$22.5726$$

$$41.8940$$

$$y_0 = 20.9470$$

$$y - \text{min} = 18.8790$$

$$R = 2.0680$$

$$x - \text{min} = 17.2070$$

$$x_0 = 19.2750$$

$$\text{Center } \begin{cases} x_0 = 19.2700 \\ y_0 = 20.9470 \end{cases}$$

2375

Innovis Center

17

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 (y - y_0)^2$	$O - C$
1	18.4462	-0.8238	-2	0.6790	4.2689	+364
2	18.0000	-1.2700	-2	1.6134	4.2560	+235
3	17.4327	-1.8373	-1	3.3760	4.2728	+403
4	17.2070	-2.0630	0	4.2560	4.2588	+263
5	17.2996	-1.9704	+1	3.8821	4.2486	+161
6	17.4990	-1.7710	+1	3.1361	4.2449	+124
7	18.0000	-1.2700	+2	1.6124	4.2550	+225
8	18.5065	-0.7635	+2	0.5826	4.2426	+101

Comp $K = 4.2325$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	19.0523	-1.8947	3	3.5899
2	19.3219	-1.6256	2	2.6426
3	20.0000	-0.9470	0	0.8968
4	21.0000	+0.0530	0	0.0028
5	21.5524	+0.6054	0	0.3665
6	22.0000	+1.0530	1	1.1088
7	22.5726	+1.6256	2	2.6426
8	22.8601	+1.9131	3	3.6600

Approx Center

$$x = 18.0 \quad y = 19.3214$$

$$22.5726$$

$$41.8940$$

$$y_0 = 20.9470$$

$$y - \text{mean} = 18.8790$$

$$R = 20.680$$

$$x - \text{mean} = 17.2070$$

$$x_0 = 19.2750$$

$$\text{Center} \begin{cases} x_0 = 19.2700 \\ y_0 = 20.9470 \end{cases}$$

Formation of moments

	ab	b _{ans}	b _m
1	+ 1.55	- 298.4	- 689.0
2	+ 2.07	- 298.4	- 383.0
3	+ 1.75	- 743.0	- 382.8
4	- 0.10	- 542.5	+ 13.1
5	- 1.20	- 317.0	+ 98.4
6	- 1.86	- 219.5	+ 130.0
7	- 2.07	- 285.5	+ 366.5
8	- 1.45	- 76.9	+ 193.0
	- 1.31	- 2781.2	- 653.8

2375

Miron's Center

18

Conditional Equations

	a	b	c	0-c	
1	-0.82	-1.89	= +364	+122 + 108 = +230	+134
2	-1.27	-1.63	= +235	+190 + 93 = +283	-48
3	-1.84	-0.95	= +403	+274 + 54 = +328	+75
4	-2.06	+0.05	= +263	+308 - 3 = +305	-42
5	-1.97	+0.61	= +161	+294 - 35 = +259	-98
6	-1.77	+1.05	= +124	+264 - 60 = +204	-80
7	-1.27	+1.63	= +225	+190 - 93 = +97	+128
8	-0.76	+1.91	= +101	+114 - 109 = +5	+96

Average 88

Normal Equations

$$\begin{aligned}
 +19.14a - 1.31b &= -2781 \\
 -1.31a + 14.91b &= -654 \\
 +1.31a - 0.09b &= -190 \\
 +14.82b &= -844 \\
 +19.14a &= -2781 - 74 = -2855
 \end{aligned}$$

$$b = -56.9$$

$$a = -149.1$$

1
2
3
4
5
6
7
8

2375

Moon's Center Conditional Equations

11

	a	b	0	c	0-c
1	-082	-189	+364	+122 + 108 = +230	+134
2	-127	-163	+235	+190 + 93 = +283	-48
3	-184	-095	+403	+274 + 54 = +328	+75
4	-206	+005	+263	+308 - 3 = +305	-42
5	-197	+061	+161	+294 - 35 = +259	-98
6	-177	+105	+124	+264 - 60 = +204	-80
7	-127	+163	+225	+190 - 93 = +97	+128
8	-076	+191	+101	+114 - 109 = +5	+96

Average 88

Normal Equations

$$+19.14 - 1.31 = -2781$$

$$-1.31 + 14.91 = -654$$

$$+1.31 - 0.09 = -190$$

$$+14.82 = -844$$

$$b = -56.9$$

$$+19.14 = -2781 - 74 = -2855$$

$$a = -149.1$$

2375

Moon's Mean Position (1912.0)

$$\begin{array}{r} X_0 = 192700'' \\ \frac{1}{2} \Delta\alpha = -75'' \\ \hline 192625'' \end{array}$$

$$\begin{array}{r} Y_0 = 209470'' \\ \frac{1}{2} \Delta\delta = -28'' \\ \hline 209442'' \end{array}$$

From Right Ascensions $X = 20.0944$ $Y = 21.9859$

$$\bar{z} = +2.0944$$

$$\eta = -0.0141$$

$$\begin{array}{r} \log \bar{z} = 0.32106 \\ -\cos \bar{z} = 9.97247 \\ \hline 8.50724 \end{array}$$

$$\begin{array}{r} \log \tan \delta = 9.5650 \\ 0.6421 \\ \hline 7.0539 \\ 7.2605 \end{array}$$

$$-(X-A) = 1.84135$$

$$\eta_1 = +18$$

$$X-A = +1.0940$$

$$\eta_0 = -0.0159$$

$$A = 2.5942$$

$$\begin{array}{r} \log \mu = 8.20140 \\ 7.33115 \\ \hline 0.87025 \end{array}$$

$$X_0 = 3.005140$$

$$\text{Red} = +4.05$$

$$\alpha' = 3.005545$$

$$(S-D) = -0.74$$

$$D = +20.1117$$

$$\delta_0 = +20.11096$$

$$\text{Red} = +2.39$$

$$\delta' = +20.11335$$

2375 Miron's Mean Position (1912.0)

$$X_0 = 19\ 27\ 00$$

$$Y_0 = 20\ 94\ 70$$

$$\frac{1}{2} \Delta = \underline{\quad 75 \quad}$$

$$\frac{1}{2} \Delta = \underline{\quad 28 \quad}$$

$$19\ 26\ 25$$

$$20\ 94\ 42$$

From plate constants $X = 20.0944$ $Y = 2198.59$

$$\bar{x} = +20944$$

$$\eta = -0.0141$$

$$\log \bar{x} = 0.32106$$

$$- \log s = 9.97247$$

$$8.50724$$

$$(\alpha - A) = 1.84135$$

$$\log \tan s = 9.5650$$

$$0.6421$$

$$7.0534$$

$$7.2605$$

$$\eta_1 = +18$$

$$\alpha - A = +09.40$$

$$\eta_0 = -0.0159$$

$$A = 2\ 59\ 42$$

$$\log \dots = 8.20140$$

$$7.33115$$

$$X_0 = 3\ 00\ 51.40$$

$$0.87025$$

$$\text{Red} = +4.05$$

$$(S - D) = -07.4$$

$$\alpha' = 3\ 00\ 55.45$$

$$D = +20\ 11\ 17$$

$$S_0 = +20\ 11\ 09.6$$

$$\text{Red} = +23.9$$

$$S' = +20\ 11\ 33.5$$

Lunar Parallax

$$\begin{array}{r}
 2375 \\
 \alpha' = 3 \quad 00 \quad 55.45 \\
 G = 4 \quad 41 \quad 53.5 \\
 G - \alpha = +1 \quad 40 \quad 58.4 \\
 = + \quad 25 \quad 14 \quad 36''
 \end{array}$$

$$+ \quad 9 \quad 44''$$

$$+ \quad 25 \quad 04 \quad 54''$$

$$\begin{array}{r}
 9.95727 \\
 0.00000 \\
 \hline
 0.04302 \\
 0.00029
 \end{array}$$

$$t = 45 \quad 06 \quad 09''$$

$$20 \quad 11 \quad 33$$

$$24 \quad 49 \quad 36''$$

$$\begin{array}{r}
 9.82640 \\
 8.22559 \\
 9.62312 \\
 \hline
 0.15037 \\
 7.82548
 \end{array}$$

$$\delta - \delta' = +23 \quad 00.1''$$

$$\delta = +20 \quad 34 \quad 33.6'' \quad \kappa = 3 \quad 02 \quad 13.36''$$

$$\text{Newt. Alund.} = +20 \quad 34 \quad 30.7'' \quad \alpha = 3 \quad 02 \quad 12.64''$$

$$O - C \quad +2.9'' \quad +0.72''$$

$$\delta' = +20 \quad 11 \quad 33.5'' \quad W$$

$$\pi = 57' \quad 47.7''$$

$$\begin{array}{r}
 9.86913 \\
 8.22559 \\
 9.62988 \\
 \hline
 0.02863 \\
 77.5323
 \end{array}$$

$$\alpha - \alpha' = +19' \quad 28.57''$$

$$= +1^m \quad 17.91''$$

$$\begin{array}{r}
 2375 \\
 \alpha' = 3 \quad 00 \quad 55.45 \\
 G = 4 \quad 41 \quad 53.8 \\
 G - \kappa = +1 \quad 40 \quad 58.4 \\
 + \quad 25 \quad 14 \quad 36''
 \end{array}$$

$$S = +20 \quad 11 \quad 33.5$$

$$\pi = 57 \quad 47.7$$

$$+ \quad 9 \quad 44$$

$$+ 25 \quad 04 \quad 54$$

$$\begin{array}{r}
 9.95727 \\
 0.00000 \\
 \hline
 0.04302 \\
 0.000029
 \end{array}$$

$$\begin{array}{r}
 9.86913 \\
 8.22559 \\
 9.62988 \\
 0.02863 \\
 \hline
 77.5323
 \end{array}$$

$$\alpha - \alpha' = +19 \quad 28.89$$

$$+ 1 \quad 17.97$$

$$f = 45 \quad 06 \quad 09$$

$$20 \quad 11 \quad 33$$

$$24 \quad 49 \quad 36$$

$$\begin{array}{r}
 9.82640 \\
 8.22559 \\
 9.62312 \\
 \hline
 0.15037 \\
 7.82548
 \end{array}$$

$$S - S' = +23 \quad 00.1$$

$$S = +20 \quad 34 \quad 33.6 \quad \kappa = 3 \quad 02 \quad 13.36$$

$$\text{Naut Almanac} = +20 \quad 34 \quad 30.7 \quad \alpha = 3 \quad 02 \quad 12.64$$

$$O - C \quad + 2.9$$

$$+ 0.72$$

1
10.
10.2
21.
323
31
24

2377

Stars - Measures

1914 Jan. 29.

21

$\begin{array}{r} 1 \\ 10.2 \\ 10.3 \end{array} \begin{array}{r} 15149 \\ 1151220 \\ 20 \\ 42 \\ 10.3629 \end{array}$

$\begin{array}{r} 18040 \\ 1168370 \\ 71 \\ 46 \\ .3627 \end{array}$

$\begin{array}{r} 14844 \\ 708080 \\ 80 \\ 36 \\ 10.2242 \end{array} \quad \begin{array}{r} 18542 \\ 1629090 \\ 9090 \\ 48 \\ .2253 \end{array}$

$\begin{array}{r} 21.3 \\ 324 \end{array} \begin{array}{r} 20027 \\ 1599000 \\ 9490 \\ 40 \\ 32.4038 \end{array}$

$\begin{array}{r} 18451 \\ 1247588 \\ 7983 \\ 47 \\ .4034 \end{array}$

$\begin{array}{r} 14240 \\ 739588 \\ 89 \\ 50 \\ 21.3144 \end{array} \quad \begin{array}{r} 17310 \\ 1413953 \\ 5546 \\ 06 \\ .3161 \end{array}$

$\begin{array}{r} 21.8 \\ 24.6 \end{array} \begin{array}{r} 18360 \\ 1238282 \\ 9082 \\ 67 \\ 24.5979 \end{array}$

$\begin{array}{r} 16257 \\ 1223029 \\ 3029 \\ 60 \\ .5975 \end{array}$

$\begin{array}{r} 18201 \\ 1646069 \\ 62 \\ 00 \\ 31.8263 \end{array} \quad \begin{array}{r} 16488 \\ 821911 \\ 1011 \\ 92 \\ .8278 \end{array}$

Grade 3

2377

Stars - Measurers

1914 Jan. 29.

21

$\begin{array}{r} 1 \\ 102 \\ 103 \end{array}$
 $\begin{array}{r} 15.149 \\ 115.1220 \\ 20 \\ 42 \\ \hline 10.3629 \end{array}$

$\begin{array}{r} 18040 \\ 1167370 \\ 71 \\ 46 \\ \hline 3627 \end{array}$

$\begin{array}{r} 14844 \\ 708080 \\ 80 \\ 36 \\ \hline 102242 \end{array}$
 $\begin{array}{r} 18542 \\ 1629090 \\ 9090 \\ 48 \\ \hline 2253 \end{array}$

$\begin{array}{r} 213 \\ 324 \end{array}$
 $\begin{array}{r} 20027 \\ 1599000 \\ 9490 \\ 40 \\ \hline 324038 \end{array}$

$\begin{array}{r} 18451 \\ 1247588 \\ 7983 \\ 47 \\ \hline 4034 \end{array}$

$\begin{array}{r} 14240 \\ 739588 \\ 89 \\ 50 \\ \hline 213144 \end{array}$
 $\begin{array}{r} 17310 \\ 1413953 \\ 5546 \\ 06 \\ \hline 3161 \end{array}$

$\begin{array}{r} 3 \\ 218 \\ 246 \end{array}$
 $\begin{array}{r} 18360 \\ 1238282 \\ 90 \\ 67 \\ \hline 245979 \end{array}$

$\begin{array}{r} 16257 \\ 1223029 \\ 3029 \\ 60 \\ \hline 5975 \end{array}$

$\begin{array}{r} 18201 \\ 1646069 \\ 62 \\ 00 \\ \hline 318263 \end{array}$
 $\begin{array}{r} 16488 \\ 821911 \\ 10 \\ 92 \\ \hline 8278 \end{array}$

Grade 3.

23 77

Moon-Measures

22

 $\frac{1}{d}$ scratch

 19.1 17547
 19.6 1101808
 1020
 50
19.6535
 19649
 1619688
 7588
 59
16534
 17403
 1118780
 80
 00
19.3781
 15218
 1544050
 5050
 22
13772
 $\frac{2}{20.0}$ 12015
 20.0 1170090
 20.0 95-90

 9705-20
 25-10
 9398
20.032010317 $\frac{3}{20.6}$
 20.6
 21.0

 16390
 1275556
 50
 93
20.6363
 13937
 756059
 6059
 31
16373
 $\frac{4}{20.7}$
 21.5
 max

 20.7
 21.0

 15338
 1269580
 92
 45
20.7349
 15025
 766250
 5050
 30
17374
 $\frac{5}{20.6}$
 22.0

 14268
 1137055
 60
 60
20.7096
 16062
 895760
 5660
 70
17110
 $\frac{6}{20.3}$
 23.0

 15000
 765555
 50
 06
20.2649
 16190
 135-1022
 16
 90
2674

2377

known-measures

22

d
1 scratch19.4 17547
19.6 1101808
102050
19.653519649
1619688
758859
653417403
1118780
80
0019.378115218
1544050
50
2237722
200 112015-
W.0 1170090
95-9020.03209705-20
25-10
93980317

3

W.6
21016390
1275556
50
93
20.636313937
756059
60
31
6373

4

W.7
21.5
max15338
1269580
92
45
20.734915025
766250
50
30
7374

5

W.6
22014268
1137055
60
60
20.709616062
895760
50
70
7110

6

W.3
23.015000
7655553
50
06
20.264916190
1351022
16
90
2674

2377

known measures.

23

<u>7</u>	a	4	16998
20.0	19350		975240
233	1660600		3253
	00		99
	59		2.745
	<u>23.2751</u>		

<u>8</u>	19445	16895
19.0	1171015	1460015
237	13	10
	50	92
	<u>23.7736</u>	<u>7714</u>

<u>9</u>	18475	17850
18.5	1035940	1598990
237	5050	92
max	78	50
in		
8	<u>23.8127</u>	<u>.8140</u>

~~10~~
~~18.0~~
~~23.5~~

Handwritten notes on graph paper, including several small tables and calculations. The text is faint and mostly illegible due to fading and bleed-through from the reverse side. Some visible fragments include:

Top left: 1000000

Top right: 1000000

Middle left: 1000000

Middle right: 1000000

Bottom left: 1000000

Bottom right: 1000000

2377 known measures.

23

$$\begin{array}{r}
 2377 \\
 200 \quad 19350 \\
 233 \quad 1660600 \\
 \quad \quad 00 \\
 \quad \quad 59 \\
 \hline
 23.2751
 \end{array}
 \qquad
 \begin{array}{r}
 16998 \\
 975240 \\
 \quad 3253 \\
 \quad 99 \\
 \hline
 2745
 \end{array}$$

$$\begin{array}{r}
 8 \\
 140 \quad 19445 \\
 237 \quad 1171015 \\
 \quad \quad 13 \\
 \quad \quad 50 \\
 \hline
 23.7736
 \end{array}
 \qquad
 \begin{array}{r}
 16895 \\
 1460015 \\
 \quad 10 \\
 \quad 92 \\
 \hline
 7714
 \end{array}$$

$$\begin{array}{r}
 9 \\
 18.5 \\
 237 \quad 18475 \\
 \text{max} \quad 1035940 \\
 \quad \quad 5050 \\
 \quad \quad 78 \\
 \hline
 23.8127
 \end{array}
 \qquad
 \begin{array}{r}
 17850 \\
 1598990 \\
 \quad 92 \\
 \quad 50 \\
 \hline
 8140
 \end{array}$$

$$\begin{array}{r}
 10 \\
 18.5 \\
 23.5
 \end{array}$$

Dec 24, $9^h 08^m 15.2 - 9 08 15.4$
 $0 24.4$

$9 07 50.9^{\checkmark}$
 $4 44 31.05^{\checkmark}$
 $13 52 21.95^{\checkmark}$
 $18 10 34.66^{\checkmark}$
 $19 41 47.29^{\checkmark}$
 $3 13.61^{\checkmark}$
 $19 38 33.68^{\checkmark}$

$\theta - \alpha = +1^m 43^s$

moon 19^h $7 22 36.37^{\checkmark}$ $+27 04 03.1^{\checkmark}$
 moon $1^m = 274.05^{\checkmark}$ $5.851^{\checkmark}$
 $38.5613^{\checkmark}$ $+1 45.68^{\checkmark}$ $- 3 45.6^{\checkmark}$
 Tabular place $7 24 22.05^{\checkmark}$ $+27 00 17.5^{\checkmark}$

moon's parallax

$60' 28.1^{\checkmark}$

semidiameter

$16 30.1^{\checkmark}$

$934 = 19.2$

R -

$990.1^{\checkmark}$

$910 = 16.0$

Augmentation

$+16.0^{\checkmark}$

Irradiation (?)

$-0.7^{\checkmark}$

R

$1005.4^{\checkmark}$

R -

$21552^{\checkmark}$

$\alpha = +1.7$

$(\alpha + 1) R -$

$21556^{\checkmark}$

$R^2 =$

$4.6466^{\checkmark}$

2377	Times etc.				
Exhaustion	1912 Dec 24,	9 ^m	01 ^m	-9 ^m	13 ^m
... moon		9	07	152 ^v	-9 07 15.4 ^v
clock fast			0	244 ^v	
H Sid T.		9	06	509 ^v	G-x = +1 ^m 43 ^m
H long		4	44	31.0 ^v	
G Sid T.		13	51	2195 ^v	
Sid T. in hour		18	10	34.66 ^v	
Internal		19	40	4729 ^v	
Reduction			3	1344 ^v	
G. in T.		19	37	3385 ^v	

From bank Allen		R. A.		Decl.	
moon 19 ^h	7 ^m	22 ^m	36 ^s 37	+27°	04' 03".1
horizontal = 2.7405				5849	
... 37.5642		41	4294 ^v	-3	39.7
Tabular place	7	24	1931	+27	00 23.9

moon's age	16 1/2 days	
parallel	60'	282
semi-diameter	16	30.1
R		990.1
Augmentation		+16.0
Irradiation (3)	-	0.7
R		1005.4
R		2.1552
(1+a)R		2.1556
R ²		4.6466

$$9342 + 142$$

$$9905 + 16.0$$

$$a = +1.7$$

2377 Times etc.
 Enthalpy 1912 Dec 24, $9^{\circ} 01^{\circ}$ - $9^{\circ} 13^{\circ}$
 known $9 07 15.2 - 9 07 15.4$
 clock fast 0 244

H. Ind. T. $9 06 50.9$ $G - 2 = +1^{\circ} 43^{\circ}$
 H. long $4 44 31.05$
 G. Ind. T. $13 51 21.95$
 S. Ind. T. $18 10 34.66$
 Internal $19 40 47.29$
 Reduction $3 13.44$
 G. Ind. T. $19 37 33.85$

Frontant Column $R. A.$ $Dec. 24$
 known 19° $7^{\circ} 22^{\circ} 36.33$ $+27^{\circ} 04' 03.1$
 known $1^{\circ} 2.7405$ 5.849
 37.5642 $-1 42.94$ $-3 39.7$
 Tabular black $7 24 19.31$ $+27 00 23.4$

known age $16 \frac{1}{2}$ days

parallel $60' 28.2$
 perpendicular $16 30.1$

$9342 + 142$
 $9902 + 140$

R 990.1
 Orientation $+16.0$
 Irradiation (3) $- 0.7$
 R 1005.4
 R 2155.2
 $a = +1.7$ $(1+a)R$ 2155.6
 R^2 4646.6

2377

Plate Constants

W

x	y	R.A.	Decl.
102248	103628	7 18 07	+25 13 14
213152	324036	24 20	28 05 54
318270	245977	30 30	27 05 31
3) 6347	6736	72 57	80 23 99
21.16	22.45	7 24 19	26 48 13
-18	-22	- 1 38	- 3 30
3.16	1.45	7 22 41	+26 44 43
31	46.5		
98 ³	210 ⁴		
= 1 ^m 38 ^s	= 3' 30"	A = 7 ^m 22 ^m 41 ^s	D = +26° 44' 43"

$$\begin{aligned}
 2 - \frac{3}{2} - 129.4 & - 1.72 & - 722 \\
 + 2077 - 1337 & + 740 - 17 & + 723 = + \\
 + 4938 - 4180 & + 758 - 36 & + 722 = 0 \\
 + 3949 - 3173 & + 776 - 54 & + 722 = 0 \\
 18.5815 - 2794 & - 32 & = 18.2267
 \end{aligned}$$

$$\begin{aligned}
 y - m & + 130.2x & + y & - 2349 \\
 + 1008 + 1331 & = + 2339 & + 10 & + 2349 = 0 \\
 - 457 + 2775 & = + 2318 & + 32 & + 2350 = + 1 \\
 - 1820 + 4144 & = + 2324 & + 25 & + 2349 = 0 \\
 21.6561 & + 2419 & + 22 & = 21.6653
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables } a & = -0.4 & b & = -0.4 & a - b & = 0.0 & b + a & = 0.0 \\
 \text{Obs } a & = +1.7 & b & = -1.0 & a - b & = +2.7 & b + a & = -1.2
 \end{aligned}$$

2377

Plate Constants

w

α	δ	R.A.	Decl.
10.2248	10.3628	7 18 07	+25 13 14
21.3152	32.4036	24 20	28 05 14
31.8270	24.5977	30 30	27 05 31
3 6347	6736	72 57	180 23 99
21.16	22.45	7 24 19	26 48 13
-18	22	- 1 38	- 3 30
3.16	.45	7 22 41	+26 44 43
31	46		
98 ^s	210 ["]		
= 1 ^m 38 ^s	= 3 ^m 30 ["]	A = 7 ^L 22 ^m 41 ^s	D = +26° 44' 43"

$$\begin{array}{rcl}
 2-3 & -1294 & -172 \\
 +2077 & -1337 & +740 -17 = +723 \\
 +4938 & -4180 & +758 -36 = +722 \\
 +3949 & -3173 & +776 -54 = +722 \\
 185815 & -2794 & -32 \\
 & & = 18.2267
 \end{array}$$

$$\begin{array}{rcl}
 y-m & +130.2x & +y \\
 +1008 & +1331 & +2339 +10 = +2349 \\
 -457 & +2775 & +2318 +32 = +2350 \\
 -1820 & +4144 & +2324 -25 = +2349 \\
 21.6561 & +2419 & +22 \\
 & & = 21.6653
 \end{array}$$

$$\begin{array}{lcl}
 \text{Tables } a = -0.4 & b = -0.4 & a-b = 0.0 & b+a = 0.0 \\
 \text{Obs } a = +1.7 & c = -1.0 & a-c = +2.7 & b+a = -1.2
 \end{array}$$

2377 Standard Coordinates.

Cape No. 1044 mag 5.1

Cape No. 1054 mag 5.1 Cape No. 1066 mag 4.3

C 7^h 17^m 22^s 777^h 23^m 35^s 617^h 29^m 45^s 67

L 77

62

70

E 76

57

68

Mean 7 17 22 77

7 23 35 60

7 29 45 68

Prec + 43.92

+ 44.84

+ 44.43

x 7 18 06.69

7 24 20.44

7 30 30.11

A 7 22 41

7 22 41

7 22 41

α-A - 4 34.31

+ 1 39.44

+ 7 49.11

Δ(A) - 2 74.29

+ 99.44

+ 469.02

log 2.43821 m

1.99756

2.67119

log 9.95650

9.94554

9.94952

log 0.90195 m

0.45034

1.12795

3 - 79790

+ 2.8206

+ 13.4261

3 - 39

+ 8

+ 60

3 10.0171

20.8214

31.4321

x 10.2248

21.3152

31.8270

x - 3 + 2077

+ 4938

+ 3949

C + 25° 14' 33.8

+ 28° 07' 20.8

+ 27° 07' 04.8

L 34.4

21.2

04.2

E 33.7

20.4

04.7

Mean + 25 14 34.0

+ 28 07 20.8

+ 27 07 04.6

Prec - 1 20.3

- 1 26.4

- 1 33.5

x + 25 13 13.7

+ 28 05 54.4

+ 27 05 31.1

D + 26 4.4 43

+ 26 44 43

+ 26 44 43

δ-A - 1 31 29.3

+ 1 21 11.4

+ 20 48.1

tan(δ-A) - 5491.6

+ 4872.3

+ 1248.1

log 3.73970 m

3.68774

3.09624

log 1.07085 m

1.01889

0.42739

tan δ 9.6730

9.7275

9.7089

log 1.8039

0.9007

2.2559

log 8.5303

7.6816

9.0182

μ_α - 11.7719

+ 10.4445

+ 2.6754

μ_δ + 339

+ 48

+ 1043

μ 10.2620

32.4493

24.7797

μ 10.3628

32.4036

24.5977

μ - 10.0000

- 457

- 1820

2377 Mandand				Coordinates								
Cape No. 1044 mag 5.1				Cape No. 1054 mag 5.1								
Cape No. 1066 mag 4.3												
C	7	17	22.77	7	23	35.61	7	29	45.67			
L			77			62			70			
E			76			57			68			
mean	7	17	22.77	7	23	35.60	7	29	45.68			
Proc		+	43.92		+	44.84		+	44.43			
x	7	18	06.69	7	24	20.44	7	30	30.11			
A	7	22	41	7	22	41	7	22	41			
a-A	-	4	34.31	+	1	39.44	+	7	49.11			
Δ(A)	-	2	74.29		+	99.44		+	469.02			
log		2.43821			1.99756			2.67119				
log S		9.95650			9.94554			9.94952				
S ₀		0.90195			0.45034			1.12795				
B ₁	-	7.9790		+	2.8206		+	13.4261				
B ₂	-	39		+	8		+	60				
B ₃		10.0171			20.8214			31.4321				
x		10.2248			21.3152			31.8270				
x - B	+	20.77		+	49.38		+	39.49				
C	+	25	14	33.8	+	28	07	20.8	+	27	07	04.8
L			34.4				21.2				04.2	
E			33.7				20.4				04.7	
mean	+	25	14	34.0	+	28	07	20.8	+	27	07	04.6
Proc	-		1	20.3	-		1	26.4	-		1	33.5
x	+	25	13	13.7	+	28	05	54.4	+	27	05	31.1
D	+	26	4.4	4.3	+	26	4.4	4.3	+	26	4.4	4.3
S-A	-	1	31	29.3	+	1	21	11.4	+		20	48.1
Δ(A)	-		5.491.6		+		4.872.3		+		1.248.1	
log		3.73970			3.68774			3.09624				
log S		1.07085			1.01889			0.42739				
Tens		9.6730			9.7275			9.7089				
S ₂		1.8039			0.9007			2.2559				
S ₁		8.5303			7.6816			9.0182				
y ₀	-	11.7719		+	10.4445		+	2.6754				
y ₁	+		33.9	+		4.8	+	10.43				
y		10.2620			32.4493			24.7797				
y		10.3628			32.4036			24.5977				
								-1.820				

pt	pos L	resid
1	1 5 8.3	-19
2	1 3 8.9	+39
3	1 0 7.6	+52
4	9 0.0	-37
5	8 0.8	+36
6	5 1.5	-22
7	4 1.1	-142
8	1 1.3	+57
9	0 0	+74

2377 Moon's Center:

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	19.3776	+0.8006	0.6410	4.6434	-32
2	20.0000	+1.4230	2.0249	4.6569	+98
3	20.6368	+2.0598	4.2428	4.6705	+239
+4	20.7362	+2.1592	4.6622	4.6622	+156
5	20.7103	+2.1333	4.5510	4.6707	+241
6	20.2662	+1.6892	2.8534	4.6651	+185
7	20.0000	+1.4230	2.0249	4.6519	+53
8	19.0000	+0.4230	0.1789	4.6669	+203
9	18.5770	0.0000	0.0000	4.6630	+164

Comp K^2 : 4.6466 $\Delta x \text{ and } \Delta y = 0$

	y	$y - y_0$	$(y - y_0)^2$
1	19.6534	-2.0006	4.0024
2	20.0318	-1.6222	2.6315
3	21.0000	-0.6540	0.4277
4	21.6540	0.0000	0.0000
5	22.0000	+0.3460	0.1197
6	23.0000	+1.3460	1.8117
7	23.2748	+1.6208	2.6270
8	23.7725	+2.1185	4.4880
+9	23.8134	+2.1594	4.6630

Aphel. Center:

$$x = 20.0 \quad y = 20.0318$$

$$23.2748$$

$$433066$$

$$y_0 = 21.6533$$

$$y_{\text{max}} = 23.8134$$

$$R = 2.1601$$

$$x_{\text{max}} = 20.7362$$

$$x_0 = 18.5761$$

$$\text{Center } \begin{cases} x_0 = 18.5770 \\ y_0 = 21.6540 \end{cases}$$

2377 Moon's Center

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)(y - y_0)^2$	$y - y_0$
1	19.3776	+0.8006	0.6410	4.6434	-3.2
2	20.0000	+1.4230	2.0249	4.6564	+9.8
3	20.6368	+2.0598	4.2428	4.6705	+23.9
4	20.7362	+2.1592	4.6622	4.6622	+15.6
5	20.7103	+2.1333	4.5510	4.6707	+24.1
6	20.2662	+1.6892	2.8534	4.6651	+18.5
7	20.0000	+1.4230	2.0249	4.6519	+5.3
8	19.0000	+0.4230	0.1789	4.6669	+2.03
9	18.5770	0.0000	0.0000	4.6630	+1.64

Comp $K^2 = 4.6466$ $\Delta x \text{ and } \Delta y = 0$

	y	$y - y_0$	$(y - y_0)^2$
1	19.6534	-2.0006	4.0024
2	20.0318	-1.6222	2.6315
3	21.0000	-0.6540	0.4277
4	21.6540	0.0000	0.0000
5	22.0000	+0.3460	0.1197
6	23.0000	+1.3460	1.8117
7	23.2748	+1.6208	2.6270
8	23.7725	+2.1185	4.4880
9	23.8134	+2.1594	4.6630

Aphel. Center

$$x = 20.0 \quad y = 20.0318$$

$$23.2748$$

$$43.3066$$

$$y_0 = 21.6533$$

$$y_{\text{max}} = 23.8134$$

$$R = 21.601$$

$$y_{\text{min}} = 20.7362$$

$$x_0 = 18.5766$$

$$\text{Center } \begin{cases} x_0 = 18.5770 \\ y_0 = 21.6540 \end{cases}$$

Formation of Journals

	ab	an	bn
1	- 1.60	- 25.6	+ 64.0
2	- 2.30	+ 139.0	- 158.8
3	- 1.34	+ 492.5	- 155.5
4	+ 0.00	+ 337.0	+ 6.0
5	+ 0.74	+ 513.0	+ 84.4
6	+ 2.28	+ 312.2	+ 250.0
7	+ 2.30	+ 75.3	+ 86.0
8	+ 0.89	+ 85.3	+ 430.5
9	+ 0.00	+ 0.0	+ 354.0
	<u>+ 0.97</u>	<u>+ 1928.7</u>	<u>+ 954.6</u>

2377

Moon's Center Conditional Equations.

28

	a	b	0		L	0 - c
1	+0.80	-2.00	-32	+71 - 84	-13	-19
2	+1.92	-1.62	+98	+127 - 68	+59	+39
3	+2.06	-0.65	+239	+184 - 27	+157	+82
4	+2.16	+0.00	+156	+193 + 0	+193	-37
5	+2.13	+0.35	+241	+190 + 15	+205	+36
6	+1.69	+1.35	+185	+151 + 56	+207	-22
7	+1.42	+1.62	+53	+127 + 68	+195	-142
8	+0.42	+2.12	+203	+37 + 89	+146	+57
9	0.00	+2.16	+164	+0 + 90	+90	+74
						Average = 56

Normal Equations

$$\begin{aligned}
 &+21.18 + 0.97 = +1929 \\
 &+0.97 + 20.77 = +955 \\
 &-0.97 - 0.04 = -88 \\
 &\quad +20.73 = +867 \\
 &\quad \quad \quad b = +41.8 \\
 &+21.18 = +1929 - 40 = +1889 \quad a = +893
 \end{aligned}$$

Arc measured = 158° Average (0-c) = +7.6

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

$$\frac{+7.6}{.19} = +0.40$$

$$\Delta n = +0.4$$

2377

Innovis Center
Conditional Equations.

28

	a	b	c						
1	+0.80	-2.00	-3.2	+	71	-84	-1.3	-1.9	
2	+1.42	-1.62	+9.8	+	127	-68	+5.9	+3.9	
3	+2.06	-0.65	+2.39	+	184	-27	+15.7	+8.2	
4	+2.16	+0.00	+15.6	+	193	+0	+18.3	-3.7	
5	+2.13	+0.35	+2.41	+	190	+15	+20.5	+3.6	
6	+1.69	+1.35	+18.5	+	151	+5.6	+20.7	-2.2	
7	+1.42	+1.62	+5.3	+	127	+6.8	+19.5	-1.42	
8	+0.42	+2.12	+20.3	+	37	+8.9	+14.6	+5.7	
9	0.00	+2.16	+16.4	+	0	+9.0	+9.0	+7.6	
								Average	-5.6

Normal Equations.

$$\begin{aligned}
 +21.18a + 0.97b &= +19.29 \\
 +0.97a + 20.77b &= +9.55 \\
 -0.97a - 0.04b &= -8.8 \\
 +20.73b &= +86.7
 \end{aligned}$$

$$b = +41.8$$

$$+21.18a = +19.29 - 40 = +18.89$$

$$a = +89.3$$

Arc measured $+158^\circ$ Average $(O-C) = +7.6$

$$\frac{7.6}{n} = 0.19$$

$$+7.6$$

$$\frac{19}{19} = +0.40$$

$$O-C = +0.4$$

Red. ad e aph.

$$\begin{array}{rcl}
 H + \alpha & 711 & = 107^{\circ} 45' \\
 H & 2348 & \\
 \alpha & = 723 & \\
 G & 2224 & \\
 G + \alpha & 547 & = 86^{\circ} 45'
 \end{array}$$

$$\begin{array}{rcl}
 l \cos(G + \alpha) & 8.7535 & \\
 q & 1.3144 & \\
 \sin & 9.9993 & \\
 \tan S & 9.7015 & \\
 \tan & 8.8239 & \\
 g' & 0.0679 & \\
 g & 9.8391 &
 \end{array}$$

$$\begin{array}{rcl}
 b & + 2.88 & \\
 g & + 0.69 & \\
 h & + 1.45 & \\
 \hline
 & + 5.02 & \checkmark
 \end{array}$$

$$S = +26^{\circ} 42'$$

$$\begin{array}{rcl}
 l \cos S & 9.9510 & \\
 \dots & 9.6563 m & \\
 \dots (l) & 9.6073 m &
 \end{array}$$

$$\begin{array}{rcl}
 l \sin S & 9.6526 & \\
 \cos(H + \alpha) & 9.4891 m & \\
 h & 1.3110 & \\
 \sin & 9.9788 & \\
 \sec S & 0.0490 & \\
 \tan & 8.8239 & \\
 h' & 0.4477 m & \\
 h & 0.1627 &
 \end{array}$$

$$\begin{array}{rcl}
 g' & + 1.17 & \\
 h' & - 2.80 & \\
 b & - 0.40 & \checkmark \\
 \hline
 & - 2.03 &
 \end{array}$$

2377 Luovon's Mean Position (1912.0)

29

$$\begin{array}{rcl}
 X_0 = 18.5770^\circ & Y_0 = 21.6540^\circ \\
 \text{wa} = +4.5^\circ & \text{wb} = +2.1^\circ \\
 \hline
 18.5815^\circ & 21.6561^\circ
 \end{array}$$

From Plate Constant $X = 18.2267^\circ$ $Y = 21.6653^\circ$

$$z = +0.2267^\circ$$

$$\eta = -0.3347^\circ$$

$$\begin{array}{rcl}
 \log z & = & 9.35545^\circ \\
 \log s & = & 9.95102^\circ \\
 & & 8.50724
 \end{array}$$

$$\begin{array}{rcl}
 \log \tan s & = & 9.7018^\circ \\
 & & 8.7109 \\
 & & 7.0534 \\
 \eta & = & 5.4661
 \end{array}$$

$$(d-A) = 0.89719^\circ$$

$$\begin{array}{rcl}
 \log \eta_0 & = & 9.52466^\circ \\
 & & 7.33515^\circ \\
 (d-D) & = & 2.19351^\circ
 \end{array}$$

$$\alpha - A = +7.89^\circ$$

$$s - D = -2.36.1^\circ$$

$$A = 7.22.41^\circ$$

$$\alpha = 7.22.48.89^\circ$$

$$D = +26.44.43^\circ$$

$$\text{Red} = +5.02^\circ$$

$$S_0 = +26.42.06.9^\circ$$

$$\alpha' = 7.22.53.91^\circ$$

$$\text{Red} = -2.0^\circ$$

$$\delta' = +26.42.04.9^\circ$$

2377 Inverse Mean Position (1912.0)

29

$$\begin{array}{r}
 X_0 = 18.5770 \quad Y_0 = 21.6540 \\
 + .05 \quad + .21 \\
 \hline
 18.5815 \quad 21.6561
 \end{array}$$

From Plate constant $X = 18.2267 \quad Y = 21.6653$

$$\bar{z} = +0.2267$$

$$\eta = -0.3347$$

$$\begin{array}{r}
 \log \bar{z} = 9.35545 \\
 \log S = 9.95102 \\
 8.50724
 \end{array}$$

$$\begin{array}{r}
 \log T_{\text{an } S} = 9.7018 \\
 8.7109 \\
 7.0534 \\
 \eta_1 = 54661
 \end{array}$$

$$(A-A) = 0.89719$$

$$\begin{array}{r}
 \log \eta_0 = 9.52466 \\
 7.33115 \\
 (S-D) = 2.19351
 \end{array}$$

$$\alpha - A = +7.89$$

$$S-D = 2.361$$

$$A = 7.2241$$

$$D = +26.44.43$$

$$\alpha = 7.22.48.89$$

$$S_0 = +26.42.069$$

$$\text{Red} = +5.02$$

$$\text{Red} = 2.0$$

$$\alpha' = 7.22.53.91$$

$$\alpha' = +26.42.049$$

$$\begin{array}{rcl}
 2377 & & \text{Lunar Parallel} \\
 \alpha' = 7^h 22^m 53^s 91'' & & \\
 \delta = 9^\circ 07' 50.9'' & & \\
 \alpha - \alpha' = +1^\circ 44' 57.0'' & & \\
 = + 26^\circ 14' 15'' & &
 \end{array}$$

$$+ 11' 06''$$

$$+ 26^\circ 03' 09''$$

$$\begin{array}{r}
 9.95727 \\
 0.00000 \\
 0.04653 \\
 \hline
 0.00380
 \end{array}$$

$$\gamma = 45 \quad 15 \quad 02.5$$

$$26 \quad 42 \quad 04.9$$

$$18 \quad 32 \quad 58.$$

$$\begin{array}{r}
 9.82640 \\
 8.24523 \\
 9.50260 \\
 0.14863 \\
 \hline
 7.72286
 \end{array}$$

$$S - S' = + 18 \quad 09.7$$

$$S = + 27 \quad 00 \quad 146$$

$$\text{Naut. Alt.} = + 27 \quad 00 \quad 17.5$$

$$O - C = - 2.9$$

$$S' = + 26^\circ 42' 04.9''$$

$$\Pi = 60' 25.1''$$

$$\begin{array}{r}
 9.86913 \\
 8.24523 \\
 9.64552 \\
 0.05014 \\
 \hline
 7.81002
 \end{array}$$

$$\alpha - \alpha' = + 22' 11.82''$$

$$= + 1'' 28.79''$$

$$\alpha = 7 \quad 24 \quad 22.70$$

$$\alpha = 7 \quad 24 \quad 22.05$$

$$+ 0.65$$

5

0 1 2 3 4

1 2 3 4 5

0 1 2 3 4

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

0 0 1

0 1 2 3 4

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

0 1 2 3 4

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

1 2 3 4 5

2377 Lunar Parallax
 $\alpha = 7^h 22^m 53.91$
 $\delta = 9^\circ 07' 50.9$
 $\alpha - \delta = +1^\circ 44' 57.0$
 $= + 26'' 54' 15''$

+ 11 06

+ 26 03 09

995727

000000

009653

000384

$\gamma = 45^\circ 15' 02.5$

26 42 04.9

18 32 58

982640

824523

950269

019863

772286

$S - S' = + 18^\circ 09.6$

$S = + 27^\circ 00' 19.5$

nankeen $+ 27^\circ 00' 27.5$

- 3.0

$S' = + 26^\circ 42' 09.9$

$\Pi = 60' 28.2$

986913

824523

964552

005014

784002

$\alpha - \delta' = + 22^\circ 44.82$

$= + 1^\circ 28.79$

$\alpha = 7^\circ 24' 22.70$

$\alpha = 7^\circ 24' 22.05$

+ 0.65

