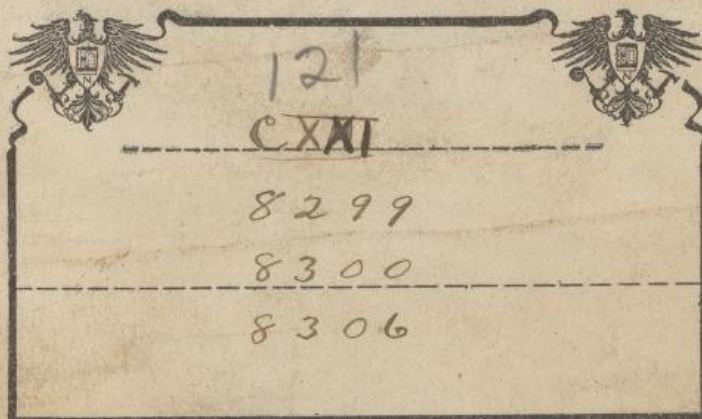


KG  
11366  
v.974







Harvard Lunar Plates  
Measures and Reductions  
Martha C. Borton

1  
1  
2  
2  
3  
1  
1  
2  
2  
1  
2  
2  
1  
3  
2  
1



8299

## Star Measures.

Remarks

1

1	16658	16720	15252	16328
18.5	12232	11142	7948	13618
27.7	3031	4644	5250	0813
	64	00	54	28
	<u>18.9430</u>	<u>18.4436</u>	<u>27.7302</u>	<u>27.7286</u>

2	14786	15658	15770	15528
20.3	11520	8724	8868	12406
7.8	3025	3831	7210	12414
	68	50	74	22
	<u>20.3256</u>	<u>20.3278</u>	<u>7.6902</u>	<u>7.6888</u>

3	14552	15348	17976	15228
34.5	9468	10798	15178	7508
19.2	6466	3976	7275	08
	32	48	88	36
	<u>34.5076</u>	<u>34.5098</u>	<u>19.2304</u>	<u>19.2274</u>

## Moon Measures.

1		16446	16542
23?		15812	7158
19+		1011	5255
7/10		46	54
max		<u>19.0639</u>	<u>19.0602</u>

2	16368	17722
22.4	12006	8700
19	1008	2010
	56	00
	<u>22.7356</u>	<u>22.7300</u>

3		15952	15716
22		7702	13658
18.8		1810	4751
		54	16
		<u>18.8242</u>	<u>18.8236</u>







8299

## Star Measures

1	16658	16720	15252	16328
18.5	12232	11142	7948	13618
27.7	3031	4674	52	08
	69	00	54	28
	<u>189930</u>	<u>189936</u>	<u>277302</u>	<u>27.7286</u>

2	14786	13658	15770	15528
20.3	11320	8929	8868	12906
7.8	3025	3831	7270	12919
	68	50	19	22
	<u>20.3256</u>	<u>20.3278</u>	<u>16902</u>	<u>7.6888</u>

3	19552	15398	17976	15228
39.5	8448	10498	15178	7508
19.2	6468	9976	7270	08
	32	98	88	36
	<u>39.5076</u>	<u>39.5098</u>	<u>19.2304</u>	<u>19.2279</u>

## Moon Measures

1		16476	16592
23?		12812	7158
19+		1011	255
May		76	59
		<u>49.0639</u>	<u>19.0602</u>

4	16368	14922
22.9	12006	8700
19	1008	2010
	54	00
	<u>22.9336</u>	<u>22.9300</u>

5		15952	15716
22		7702	13658
18.8		18	49
		59	16
		<u>18.8292</u>	<u>18.8236</u>







8299

## Moon Measures.

2

$$\begin{array}{r}
 4 \quad 17338 \quad 15274 \\
 21.3 \quad 1517469 \quad 742025 \\
 18 \quad 64 \quad 30 \\
 \quad 26 \quad 69 \\
 \hline
 21.2166 \quad 21.2160
 \end{array}$$

$$\begin{array}{r}
 5 \quad 17298 \quad 15360 \\
 21.4 \quad 17020 \quad 5632 \\
 17 \quad 1417 \quad 1227 \\
 \quad 84 \quad 62 \\
 \hline
 21.0280 \quad 21.0266
 \end{array}$$

$$\begin{array}{r}
 6 \quad 17258 \quad 13990 \\
 21.6 \quad 12797 \quad 8460 \\
 16 \quad 8489 \quad 5859 \\
 \quad 44 \quad 82 \\
 \hline
 21.4977 \quad 21.4777
 \end{array}$$

$$\begin{array}{r}
 7 \quad 15522 \quad 14842 \\
 22 \quad 10192 \quad 1619895 \\
 15.6 \quad 88 \quad 10192 \\
 \quad 22 \quad 32 \\
 \hline
 15.5332 \quad 15.5358
 \end{array}$$

$$\begin{array}{r}
 8 \quad 15900 \quad 14202 \quad 15864 \quad 14952 \\
 22.2 \quad 1425755 \quad 5848 \quad 1133729 \quad 9512 \\
 15.8 \quad 5655 \quad 48 \quad 2829 \quad 0810 \\
 30 \quad 00 \quad 192 \quad 80 \quad 66 \\
 \hline
 22.1675 \quad 22.1658 \quad 15.4542 \quad 15.4550
 \end{array}$$







2299

Moon Measures

2

2	17 338	15 274
23	131 79.69	79 20
18	69	30.25
	26	69
	<u>21 21 66</u>	<u>21 21 60</u>

2	17 298	15 360
21	170 20	36 32
	19.17	22.17
17	89	62
Kings	<u>21 02 80</u>	<u>21 02 66</u>

6	17 258	139 90
216	12799	89 60
16	8989	58.59
	99	82
	<u>21 99 39</u>	<u>21 44 79</u>

7		130 22	148 92
22		101 92	101 78.5
15.6		88	101 72
		22	32
		<u>10 53 22</u>	<u>10 53 58</u>

8	159 00	112 02	108 69	129 02
22.2	146 59.5	57 78	113 39	9 12
12.9	56.55	98	129	10
50	00	172	80	66
	<u>22 16 45</u>	<u>22 16 22</u>	<u>10 45 42</u>	<u>10 15 50</u>







8299

Junes &amp; Etc.

3

Mar 24 '15

Exp. to Stars	08	35		08	47
" " Moon	8	40	42.5	8	40 42.8
Clock slow			1.3		

H. Sid Time	8	40	43.95	$\theta - \alpha = +1^\circ$	3.0 <sup>m</sup>
H. Long	4	44	31.05		
Green Sid T.	13	25	15.00		
Sid T. M. H.	0	03	30.80		
Industrial	13	21	44.20		
Reduction		2	11.35		
G. M. T.	13	19	32.85		

From Naut. Almanac. R.A.

Dec.

Moon 13 <sup>h</sup>	07	09	17.82	+25	53	00.8
Moon in <sup>m</sup>			2.2998			5.800
" 19.3975			43.97		1	53.9
Tabular Place	07	10	01.79	+25	51	07.4

Moon's Age 9 days

937- 14.3

Parallax	55'	26.7
Semid	15	8.0
R.		908.0
Aug.		13.5
Dr d=2		-01
R		921.4
R		1.9751
ak		-940
Ha R		1.8811
R		3.5386

a = -500

+27

-476







8279

Lunar + etc.

2

Mar 27 '15

Exp. to Stars	08	35	08	47
" " Moon	8	40	42.5	40 42.8
clock slow			1.3	

H Sid time	8	40	43.95	$\delta - \alpha + 1^h$	30 <sup>m</sup>
H Long	7	49	31.05		
Green Sid T.	13	23	14.40		
Sid T M. H.		03	30.20		
Interval	13	21	49.20		
Reduction		2	11.35		
G M. J.	13	19	32.55		

From Naut. Almanac R.A.

Moon 13 <sup>h</sup>	07	07	17.82	+25	53	00.8
Moon m <sup>1</sup>			29.18			5.800
" 19.3975			43.77		1	53.9
Antular Place	07	15	01.79	+25	51	07.4

Moon's Age 9 days

Parallax	35"	26.9"
Semid	15	8.0"
H		908.0
Aug.		13.5
Pro. 12		-01
H		921.9
R		1.97514
ap		-940
Half		18811
H		3.5386

939- 14.3

a = -500

+29

-476



$\beta$	$\eta$	$\Delta\eta$	$-3.83$	$-.14$	$-3$	
1	-9.10	+10.28	-12	+16	+8	-12 +3
2	-2.15	-10.80	-6	+8	+2	+12 +3
3	+12.75	+11.21	+51	-88	+3	0 +3
M	+0.57	-0.89	-2	0	-5	<u>-5</u> +0.2
		$\Delta\eta$	$-3.2\eta$	$-.23$	+1	
		+32	-33	-1	+1	= 0
		-37	+37	0	0	= 0
		+5	-4	+1	-3	= -2
		0	+3	0	+4	+0.2



8299

## Standard Coordinates.

Cape No 1022-mg 5.6

Cape No 1024-5.8

Cape No 1070-mg 8.6

C 07 05 10.98

07 06 21.83

07 14 55.29

L 10.95

21.85

55.25

E 11.05

21.89

55.36

Mean 07 05 10.99

07 06 21.89

07 14 55.30

Pec +55.86

+57.71

55.27

 $\alpha$  07 06 06.85

07 07 16.55

07 15 50.57

A 7 08 30

7 08 30

7 08 30

 $q-A$  -2 23.15

-1 13.95

+7 20.57

 $\sin(q-A)$  -143.15

-73.45

+940.49

log " 2.15579 n

1.86599 n

2.67399

cosd 9.94989

9.95981

9.95429

 $\zeta_0$  0.61292 n

0.33304 n

1.10547

 $\zeta_1$  -7.1013

-2.1530

+12.7988

 $\zeta_2$  -12

-6

+51

 $\zeta_3$  17.8975

19.8964

34.7539

 $\chi$  18.7733

20.3267

34.5087

 $\chi-\zeta$  +0.5458

+7.803

-24.52

C +27 01 15.1

+24 17 44.7

+25 51 16.9

L 15.2

45.7

17.4

E 14.6

45.0

17.5

Mean 27 01 15.0

24 17 45.0

25 51 17.3

Pec -1 25.6

-1 27.0

-1 37.1

S +26 59 49.4

+24 16 18.0

+25 49 40.2

D 25 40 15

25 40 15

25 40 15

S-D +1 19 34.4

-1 23 57.0

+0 09 25.2

 $\tan(S-D)$  +9.775.2

-5.038.0

+565.2

log " 3.67899

3.70226 n

2.75220

 $\eta_0$  1.01014

1.03321 n

0.08335

 $\tan \delta$  9.7071

9.6541

9.6849

 $\zeta_2$  1.2258

0.6661

2.2109

 $\eta_1$  7.9863

7.3736

8.9492

 $\eta_0 + 10.2362$ 

-10.7997

+1.2116

 $\eta_1 + 0.0097$ 

+0.0024

+0.0890

 $\eta$  28.2759

7.2027

1.93006

 $\eta$  27.7298

7.6895

1.92289

 $\eta - \eta$  -5.165

+7.828

-0.717







8297

## Standard Coordinates

Cape No 1022 - May 5.6

Cape No 1029 - 5.8

Cape No 1070 - May 8.6

C	07 05 10.98	07 06 21.83	07 14 35.29
L	10.95	21.85	35.25
E	11.05	21.89	35.36
Mean	07 05 10.99	07 06 21.89	07 14 35.30
Proc	135.86	139.71	35.27
d	07 06 06.85	07 07 16.55	07 15 50.57
A	7 08 30	7 08 30	7 08 30
A-A	-2 23.15	-1 13.95	+7 20.51
Sum (A-A)	-143.15	-73.95	+990.99
Log	2.155799 n	1.86599 n	2.7299
cos d	9.91989	9.92981	9.95929
$\frac{1}{10}$	0.61292 n	0.33309 n	1.10547
$\frac{1}{10}$	-7.1013	-2.1530	127988
$\frac{1}{10}$	-12	-6	+51
$\frac{1}{10}$	178175	19.8969	347539
L	184933	20.3267	37.5087
x-5	+05458	+9803	-2432
C	+27 01 15.1	+29 17 49.7	+25 51 16.7
L	15.2	7.9	17.9
E	19.6	75.0	11.5
Mean	27 01 15.0	29 17 45.0	25 51 17.3
Proc	-1 25.6	-1 27.0	-1 37.1
d	+26 59 49.9	+29 16 18.0	+25 49 40.2
D	25 40 15	25 40 15	25 40 15
D-D	+1 19 39.4	-1 23 57.0	+0 09 25.2
Sum (D-D)	+97152	-5038.0	+5652
Log	3.67899	3.70226 n	2.75120
$\frac{1}{10}$	1.01014	1.03371 n	0.08335
cos d	7.7071	9.6541	9.6899
$\frac{1}{10}$	1.2258	0.6661	2.2109
$\frac{1}{10}$	7.9863	7.3736	8.9992
$\frac{1}{10}$	+102362	-107997	+12116
$\frac{1}{10}$	+00097	+00029	+0.0890
$\frac{1}{10}$	282159	72027	1.93006
$\frac{1}{10}$	277297	76895	192289
$\frac{1}{10}$	-5165	+9868	-717



$\phi - \# - - 2.1^m$



# Plate center

5-

X	Y	d	b
18.4433	27.7294	7 06 06.85	26 59 49.9
20.3267	7.6895	7 07 16.55	29 16 18.0
34.5087	19.2289	7 13 50.57	25 49 40.2
3) 73.2787	54.6478	3) 28 73.97	75 124 107.6
24.4262	18.2159	7 9 44.66	25 41 55.9
22	18	- 75.4	- 1 40.8
-2.43	- .216	7 8 29.26	25 40 15.1
<u>315</u>	<u>466.5</u>		

$$-75.4 \quad -100.76$$

$$\text{Center} \begin{cases} A = 70830 \\ D = 254015 \end{cases}$$

$$\begin{aligned} X-3 &+ 500X &+ 19.27 &- 0X &- 15075 \\ + 5958 + 9222 &= + 17680 + 399 &= + 15074 &= -1 \\ + 4803 + 10163 &= + 14966 + 109 &= + 15075 &= 0 \\ + 2452 + 17259 &= + 19802 + 273 &= + 15075 &= 0 \\ 22.9108 + 117.55 &+ 299 &= 22.5732 \end{aligned}$$

$$\begin{aligned} Y-4 &+ 500Y &- 12.54 &- 54 &- 8955 \\ - 5765 + 13865 &= + 8700 - 231 &= + 8769 - 14 &= + 8955 &0 \\ + 4868 + 3845 &= + 8718 - 254 &= + 8959 - 4 &= + 55 &+ 0 \\ - 717 + 9614 &= + 8897 - 931 &= + 8966 - 10 &= + 56 &+ 1 \\ 17.1805 + 85.90 &- 286 &- 8 &= 17.1648 \end{aligned}$$

$$\begin{aligned} \text{Tables} &a = +9 &e = +9 &abe = 0 &b + d = 0 \\ \text{lbs} &= 500 &= -499.7 &= -.3 &= -1.8 \end{aligned}$$

$$O-C \quad -500.9 \quad -500.6 \quad -1.8$$







## Plate center

5

$\lambda$	$\gamma$	$\alpha$	$\delta$
18.4433	27.7294	7.06 06.85	26.57 99.9
20.3267	168.95	7.07 16.55	29.16 18.0
39.5087	19.2289	7.15 50.57	25.99 90.2
3) 73.2781	59.64.78	2) 28.73.97	75.129 107.6
24.9262	18.2159	7.9 99.66	25.41 55.9
2.212	18	- 75.9	- 1 90.8
-2.93	- 21.6	7.8 29.26	25.40 15.1
<u>312</u>	<u>966.3</u>		
- 7.5 <sup>5</sup> 9	- 10.0" 16		

center } A = 7.08 30  
 } D = 25.90 15

$$\begin{array}{rclcl}
 \lambda - 3 & + 500\lambda & + 19.27 & - 0\lambda & - 15.075 \\
 + 5958 + 9222 & = + 17680 + 399 & = + 15079 & = & -1 \\
 + 9803 + 10163 & = + 17966 + 109 & = + 15075 & = & 0 \\
 - 2952 + 17259 & = + 17802 + 273 & = + 15075 & = & 0 \\
 22.9108 + 119.55 & = & + 297 & = & 22.5732
 \end{array}$$

$$\begin{array}{rclcl}
 \lambda - 11 & + 500\lambda & - 12.84 & - 54 & - 895. \\
 - 5165 + 13865 & = + 8700 - 234 & = 8769 & - 19 & = 8955 \\
 + 9868 + 3845 & = + 8718 - 254 & = 8952 & - 9 & = 8955 \\
 - 717 + 9614 & = + 8897 - 931 & = 8966 & - 10 & = 8956 \\
 17.1805 + 85.90 & = & - 286 & - 8 & = 17.1694
 \end{array}$$

$$\begin{array}{rclcl}
 \text{tabler} & a = 1.9 & c = 1.9 & a + c = 0 & b + d = 0 \\
 \text{obs} & = 500 & = -999.7 & = +.3 & = -1.8
 \end{array}$$



$$A = + .7$$

$$B = + .09$$



8 299

## Approximate Center of Moon.

6

	$x$	$x-x_0$	$\Delta x$	$(x-x_0)^2$	$(x-x_0)^2/(y-y_0)^2$	$\phi - c$
1	22.9100	+0.0000	+1	0.0000	3.5712	+26
2	22.7328	-0.4772	+1	0.2276	3.5400	+14
3	22.0000	-0.9100	+1	0.8279	3.5303	-83
4	21.2163	-1.6937	+0	2.8686	3.5410	+24
5	21.0273	-1.8827	0	3.5446	3.5446	+60
6	21.7777	-1.4626	-0	2.1392	3.5316	-70
7	22.0000	-0.9100	-1	0.8283	3.5359	-27
8	22.1650	-0.7450	-1	0.5551	3.5321	-65

$$R = 3.5386$$

	$y$	$y-y_0$	$\Delta y$	$(y-y_0)^2$	$L$
1	+19.0618	+1.8818	+0	3.5412	0
2	19.0000	+1.8200	+0	3.3127	345
3	18.8239	+1.6439	+0	2.7027	331
4	18.0000	+0.8200	+0	0.6724	296
5	17.1800	0.0000	0	0.0000	270
6	16.0000	-1.1800	-0	1.3927	231
7	15.5345	-1.6455	-0	2.7076	209
8	15.4546	-1.7254	-0	2.9770	203

157

Approximate Center

$$x_c = 22 \quad y = 18.8239$$

$$15.5345$$

$$34.3584$$

$$y_0 = 17.1792$$

$$y_{max} = 19.0618$$

$$R = 1.8826$$

$$x_{min} = 21.0273$$

$$x_0 = 22.9099$$

Moon's Center

$$\begin{cases} x_0 = 22.9100 \\ y_0 = 17.1800 \end{cases}$$







2299

Approximate Center of Moon

6

	$x$	$x - x_0$	$\Delta x$	$(x - x_0)^2$	$(y - y_0)(x - x_0)$	$(y - y_0)$
1	229000	+000000	-1	000000	35912	+2
2	229328	+04772	1	02276	32900	+19
3	220000	-09100	+1	08279	33303	-83
4	212163	-16937	0	28686	33910	+29
5	210273	-18827	0	35476	33996	+60
6	219979	-19626	0	21392	33316	-70
7	220000	-09100	-1	08283	33339	-27
8	221650	-07930	-1	05251	33321	-63

 $R = 35386$ 

	$y$	$y - y_0$	$\Delta y$	$(y - y_0)^2$	$z$
1	190618	+18818	0	35412	0
2	190000	+18200	0	33129	395
3	188239	+16439	0	27027	331
4	180000	+08200	0	06729	296
5	171800	00000	0	00000	270
6	160000	-11800	0	13929	231
7	155395	-16455	0	27070	209
8	159596	-17259	0	29770	203

197

Approximate Center

 $x_0 = 22$  $y_0 = 18.8239$  $15.5372$  $34.3384$  $y_0 = 17.1792$  $y_{max} = 19.0618$  $R = 1.9826$  $x_{min} = 21.0273$  $x_0 = 22.9099$ 

Moon's Center

$$\begin{cases} x_0 = 22.9100 \\ y_0 = 17.1800 \end{cases}$$



# Formation of Normals:

1	0.00	0.0	+ 79.0
2	- 0.87	- 6.5	+ 25.5
3	- 1.49	+ 75.5	- 136.0
4	- 1.39	- 40.5	+ 119.5
5	0.00	- 113.0	0.00
6	+ 1.72	+ 102.0	+ 82.5
7	+ 1.50	+ 24.5	+ 44.5
8	+ 1.28	+ 48.0	+ 112.5
	+ 4.50	+ 350.0	+ 333.5
	- 3.75	- 160.0	- 136.0
	+ 0.75	+ 190.0	+ 197.5

	a	b	c	new a-c
a	+33	- 0	- 9	+36 <sup>v</sup>
b	- 5	- 56	- 9	+20 <sup>v</sup>
c	+ 25	- 30	- 8	+ 7 <sup>v</sup>
	- 56	- 4	- 15 <sup>v</sup>	+29
	- 62	0	- 17 <sup>v</sup>	+ 7 <sup>v</sup>
	- 48	+ 6	+ 3 <sup>v</sup>	-30
	- 30	+ 8	+23 <sup>v</sup>	+28 <sup>v</sup>
	- 24	+ 9	+30 <sup>v</sup>	- 7 <sup>v</sup>

0.068

$$+10.99 + 0.75 = -8.07$$

+26<sup>u</sup>

$$0.75 + 17.30 = +1.60$$

$$+ [ ] + 0.5 = -0.55$$

$$+17.25 = +2.15$$



8299

7

## Conditional Equations.

							U-C
1	0.00	+ 1.88	= + 26	00	+ 20	= + 20	+ 6
2	-0.78	+ 1.82	= + 14	-81	+ 19	= -62	+ 76
3	-0.91	+ 1.67	= - 83	-15	+ 17	= + 2	- 85
4	-1.69	+ 0.82	= + 24	-29	+ 9	= -20	+ 44
5	-1.88	0.00	= + 60	-32	0	= -32	+ 92
6	-1.96	- 1.18	= - 70	-25	- 12	= -37	- 33
7	-0.91	- 1.65	= - 27	-15	- 17	= -32	+ 5
8	-0.77	- 1.73	= - 65	-13	- 18	= -31	- 39
							+ 223 = 152

$$+ 10.99 + 0.75 = + 190, \quad -8.07$$

$$+ 0.75 + 17.30 = + 197.5 \quad + 1.60$$

$$+ 0.75 + 0.05 = + 13.0$$

$$+ 17.25 = + 184.5$$

$$b = + 10.6 + 0.12 \Delta$$

$$+ 10.99 = + 190 - 8 = + 182$$

$$a = + 17.0 - 0.79$$

Arc measured  $154^\circ$ 

$$\frac{P}{h} = .19$$

$$\frac{\Sigma V}{h} = + 8.9$$

$$\text{In 2 } R 1.88$$

$$+ 8.9 = + 47.$$

$$\Delta R = + 0.6$$

$$-2RC = + 2.26$$

$$19$$

$$\text{Corr} = -0.6$$

$$\Delta b = + 10.27 \quad \Delta \delta = + 0.1$$

$$\Delta R = + 0.2$$

$$\Delta a = -1.67 \quad \Delta \alpha = -0.06$$







## Conditional Equations

C-C

$0.00 + 1.88 = +24$	$0.0 + 2.0 = +20$	$+6$
$-0.78 + 1.82 = +19$	$-81 + 17 = -62$	$+76$
$-0.91 + 1.69 = -83$	$-15 + 17 = +2$	$-85$
$-1.69 + 0.82 = +24$	$-29 + 9 = -20$	$+44$
$-1.88 + 0.00 = +60$	$-32 + 0 = -32$	$+92$
$-1.96 - 1.18 = -70$	$-25 - 12 = -37$	$-33$
$-0.91 - 1.65 = -21$	$-15 - 17 = -32$	$+5$
$-0.79 - 1.73 = -65$	$-13 - 18 = -31$	$-39$
	$+223 = 1574$	

$$10.99 + 0.75 = +190.$$

$$0.75 + 17.30 = +197.5$$

$$0.75 + 0.00 = +13.0$$

$$+17.25 = +184.5$$

$$0.99 = +190 - 8 = +182$$

$$b = +10.6$$

$$a = +170$$

are measured  $15.7^\circ$

$$\frac{p}{h} = 1179$$

$$\frac{\Sigma v}{h} = +18.9$$

$$\frac{+18.9}{1179} = -0.016$$

$$\Delta P = \pm 0.6$$







# Moon's Mean Position

$$\begin{array}{r} \lambda_0 = 22.9100^{\circ} \\ + 8^{\circ} \\ \hline 22.9108^{\circ} \end{array}$$

$$\begin{array}{r} \gamma_0 = 17.1800^{\circ} \\ + 8^{\circ} \\ \hline 17.1808^{\circ} \end{array}$$

## From Plate Constants

$$\lambda = 22.5732^{\circ}$$

$$\gamma = 17.1648^{\circ}$$

$$\zeta = +.5732^{\circ}$$

$$\eta = -0.8359^{\circ}$$

$$\begin{array}{r} \log \zeta = 9.75834^{\circ} \\ 9.95526^{\circ} \\ \hline 8.50724^{\circ} \\ 1.29581^{\circ} \end{array}$$

$$\begin{array}{r} \log \tan \delta = 9.6801^{\circ} \\ \zeta = 9.5166^{\circ} \\ \hline 7.0538^{\circ} \\ 26.2587^{\circ} \end{array}$$

$$\eta_1 = +0.0002^{\circ}$$

$$\eta_0 = -0.8358^{\circ}$$

$$\begin{array}{r} \log \eta_0 = 9.92200^{\circ} \\ 7.33115^{\circ} \\ \hline 2.59085^{\circ} \end{array}$$

10.

$$\alpha - A = +19.75$$

$$-389.8$$

$$A = 7 \ 08 \ 30^{\circ}$$

$$\delta - D = -6 \ 29.7$$

$$\alpha = 7 \ 08 \ 49.75^{\circ}$$

$$D = 25^{\circ} \ 40 \ 15^{\circ}$$

$$\delta = 25^{\circ} \ 33 \ 45.3^{\circ}$$

$$\text{Red} = +1.95^{\circ}$$

$$\text{Red} = +5.6^{\circ}$$

$$\alpha' = 7 \ 08 \ 51.71^{\circ}$$

$$\delta' = 25^{\circ} \ 33 \ 50.9^{\circ}$$







# Means Mean Position

$$\begin{array}{r} \lambda_0 = 22.9100'' \\ + 8 \\ \hline 22.9108'' \end{array}$$

$$\begin{array}{r} \mu = 17.1800'' \\ + 5 \\ \hline \text{Obs} 17.1805'' \end{array}$$

## Mean Plate Constants

$$\lambda = 22.5732$$

$$\eta = 17.1698''$$

$$\mu = +.5732''$$

$$\eta = -0.8359''$$

$$\begin{array}{r} \log \gamma = 9.75834'' \\ 9.95526'' \\ \hline 8.50724'' \\ 1.29589 \end{array}$$

$$\begin{array}{r} \log \tan \delta = 9.6801'' \\ = 9.5166'' \\ \hline 7.0239'' \\ 26.2501'' \end{array}$$

$$m_1 = .0002''$$

$$m_2 = -0.8356''$$

$$\begin{array}{r} \log m_2 = 9.92200'' \\ 7.33115'' \\ \hline 2.59085'' \end{array}$$

$$\delta - A \quad + 19.76$$

$$-389.81$$

$$A \quad 7.08 \quad 30''$$

$$\delta - D \quad - 6 \quad 29.7$$

$$d \quad 7.08 \quad 49.76''$$

$$D \quad 25 \quad 40 \quad 15''$$

$$\delta \quad 25 \quad 33 \quad 45.3''$$

$$\text{Red} \quad + 1.95''$$

$$\text{Red} \quad + 5.65''$$

$$\delta' \quad 7.08 \quad 51.71''$$

$$\delta' \quad 25 \quad 33 \quad 50.9''$$



$$\begin{array}{r}
 6 \quad 59 \quad 6.48 \\
 \underline{4.13} \\
 2.35
 \end{array}$$

WDM 9  
date,

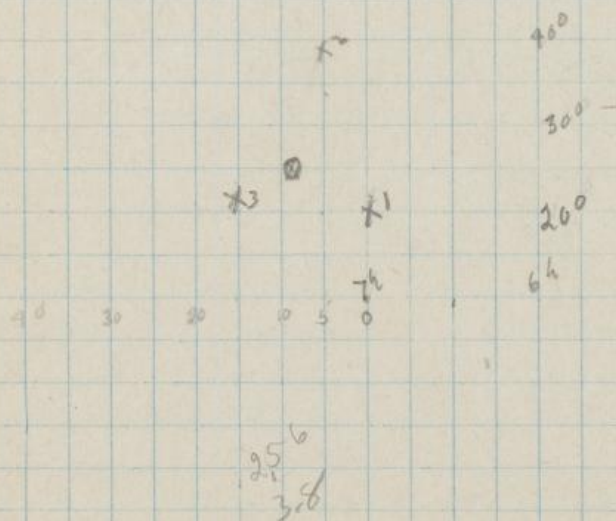
$$\begin{array}{r}
 + 20 \quad 91 \quad 49.1 \\
 \underline{45.3} \\
 3.8
 \end{array}$$

$$\begin{array}{r}
 7 \quad 05 \quad 51.59 \\
 \underline{48.72} \\
 2.87
 \end{array}$$

$$\begin{array}{r}
 + 39 \quad 27 \quad 42.7 \\
 \underline{37.1} \\
 5.6
 \end{array}$$

$$\begin{array}{r}
 7 \quad 15 \quad 51.32 \\
 \underline{29.1} \\
 24.1
 \end{array}$$

$$\begin{array}{r}
 + 22 \quad 08 \quad 26.2 \\
 \underline{23.3} \\
 2.9
 \end{array}$$





8299

9

## Reduction to apparent place

$$= 13^{\circ} 31.5'$$

$$H + \alpha \quad 24 \quad 59.1$$

$$\Delta \quad 17 \quad 45.3$$

$$\alpha \quad 7 \quad 08.83$$

$$G \quad 21 \quad 6.9$$

$$G + \alpha \quad 28 \quad 15.7$$

$$= 63^{\circ} 55.5'$$

$$\cos G + \alpha \quad 9.6430$$

$$g \quad 1.0648$$

$$\sin G + \alpha \quad 9.9534$$

$$\tan \delta \quad 9.6798$$

$$8.8239$$

$$\delta + 25^{\circ} 33 \quad 95.2$$

$$\log \cos \delta \quad 9.9552$$

$$i \quad 0.9101n$$

$$9.2 \quad 0.8653n$$

$$\log \sin \delta \quad 9.6350$$

$$\cos H + \alpha \quad 9.9878$$

$$\Delta \quad 1.2738$$

$$\sin H + \alpha \quad 9.3690$$

$$\sec \delta \quad 0.0748$$

$$8.8239$$

$$\log g' \quad 0.7078$$

$$g \quad 9.5219$$

$$h' \quad 0.8966$$

$$h \quad 9.5115$$

$$f \quad +1.292$$

$$g \quad +0.332$$

$$h \quad +0.324$$

$$+1.948$$

$$g' \quad +5.103$$

$$h' \quad +7.882$$

$$i' \quad -7.334$$

$$+5.651$$







299

## Reduction to Apparent place

 $= 13^{\circ} 31.5''$ 

H + L 29 29.1

H 11 45.3

K 7 08.53

G + L 21 6.9

G + L 28 15.7

 $= 63^{\circ} 55.2''$ 

C (incl G + L) 9.6430

g 1.0644

Star G + L 9.9534

Star L 9.6798

8.8239

 $\delta' + 25^{\circ} 33' 75.2''$ log cos  $\delta = 9.95524$  $= 0.9101n$ 

9.8653n

log  $\sin \delta = 9.6350$ 

cos H + L 9.9878

H 1.2738

sin H + L 7.3690

Sec  $\delta = 0.0988$ 

8.8239

log  $q' = 0.7078$ 

g 9.5289

 $L' = 0.8765$ 

L 9.5118

1 10 1.78

C

A + 1.292

g + 0.332

L + 0.327

S 1.751

 $q' + 5.105$  $L' + 7.882$  $L' - 7.337$ 

+ 7.337







# Lunar Parallaxes

10

$\alpha'$  7 08 51.70"  $\delta'$  25 33 50.9  
 $\theta$  8 40 43.95"  
 $\theta - \alpha' + 1$  31 52.28"  $\pi$  55' 26.4"  
 $=$  22° 58' 03.60"

$\frac{1}{2}(\theta - \alpha')$  8 53.52"  $\log$  9.86913"  
 22° 49' 10.08" 8.20753"  
 9.59130"  
 0.04580"  
 7.71378"

9.95727"  
 0.00000"  
 0.03540"  
 9.99267"

$\alpha - \alpha' =$  + 17 47.96"  
 $=$  + 1 11.48"  
 08 51.70

$\theta = 27^{\circ} 31' 00''$

$\delta = 25^{\circ} 33' 50.9''$

$\theta - \delta = 18^{\circ} 57' 09.1''$

9.82640"  
 8.20753"  
 9.51169"  
 0.15428"  
 7.69974"

$\delta - \delta'$  17 13.1"  
 33 50.9"

$\delta$  25 51 04.0" 07 10 02.85"  
 $\delta$

Am Eph 25 51 07.9" 07 10 01.79"

$\theta - \epsilon$  - 3.4" + 1.06"

2nd Order Ref 0.0  
 curv. of Plate + 0.2 - 0.02

Iss Corr + 0.1 - 0.06

$\delta$  + 25 51 07.1"  $\alpha$  07 10 02.91"  
 $\theta - \epsilon$  - 3.3 + 1.12







# Lunar Parallaxes

10

$\alpha'$  7 08 51.74"  $\delta'$  25 33 50.9  
 $\theta$  8 40 43.95"  
 $\theta - \alpha' + 1$  31 52.29"  $\pi$  55' 26.4"  
 $=$  22° 58' 03.60"

$\frac{1}{2}(\alpha - \alpha')$  8 53.52"  
 22° 49' 10.08"

Log

9.86913"  
 8.20753"  
 9.59130"  
 0.09580"  
 7.71376"

9.95727"  
 0.00000"  
 8.80590"  
 9.99267"

$\alpha - \alpha' = + 17 97.99$

$= + 1. 11.85$

$\gamma = 99^{\circ} 31' 00''$

$\delta = 25^{\circ} 33' 50.9''$

$\gamma - \delta = 18^{\circ} 57' 09.1''$

9.82640"  
 8.20753"  
 9.59169"  
 0.15921"  
 1.69979"

$\delta - \delta' = 17 13.1''$

$\delta$

$\delta = 25^{\circ} 51' 09.0''$

07 10 02.85"

asn Eph 25 51 07.9"

07 10 01.79"

$\phi - c = - 3.4''$

+ 1.86"

curr of plate + 0.2

- 0.02



1  
17.  
27.

2  
19.  
7.

3  
33.  
18.

1/22.  
18.  
7  
may

2  
22  
18

3  
21  
18



8300

## Star Measures

1022

11

1	17.4 27.8	19002 1021820 2220 10 <u>17.3789</u>	17932 1171619 2219 26 <u>17.3790</u>	15540 728078 7678 48 <u>27.8268</u>	16519 1476872 76 22 <u>27.8256</u>
2	19.2 7.8	15998 139706869 6008 <u>19.2032</u>	16038 8092 92 54 <u>19.2042</u>	15526 768285 88 20 <u>7.7836</u>	15840 1365855 5255 36 <u>7.7876</u>
3	33.4 17.3	16868 12698 98 70 <u>33.7170</u>	15088 9267 927067 88 <u>33.7175</u>	15837 13042 3840 24 <u>19.2800</u>	16768 9536 36 72 <u>19.2764</u>

## Moon Measures.

1	22.5 18.9 4 may	18390 9604 0002 70 <u>18.8788</u>	16830 15611710 0610 40 <u>18.8778</u>
2	22 18.7	18710 10380 9286 16 <u>18.8028</u>	15800 1383230 2830 06 <u>18.8028</u>
3	21 18.1	16082 1522028 36 88 <u>18.0859</u>	18032 888887 88 34 <u>18.0857</u>







8300

Star Measures

11

	19002	17932	15540	16519
4	10218 <sup>20</sup>	11716	1280 <sup>18</sup>	17768 <sup>72</sup>
8	22	22 <sup>17</sup>	76	76
	10	26	48	22
	<u>17.3789</u>	<u>17.3790</u>	<u>278268</u>	<u>278256</u>
	15998	16038	85526	15840
2	13970	8092	7682 <sup>85</sup>	13658 <sup>55</sup>
8	18	96	88	52 <sup>55</sup>
	0008	59	20	36
	<u>192032</u>	<u>192092</u>	<u>7.7836</u>	<u>7.7898</u>
	16868	16988	15839	16768
1	12698	9269	13092	9536
3	78	7270 <sup>7</sup>	3890	36
	70	88	29	72
	<u>33.9170</u>	<u>33.9178</u>	<u>172800</u>	<u>19.2769</u>

Moon Measures

18398	16830
9609 <sup>02</sup>	15019 <sup>10</sup>
00	06
70	90
<u>188788</u>	<u>188778</u>
18710	15800
10380 <sup>86</sup>	13832 <sup>30</sup>
92	28
16	06
<u>188028</u>	<u>188028</u>
10082	18022
12220 <sup>28</sup>	8888 <sup>65</sup>
36	88
88	39
<u>18.0859</u>	<u>18.0839</u>



7  
20  
18

5  
20  
17  
X

6  
20  
16

7  
21  
15

8  
22  
15



8300

## Moon Measures.

2

<u>2</u>	17082	17460
20.9	765050	1687080
18	50	16890
	86	64
	<u>20.9436</u>	<u>20.9420</u>

<u>5</u>	16968	16490
20.6	998681	1300299
17	76	96
-X	76	00
	<u>20.6492</u>	<u>20.6506</u>

<u>6</u>	18760	17527	18392
20.9	910099	16930	
16.	098	2226	
	69	32	
	<u>20.9369</u>	<u>20.9402</u>	

<u>7</u>	17588	18682
21	8530	17780
15.9	2829	7075
	89	76
	<u>15.9056</u>	<u>15.9099</u>

<u>8</u>	16960	18790
22	1958776	1058279
15.2	68	76
	62	20
	<u>15.1889</u>	<u>15.1860</u>







8300

2

## Moon Measures

<u>2</u>	170 82	179 60
20.9	76 50 <sub>50</sub>	168 70 <sub>40</sub>
18	50	168 90
	86	64
	<u>20.9436</u>	<u>20.9420</u>

<u>5</u>	169 68	169 90
20.6	99 86 <sub>91</sub>	130 02 <sub>49</sub>
17	76	96
18	76	00
	<u>20.6472</u>	<u>20.6506</u>

<u>6</u>	189 60	175 29	185 92
20.9	91 00 <sub>99</sub>	169 30	
16	0 98	22 <sub>26</sub>	
	69	32	
	<u>20.9069</u>	<u>20.9402</u>	

<u>7</u>		175 88	186 82
21		85 30	177 80
15.9		28 <sub>29</sub>	107 <sub>5</sub>
		89	16
		<u>15.9036</u>	<u>15.9099</u>

<u>8</u>		169 60	187 90
22		148 89 <sub>76</sub>	105 82 <sub>79</sub>
15.2		68	76
		62	20
		<u>15.1889</u>	<u>15.1860</u>







9300

Times &amp; Etc.

13

Mar 24 '15

Exp. to stars.	8	52		9	09	
" " Moon	8	57	31.7 <sup>✓</sup>	8	57	31.7 <sup>✓</sup>
Clock slow			1.3 <sup>✓</sup>			

H. Sid Time	8	57	32.85 <sup>✓</sup>	$\Delta = +1^h$	47 <sup>m</sup>
H. Long	4	44	31.05 <sup>✓</sup>		
G. Sid T.	13	42	03.90 <sup>✓</sup>		
Sid. T. M. Norm	0	3	30.80 <sup>✓</sup>		
Interval	13	38	33.10 <sup>✓</sup>		
Reduction		2	19.10 <sup>✓</sup>		
G. M. T.	13	36	19.00 <sup>✓</sup>		

From Naut Alman.	R. A.	Dec.
Moon 13 <sup>h</sup>	07 09	17.82 25 53 00.8
Motion 1 <sup>m</sup>		+2.2496 - 5.819
" 36 <sup>m</sup> 31.67	+1	21.698 - 3 31.3
Tabular Place 07	10	39.52 +25 49 29.5 <sup>✓</sup>

Moon's Age 9 days.

Parallax	55' 26" 88 <sup>✓</sup>
Semid.	15' 08.1 <sup>✓</sup>
P	908.1 <sup>✓</sup>
Augm.	13.2 <sup>✓</sup>
$\Delta R \approx 2$	-0.1 <sup>✓</sup>
P	921.2 <sup>✓</sup>
P	1.9777 <sup>✓</sup>
$\Delta R$	-972 <sup>✓</sup>
$(1+\Delta)P$	1.8805 <sup>✓</sup>
$P^2$	3.5363 <sup>✓</sup>

939 = 13.95<sup>✓</sup>

$$a = 501.2<sup>✓</sup>$$

$$\begin{array}{r} 24 \\ - 777.2<sup>✓</sup> \end{array}$$







8300

Jupiter &amp; Etc.

13

Mar 24 '15

Exp. to stars	8	52		9	09	
" " Moon	8	57	31.9"	8	57	31.7"
Clock slow			1.3"			

4 sid time	-88	57	32.85"	8-1-	1"	47"
H. Long	4	44	31.05"			
9 sid J.	13	42	03.90"			
Sid J. M. Noon	0	3	30.80"			
Interval	13	38	33.10"			
Reduction		2	19.10"			
g. M. J.	13	36	19.00"			

From Naut Alman.	R. A.	Dec.
Moons 13"	07 09	17.82 25° 53' 00.8
Motion 1 <sup>m</sup>		+2.2496 - 5.819
" 36 <sup>m</sup> 3167	+1	21.698 - 3 31.3
Tabular Place 07	10	39.52 25° 49' 29.5"

Moon's Age 9 days.

Parallax	50' 20" 84"
Semid.	15' 08.1"
R	908.1"
Augm.	132"
Dir	-0.1"
R	9212"
R	1.9747 E
apR	-942"
(1+a)/R	1.8805"
R <sup>2</sup>	3.5363

939: 13.95"

$$a = 501.2$$

$$\frac{24}{-717.2}$$



G-12 - 2m.



$X$	17.3787	19.2037	33.9177
$Y$	17.8975	19.8767	37.7539
$X-Y$	- .5188	- .6727	- 1.3365

$\eta$	27.8262	7.7826	19.2782
$\eta$	28.2759	7.2027	19.3006
$\eta-\eta$	- .4497	+ .5799	- .222

$X-Y$	+ 500X	-16.17	+1.2X	-3073
-5188 + 8689	= +3501	- 998	= +3053 + 20	= +3073
-6727 + 9602	= +3175	- 125	= +3050 + 23	= +3073
-13365 + 16709	= +3344	- 310	= +3034 + 90	= +3074
22.5318	+ 11266	- 274	+ 27	= 23.3267

$\eta-\eta$	+ 500Y	+ 19.0X	.5Y	- 10060
-4497 + 13913	= + 9416	+ 330	= +10096 + 17	= + 10060
+5799 + 3891	= + 9690	+ 365	= +10055 + 4	= + 10059
-222 + 9639	= + 9417	+ 635	= +10050 + 10	= + 10060
16.9961	+ 8498	+ 928	+ 8	= 16.8835

Tables	$a = +.9$	$e = +.9$	$a-e = 0$	$b+d = 0$
Obs	= -501.2	= +500.5	= - 0.7	= - 2.9
	-502.1	-501.4		- 2.9







8300

Data

Constants

19

$$\begin{array}{rcl}
 K & 17.3787 & 19.2037 & 339179 \\
 \gamma & 17.8975 & 17.8967 & 97259 \\
 A-\gamma & -5188 & -6927 & -13365
 \end{array}$$

$$\begin{array}{rcl}
 q & 27.8262 & 7.7826 & 19.2782 \\
 n & 28.2957 & 1.2022 & 19.3006 \\
 q-n & -9197 & +5799 & -229
 \end{array}$$

$$\begin{array}{rcl}
 A-\gamma & +5001 & -1614 & -121 & -3073 \\
 -5188 + 1649 & = +3501 & -998 & -5053 & +26 = +3073 & = 0 \\
 -6927 + 7612 & = +3175 & -125 & -5050 & +23 = +3073 & = 0 \\
 -13365 + 16709 + 3397 & -310 & = +3039 & +90 & = +3079 & = +1 \\
 22.5318 + 11266 & -274 & +27 & & = 23.3269
 \end{array}$$

$$\begin{array}{rcl}
 q-n & +5007 & +19.01 & .57 & -10060 \\
 -9197 + 13915 & = +4718 & +330 & -10094 & +17 = +10060 & = 0 \\
 15799 + 2871 & = +18670 & +365 & -10053 & +9 & +59 = -1 \\
 -229 + 7639 & = +7410 & +635 & -10080 & +10 & +60 = 0 \\
 16.9961 + 8998 & +928 & +8 & & = 16.8835
 \end{array}$$

$$\begin{array}{rcl}
 \text{Tables} & a = +7.7 & e = +7 & q-e = 0 & b+d = 0 \\
 \text{Obs} & = -501.2 & = -500.5 & = -0.7 & = -2.9
 \end{array}$$



$$\alpha = +5^\circ$$

$$\beta = 0$$



8300

## Moon's Center

15

	$x$	$x - x_0$	$\Delta x$	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	$y - y_0$
1	22.5320	0.0000	+1	0.0000	3.5430	+67
2	22.0000	-0.5320	+1	0.2829	3.5477	+111
3	21.0000	-1.5320	+0	2.3470	3.5338	-25
4	20.9928	-1.5392	+0	2.5255	3.5335	-28
5	20.6999	-1.8821	0	3.5423	3.5423	+60
6	20.9383	-1.5937	-0	2.5398	3.5318	-95
7	21.0000	-1.5320	-0	2.3470	3.5318	-95
8	22.0000	-0.5320	-1	0.2831	3.5579	+186

$$R = 3.5363$$

	$y$	$y - y_0$	$\Delta y$	$(y - y_0)^2$	$L$
1	+18.8783	+1.8823	0	3.5430	360 <sup>v</sup>
2	18.8028	+1.8068		3.2645	344 <sup>v</sup>
3	18.0857	+1.0897		1.1868	305 <sup>v</sup>
4	18.0000	+1.0040		1.0080	302 <sup>v</sup>
5	16.9960	0.0000		0.0000	270 <sup>v</sup>
6	16.0000	-0.9960		0.9920	238 <sup>v</sup>
7	15.9075	-1.0885		1.1848	235 <sup>v</sup>
8	15.1872	-1.8088		3.2718	196 <sup>v</sup> 164 <sup>0</sup>

## Approximate Center

$$x = 21 \quad y = 18.0857$$

$$15.9075$$

$$33.9929$$

$$y_0 = 16.9967$$

$$y_{\max} = 18.8783$$

$$R = 1.8819$$

$$x_{\min} = 20.6999$$

$$x_0 = 22.5318$$

## Moon's Center

$$\begin{cases} x_0 = 22.5320 \\ y_0 = 16.9960 \end{cases}$$







8300

Moon's Center

	$x$	$x - x_0$	$\Delta x$	$(x - x_0)^2$	$(x - x_0) + (y - y_0)$	$(y - y_0)$
1	22.5320	0.0000	+1	0.0000	3.5930	+1.67
2	22.0000	-0.5320	+1	0.2829	3.5979	+1.11
3	21.0000	-1.5320	+0	2.3470	3.5338	-2.5
4	20.9928	-1.5392	+0	2.3695	3.5333	-2.8
5	20.6999	-1.8821	0	3.5423	3.5423	+1.60
6	20.9383	-1.5937	-0	2.5418	3.5318	-7.5
7	21.0000	-1.5320	-0	2.3470	3.5318	-9.5
8	22.0000	-0.5320	-1	0.2831	3.5599	+1.86

$$R = 3.5363$$

	$y$	$y - y_0$	$\Delta y$	$(y - y_0)^2$	$L$
1	+18.8783	+1.8823	0	3.5430	360
2	18.8028	+1.8068		3.2645	349
3	18.0857	+1.0899		1.1868	305
4	18.0000	+1.0044		1.0080	302
5	16.8860	0.0000		0.0000	270
6	16.0000	-0.9960		0.9920	238
7	15.9075	-1.0885		1.1848	235
8	12.1872	-1.8028		3.2518	196

Approximate Center

$$x = 21 \quad y = 18.0857$$

$$15.9075$$

$$23.9929$$

$$y_0 = 16.9967$$

$$y_{\max} = 18.8783$$

$$R = 1.8819$$

$$x_{\min} = 20.6999$$

$$x_0 = 22.5318$$

Moon's Center

$$\begin{cases} x_0 = 22.5320 \\ y_0 = 16.9960 \end{cases}$$



# Formation of Normals.

1	0.00	-	000	+	126.0
2	- 0.96	-	59.0	+	201.0
3	- 1.67	+	38.0	-	27.0
4	- 1.59	+	44.5	-	28.0
5	0.00	-	113.0		0.0
6	+ 1.59	+	71.5	+	45.0
7	+ 1.67	+	69.0	+	49.0
8	+ 0.96	-	98.5	-	337.0
	<u>+ 4.22</u>		<u>+ 223.0</u>		<u>+ 421.0</u>
	<u>- 4.22</u>		<u>- 270.5</u>		<u>- 392.0</u>
	0.00		- 47.5		+ 29.0

$$a = 13.86$$

$$B = 14.45$$

	a	b	c	new a-c
	- 6	- 11	+ 35 <sup>v</sup>	+ 98
a	+ 30	- 16	+ 18 <sup>v</sup>	+ 123
b	- 6	- 46	- 8 <sup>v</sup>	- 40
c	+ 75	- 48	- 9 <sup>v</sup>	- 47
	- 56	0	- 11 <sup>v</sup>	+ 73
	- 48	+ 6	+ 3 <sup>v</sup>	- 45
	- 46	+ 4	+ 6 <sup>v</sup>	- 42
	- 16	+ 11	+ 40 <sup>v</sup>	+ 228



8300

## Conditional Equations.

16

					$c$	$0-c$
1	0.00	+ 1.88	= + 67	+ 4	= + 4	+ 63
2	- 0.53	+ 1.81	= + 111	+ 2 + 4	= + 6	+ 105
3	- 1.53	+ 1.09	= - 25	+ 3 + 2	= + 7	- 32
4	- 1.59	+ 1.00	= - 28	+ 3 + 2	= + 7	- 35
5	- 1.88	0.00	= + 60	+ 6 - 0	= + 6	+ 54
6	- 1.59	- 1.00	= - 45	+ 3 - 2	= + 3	- 48
7	- 1.53	- 1.09	= - 43	+ 3 - 2	= + 3	- 48
8	- 0.53	- 1.81	= + 186	+ 2 - 4	= - 2	+ 188
					+ 710	- 163

$$+13.86 + 0 = -47.5 - 9.18\Delta \quad a = -3.9$$

$$0 + 17.95 = +29.0 + 1.88\Delta \quad b = +2.0$$

$$+113\Delta$$

Arc measured 1640

$$\frac{p}{h} = .215$$

$$\frac{\Sigma V}{h} = +30.9$$

$$\text{Inv } 2 \quad R \quad 1.88 \quad \frac{+30.9}{.215} = +144 \quad \Delta R = +1.8$$

$$-2RC = +2.26$$

$$\text{Corr} = .6$$

$$\Delta R = +2.7$$

$$\Delta b = +0.29 \quad \Delta d = +0.1$$

$$\Delta a = -1.79 \quad \Delta d = -0.06$$







8300

## Conditional Equations.

16

1	0.00	+ 1.88	=	+ 67		+ 9	=	+ 9	0-C
2	- 0.53	+ 1.81	=	+ 111		+ 2 + 9	=	+ 4	+ 63
3	- 1.53	+ 1.09	=	- 25		+ 5 + 2	=	+ 7	+ 105
4	- 1.59	+ 1.00	=	- 28		+ 5 + 2	=	+ 7	- 32
5	- 1.88	0.00	=	+ 60		+ 6 - 0	=	+ 6	- 35
6	- 1.59	- 1.00	=	- 95		+ 5 - 2	=	+ 3	+ 59
7	- 1.53	- 1.09	=	- 95		+ 5 - 2	=	+ 3	- 98
8	- 0.53	- 1.81	=	+ 186		+ 2 - 9	=	- 2	- 98
									+ 188
									+ 910 - 163

$$+ 13.86 + 0 = - 97.5 \quad a = - 3.7$$

$$0 + 19.95 = + 29.0 \quad b = + 2.0$$

Arc measured 1690

$$\frac{P}{h} .215$$

$$\frac{EV}{h} = + 30.9$$

$$\frac{+ 30.9}{.215} = + 144$$

$$\Delta R = + 1.8$$







8300

Moon's Mean Position.

17

$$\begin{array}{r} \alpha_0 = 22.5320'' \\ \quad \quad \quad - 2'' \\ \hline 22.5318'' \end{array}$$

$$\begin{array}{r} \eta_0 = 16.9960'' \\ \quad \quad \quad + 1'' \\ \hline 16.9961'' \end{array}$$

From Plate Constants.

$$\chi = 23.3267''$$

$$\eta = 16.8835''$$

$$\xi = +1.3267''$$

$$\eta = -1.1165''$$

$$\log \xi = 0.12267''$$

$$\log \tan \delta \quad 9.67850''$$

$$\cos \delta \quad 9.95540''$$

$$\xi'' \quad 0.2453''$$

$$8.50729''$$

$$7.0534''$$

$$\log d-A \quad 1.56003''$$

$$6.9772''$$

$$d-A \quad +45.71''$$

$$\eta_1 +.0009''$$

$$\eta_0 -1.1174''$$

$$A \quad 07 \quad 08 \quad 30''$$

$$\log \eta'' \quad 0.04821''$$

$$7.33115''$$

$$\alpha_0 \quad 07 \quad 09 \quad 15.71''$$

$$2.71706''$$

$$\text{Red} \quad +1.95''$$

$$s-D \quad -8 \quad 41.3''$$

$$\delta' \quad 07 \quad 09 \quad 17.66''$$

$$D +25 \quad 40 \quad 15''$$

$$\delta_0 +25 \quad 31 \quad 33.7''$$

$$\text{Red} \quad +5.6''$$

$$\delta' +25 \quad 31 \quad 39.3''$$







8300

Moon's Mean

Position.

17

$$\begin{array}{r} \gamma_0 = 22\ 53\ 20'' \\ - 2'' \\ \hline 22\ 53\ 18'' \end{array}$$

$$\begin{array}{r} \gamma_0 = 16.9960'' \\ + 1'' \\ \hline 16.9961'' \end{array}$$

From Plate Constants

$$x = 23.3269''$$

$$y = 16.8835''$$

$$z = +1.3269''$$

$$n = -1.1165''$$

$$\log \tan \delta \quad 9.67855$$

$$z'' \quad 0.2453''$$

$$7.0539''$$

$$69.772''$$

$$\log \tau = 0.12267''$$

$$\cos \quad 995590''$$

$$8.50729''$$

$$\log 1-A \quad 1.56003''$$

$$n_1 + 0009''$$

$$n_0 - 1.1179''$$

$$\delta-A \quad +95.71''$$

$$\log n_0 \quad 0.09821''$$

$$7.33115''$$

$$2.71706''$$

$$A \quad 07\ 08\ 30''$$

$$\gamma_0 \quad 07\ 09\ 15.71''$$

$$S-D \quad -8\ 91''$$

$$Red \quad +1.95''$$

$$D + 25\ 40\ 15''$$

$$\delta_0 + 25\ 31\ 33''$$

$$\delta' \quad 07\ 09\ 17.66''$$

$$Red \quad +5.4''$$

$$\delta' + 25\ 31\ 39.3''$$



$$\begin{array}{r}
 7 \quad 05 \quad 51.61 \\
 \underline{48.72} \\
 2.89
 \end{array}$$

$$\begin{array}{r}
 +39 \quad 27 \quad 42.5 \\
 \underline{37.1} \\
 5.9
 \end{array}$$

$$\begin{array}{r}
 7 \quad 08 \quad 31.83 \\
 \underline{29.52} \\
 2.31
 \end{array}$$

$$\begin{array}{r}
 16 \quad 18 \quad 17.8 \\
 \underline{14.9} \\
 2.9
 \end{array}$$

$$\begin{array}{r}
 7 \quad 23 \quad 41.97 \\
 \underline{38.77} \\
 2.68
 \end{array}$$

$$\begin{array}{r}
 31 \quad 57 \quad 20.2 \\
 \underline{16.9} \\
 3.3
 \end{array}$$

$$.1 \quad -70^{\circ}$$

$$-36$$

$$3 \quad -32$$

$$-28$$

$$-24$$

$$-20$$

$$.2$$

$$25 \quad 20 \quad 15 \quad 10 \quad 5 \quad 7^h \quad -16^{\circ}$$



## Reduction to Apparent Place.

$$\begin{array}{rcl}
 & 13^{\circ} & 37.5' \\
 H + \alpha & 24 & 54.5 \\
 H & 17 & 45.3 \\
 \alpha & 7 & 09.2 \\
 G & 21 & 06.9 \\
 G + \alpha & 28 & 16.1 \\
 & 69^{\circ} & 01.5'
 \end{array}$$

$$\begin{array}{rcl}
 \log \cos (G + \alpha) & 9.6419 \\
 " \quad g & 1.0655 \\
 " \quad \sin & 9.9537 \\
 " \quad \tan \delta & 9.6790 \\
 & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 \log g' & 0.7069 \\
 " \quad g & 9.5221
 \end{array}$$

$$\begin{array}{rcl}
 f & + & 1.292 \\
 g & + & .332 \\
 h & + & .327 \\
 \hline
 & + & 1.951
 \end{array}$$

$$\begin{array}{rcl}
 \delta + 25^{\circ} & 31 & 33. \\
 \log \cos \delta & .99554 \\
 & \underline{1.091017} \\
 & 1.086567
 \end{array}$$

$$\begin{array}{rcl}
 \log \sin \delta & 9.6344 \\
 " \quad \cos (H + \alpha) & 9.9876 \\
 " \quad h & 1.2738 \\
 " \quad \sin & 9.3721 \\
 " \quad \sec \delta & 0.0746 \\
 & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 h' & 0.8958 \\
 h & 9.5144
 \end{array}$$

$$\begin{array}{rcl}
 g' & + & 5.093 \\
 h' & + & 7.867 \\
 i & - & 7.337 \\
 \hline
 & + & 5.623
 \end{array}$$







## Reduction to Apparent Place

18

$$\begin{array}{rcl}
 & 13^{\circ} & 37.5' \\
 H + \alpha & 29 & 59.5 \\
 H & 17 & 45.3 \\
 \alpha & 7 & 09.2 \\
 G & 21 & 06.9 \\
 \gamma + \alpha & 28 & 16.1 \\
 & 69^{\circ} & 01.5'
 \end{array}$$

$$\begin{array}{rcl}
 \log \cos (H + \alpha) & 9 & 6919 \\
 " & g & 10655 \\
 " & \sin & 99537 \\
 \tan \delta & & 96790 \\
 & & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 \log q' & 0.7069 & '' \\
 " & q & 9.5221
 \end{array}$$

$$\begin{array}{rcl}
 f & + & 1.292 \\
 g & + & .332 \\
 h & + & .329 \\
 \hline
 & + & 1.951
 \end{array}$$

$$\begin{array}{rcl}
 \delta + 25^{\circ} & 31 & 33 \\
 \log \cos \delta & 9 & 9359 \\
 " & \alpha & 0.91017 \\
 " & \alpha & 0.86557
 \end{array}$$

$$\begin{array}{rcl}
 \log \sin \delta & 9 & 6349 \\
 \cos (H + \alpha) & 9 & 9876 \\
 " & & 1.2738 \\
 \sin & " & 9.3721 \\
 \sec \delta & & 0.0946 \\
 & & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 h' & 0.8958 \\
 h & 9.5194
 \end{array}$$

$$\begin{array}{rcl}
 g' & + & 5.093 \\
 h' & + & 7.867 \\
 i & - & 7.337 \\
 \hline
 & + & 5.623
 \end{array}$$







8300

## Lunar Parallax.

19

$$\begin{array}{rcl}
 \alpha' & 07 & 09 & 17.66'' \\
 \delta & 8 & 57 & 32.85'' \\
 \delta - \alpha' & 1 & 48 & 15.19'' \\
 = & 27 & 03 & 47.85''
 \end{array}$$

$$\begin{array}{rcl}
 \delta' & 25 & 31 & 39.3'' \\
 \pi & & 55 & 26.9''
 \end{array}$$

$$\frac{1}{2}(\delta - \alpha') \quad 10' \quad 21.92''$$

$$26 \quad 53 \quad 23.93''$$

$$9.95727''$$

$$0.00000''$$

$$004970''$$

$$\hline 0.00697''$$

$$\gamma \quad 95^\circ \quad 27' \quad 36.0''$$

$$\delta \quad 25 \quad 31 \quad 39.3''$$

$$\gamma - \delta \quad 19 \quad 55 \quad 56.7''$$

$$9.82690''$$

$$8.20760''$$

$$953268''$$

$$0.14706''$$

$$\hline 7.71349''$$

$$9.86913''$$

$$8.20760''$$

$$965798''$$

$$0.04563''$$

$$\sin(\delta - \alpha') \quad 7.78037''$$

$$\delta - \alpha' = \quad + 20 \quad 43.84''$$

$$= \quad + 1 \quad 22.92''$$

$$9 \quad 17.66$$

$$(\delta - \delta') \quad 31 \quad 39.3 \quad \alpha \quad 07 \quad 10 \quad 40.58''$$

$$\delta \quad 25 \quad 49 \quad 26.2''$$

$$\text{Am. Eph} \quad 25 \quad 49 \quad 29.5''$$

$$07 \quad 10 \quad 39.52''$$

$$\alpha - \alpha' \quad -3.3$$

$$\alpha - \alpha' \quad +1.06''$$

$$2^{\text{nd}} \text{ Order Ref} \quad 0.0$$

$$\text{Curv. of Plate} \quad +0.2$$

$$-1.02$$

$$\text{Imm. Corr} \quad +0.1$$

$$-0.06$$

$$\delta \quad +25 \quad 49 \quad 26.3$$

$$\alpha \quad 7 \quad 10 \quad 40.52$$

$$\alpha - \alpha' \quad -3.2$$

$$+1.00$$







8300

## Lunar Parallax

19

$\lambda'$	07	09	17.66"	$\delta'$	25	31	39.3"
$\pi$	8	57	32.85"				
$\theta - \lambda'$	1	98	15.19"	$\pi$	55	26.9"	
$=$	27°	03'	47.85"				

 $\frac{1}{2}(\lambda - \lambda')$  10 29.92"

26 53 28.93"

9.95727"

0.00000"

0.99970"

0.00027"

 $\lambda$  95° 27' 36.2" $\delta$  25 31 39.3" $\mu$  19 55 56.7"

9.82690"

0.20760"

9.53968"

0.19706"

7.71379"

9.86913"

8.20760"

9.65798"

0.07563"

Sum  $(\lambda - \lambda')$  7.78037" $\lambda - \lambda' = +20$  93.85"

+1 22.92"

1 17.66"

$(\delta - \delta')$	17	46.9"	$\lambda$	07	10	40.58"
$\delta$	25	49	26.2"			
Am Eph	25	49	27.5"		07	10 39.52"

 $\theta - \epsilon$  -3.3  $\theta - \epsilon$ 

+1.06"

Curv. of Plate +0.2

-0.2



















17916  
 1175256  
 6056  
 22  
 .6164

Star 1 <sup>1</sup> remeasured <sup>2</sup>  
 18172 17532  
 974850 1594642  
 52 38  
 62 26  
1588 191590



8306

## Star Measures.

10 = 4

21

1	16910	16244	16188	17050
18.6	1073041	1242026	1457276	862023
19.2	52	32	80	2623
	08	42	92	98
	<u>18.6168</u>	<u>18.6184</u>	<u>19.1612</u>	<u>19.1577</u>
2	16202	16126	16850	17166
29.7	9212	1313230	1982224	916869
10.2	12	13128	2624	7069
	20	32	60	68
	<u>29.7000</u>	<u>29.7002</u>	<u>10.2028</u>	<u>10.2002</u>
3	16556	15968	16522	17884
29.2	1456266	796461	11579089	860809
19.04	70	58	88	1009
	62	70	26	910
	<u>29.1990</u>	<u>29.1992</u>	<u>19.0734</u>	<u>19.0700</u>

## Moon Measures.

1		16468	18438
21		8202	16740
15.8		04037	5246
		94	60
		<u>15.8286</u>	<u>15.8304</u>
2	16522	16792	
20.8	867239	1474449	
16	3639	5449	
	30	810	
	<u>20.7888</u>	<u>20.7952</u>	
3	15540	15784	
20.3	1335854	8020	
17.0	5054	20	
	50	802	
	<u>20.2188</u>	<u>20.2222</u>	







8366

## Star Measures.

10 = 9

21

1	1681100	16249	16188	17050
18.6	1073091	1292026	19572	86203
19.6	52	526	5076	2623
	298	92	92	98
	<u>186168</u>	<u>186189</u>	<u>19.1612</u>	<u>19.1579</u>

2	16242	16126	16850	17166
29.7	9212	1313230	1982229	91689
10.2	12	12128	2629	7069
	20	32	60	68
	<u>297000</u>	<u>297002</u>	<u>10.2028</u>	<u>10.2002</u>

3	16556	15968	16522	17889
29.2	1956266	7969	11579089	86089
19.01	70	5801	8889	1009
	62	70	26	910
	<u>29.1990</u>	<u>29.1992</u>	<u>19.0739</u>	<u>19.0700</u>

## Moon Measures.

1		16768	118936
21		8202	1678496
15.8		09037	5296
		93	60
		<u>15.8286</u>	<u>15.8309</u>

2	16572	16792
20.8	867239	1979999
16	3639	599
	30	810
	<u>20.7888</u>	<u>20.7952</u>

3	15590	15789
26.3	1335857	8020
17.0	5057	20
Xmm	50	802
	<u>20.2188</u>	<u>20.2222</u>



2  
2  
17  
2  
5  
20  
18  
6  
21  
19  
7  
22  
19  
8  
22  
19  
\*2  
8  
16  
10



8306

Moon Measures

22

4	15562	15790
20.31	13838	7518 <sup>15</sup>
17.5	38	12
x	50	804
	<u>20.1722</u>	<u>20.1712</u>

5	15564	15790
20.3	12973	8422 <sup>22</sup>
18	3640	22
	62	96
	<u>20.2624</u>	<u>20.2626</u>

6	17716
21	1735246
19.04	40
	20
	<u>19.0070</u>

17716	15832
1735246	5880
40	9085
20	838
<u>19.0070</u>	<u>19.0078</u>

2
22
19.3

19516	15836
11028	9332 <sup>27</sup>
28	22
28	52
<u>19.3492</u>	<u>19.3480</u>

8
221
19.34

16786	15826
12979	9360 <sup>59</sup>
4072	58
97	50
<u>19.3576</u>	<u>19.3516</u>

5th Star

166	19368	17508
10.7	12988	13902
	9692	02
	88	08
	<u>16.6388</u>	<u>16.6394</u>

19548	17366
1366263	1327039
67	38
58	60
<u>10.5890</u>	<u>10.5876</u>







8306

Moon Measure

2

2	15562	15790
20.31	13838	7518.15
17.5	38	12
x	50	809
	<u>201722</u>	<u>201712</u>

5	15569	15790
20.3	12993	8922.22
18	3690	22
	62	76
	<u>202629</u>	<u>202626</u>

4	19466
21	19466
19.01	9096
	80
	<u>190070</u>

17916	15832
1735246	2880
40	9085
20	838
<u>19.0070</u>	<u>19.0048</u>

2	19516	15836
22	11028	9332.27
19.3	28	22
	28	32
	<u>19.3972</u>	<u>19.3980</u>

3	16786	15826
22+	1299942	9360.59
19.3+	4092	38
	99	50
x	<u>19.3596</u>	<u>19.3516</u>

8th Star

16.6	19368	17508
10.7	12988	13902
	9692	02
	88	08
	<u>16.6388</u>	<u>16.6399</u>

19548	17366
1366263	13270.39
67	38
58	60
<u>10.5890</u>	<u>10.5876</u>







8306

Times &amp; Etc.

73

Mar 26 '15

Export Stars	08	26		08	38	
" " Moon	8	30	43.8	08	30	49.0
clock fast			.2			

H. Sid. Time	8	30	43.7	$\delta - \alpha = -$	24 <sup>m</sup>	28 <sup>s</sup>
H. Long	4	44	31.05			
G. Sid. T.	13	15	14.75			
Sid. T. M. Nom	0	11	23.90			
Interval	13	03	50.85			
Reduction		02	08.41			
G. M. T.	13	01	42.44			

From Naut Almanac R.A.

Dec.

Moon 13 <sup>h</sup>	08	55	08.35	+18	47	15.0
Motion m/m			+2.1543			-11.772
" " 1.7073			+3.69			-20.1
Tabular Place	08	55	12.03	+18	46	54.9

Moon's age 11 days

939 = 14,25

Parallax	56'	59".58
Semid.	15'	33.3"
R.	933.3	
Aug.	14.2	
Gr (4)	-0.6	
R	946.9	
R	2.0298	
AR	-967	
V+AR	1.9337	
R <sup>2</sup>	3.7381	

a = -499.1

24

-475.1







306

Juno 7 Etc.

23

Mar 26 '15

Star	08	26		08	38
.. Moon	8	30	93.8	08	30 99.0
lock fast			.2		

Sid Time	8	30	93.7	✓	$\theta - \alpha = - 24^m$	$28^s$
Long	9	72	311.05			
Sid J	13	15	18.75	✓		
d J M m	0	11	23.90	✓		
Interval	13	03	50.85	✓		
Reduction		02	08.91	✓		
g M J	13	01	92.94	✓		

on Naut Almanac R.A.

Dec.

Moon 13	08	55	08.35	+18	47	15.0
motion in 1 <sup>m</sup>			+2.1543			-11.792
"			+3.69			-20.1
atular Place	08	55	12.03	+18	46	51.9

Moon's Age 11 days

29 = 14.25

Parallax	58'	39.51
Semi-d	12'	33.3
R	933.3	✓
Aug	14.2	✓
Br (1)	-0.6	✓
R	946.9	✓
R	2.0298	✓
atR	-967	✓
4+atR	1.9339	✓
R	3.7381	✓

4 - 799.1

24

- 775.1







8306

Plate center

27

X	Y	d	D
18,6176	19,1393	08 53	29.9
29,7001	10,2015	8 56	57.5
29,1991	19,0717	8 59	34.5
3) 72,3168	48,4325	3) 168	121.9
29,1722	16,1442	8 56	40.6
22	18	-1	7.3
+ 2,172	+ 1,856	8 55	33.3
315	966.5		
- 1" 7.3	+ 19' 23.02		

16,6391

10,5883

 Plate center { A = 8 55 33.  
 D = 18 27 46

$$\begin{aligned}
 X-3 + 500X &+ 46.74 &- .9X &- 13866 \\
 + 3678 + 9309 &= +12987 + 895 = +13882 - 16 = +13866 = 0 \\
 + 1062 + 12350 &= +13412 + 476 = +13888 - 22 = +13866 = 0 \\
 - 1597 + 14660 &= +13063 + 891 = +13894 - 27 = +13867 = +1 \\
 22,1063 + 11053 &+ 814 = 21,9044
 \end{aligned}$$

$$5068 + 8320 = 13388$$

$$\begin{aligned}
 Y-7 + 500Y &- 57.27 &- .84 &- 6670 \\
 - 1972 + 9580 &= +7608 - 953 = +6655 - 15 = +6640 = 0 \\
 + 2893 + 5701 &= +8594 - 1265 = +7329 - 8 = +7321 = 0 \\
 - 1356 + 9536 &= +8180 - 1495 = +6685 - 15 = +6670 = 0 \\
 17,4189 + 8709 &- 1132 = 17,5077
 \end{aligned}$$

$$ab \quad a = 799.1 \quad e = 500.1 \quad a-e = +1.0 \quad b+d = +3.0$$

$$\begin{aligned}
 Tables \quad a &= +7 \quad e = +4.5 \quad a-e = +2.5 \quad b+d = +0.5 \\
 (lks) \quad &= -799.1 \quad = -500.1 \quad = +1.1 \quad = +4.5
 \end{aligned}$$

$$\begin{aligned}
 -1972 + 9580 &= +7608 - 931 = 6707 + 6 = 6713 + 2 = 6715 = -9 \\
 + 2893 + 5701 &= +8594 - 1235 = 7359 + 7 = 7366 + 1 = 7367 = -9 \\
 - 1356 + 9536 &= +8180 - 1460 = 6720 + 9 = 6729 + 2 = 6731 = +9 \\
 + 2266 + 5297 &= +7563 - 802 = 6761 + 5 = 6766 + 1 = 6767 = +10 \\
 17,4189 + 8709 &- 1099 = 17,5077 + 2 = 17,5072
 \end{aligned}$$

$$O-C = -799.8 \quad -500.6 \quad +2.5$$



Cape No 1237- 6.3

08 50 31.03

49. 31.10

31.03

08 51 31.05

+ 50.67

08 52 21.72

8 55 33.

- 03 11.28

- 191.27

2.28 169 n

9.97 749

0.76837 n

- 5.86 69

- 13

16.1323

16.6391

+ 5.068

+17 31 92.8

49 43.3

92.8

17 31 93.0

- 3 25.5

17 28 17.5

18 27 96.

0 59 28.5

- 35.689

3.55 254 n

0.88369 n

9.9980

1.5367

8.0801

- 7.6505

+ 0.0122

10.3617

10.5883

+ 2266



8306

Plate center

29

$\lambda$	$\gamma$	$\alpha$	$\delta$
18.6176	19.1393	08 53 29.9	18 38 19.9
29.7001	10.2015	8 56 57.5	17 29 59.7
29.1991	19.0717	8 59 34.2	18 36 59.6
317.25168	98.4325	31 168 121.9	31 98 129.2
29.1722	16.1492	8 56 40.6	18 13 23.1
23	18	-1 7.3	+19 23.0
+2.172	+1856	8 55 33.3	18 27 46.1
315	966.2		
-1' 7.3	+19' 23.02		

Plate center  $\begin{cases} A = 8 55 33. \\ D = 18 27 46 \end{cases}$

$$\begin{aligned} & \lambda - 3 + 500\lambda & + 767\gamma & - .9\alpha & - 1386\delta \\ & + 3678 + 9309 = +12995 + 895 = +13882 - 16 = +13866 = 0 \\ & + 1062 + 12357 = +13912 + 976 = +13888 - 22 = +66 = 0 \\ & - 1597 + 19600 = +13003 + 891 = +13894 - 27 = +67 = +1 \\ & 22.1063 + 11053 & + 814 & - 20 & = 21.9094 \end{aligned}$$

$$5068 + 8320 = 13388$$

$$\begin{aligned} & \gamma - n & + 500\gamma & - 57.2\lambda & - .8\alpha & - 601\delta \\ & - 7892 + 9580 = 7638 - 953 = +6685 - 15 = +6670 = 0 \\ & + 2893 + 5100 = 7993 - 1265 = +6678 - 8 = +6670 = 0 \\ & - 1356 + 9536 = 8180 - 1995 = +6685 - 15 = +6670 = 0 \\ & 17.9189 + 8709 & - 1132 & - 19 & = 17.5079 \end{aligned}$$

$$\text{Obs } a = 799.1 \quad e = 500.1 \quad a - e = -1.0 \quad b + d = +3.0$$

$$\begin{aligned} \text{Tables } a &= 7.1 & e &= +5 & a - e &= +1.2 & b + d &= 0 \\ (\text{Obs}) &= -799.1 & &= -999.2 & &= +1 & &= +9.5 \end{aligned}$$

$$\begin{aligned} & -50\lambda & +.3\alpha & +.1\gamma & -672\delta \\ & +9580 - 7638 - 931 = 6707 + 6 = 6713 + 2 = 6715 = - \\ & +5101 + 7993 - 1235 = 6708 + 7 = 6715 + 1 = 15 = -9 \\ & +9536 + 8180 - 1960 = 6720 + 9 = 6729 + 2 = 31 = +9 \\ & 2266 & = +7560 - 832 & 6728 + 3 & 6733 + 1 & 3\lambda = +16 \\ & 17.9189 + 8709 & - 1132 & 1099 & + 2 & = 17.507 \end{aligned}$$



Cape No 1237- 6.3

08 51 31.03

ag. 31.10

31.03

08 51 31.05

+ 50.67

08 52 21.72

8 55 33.

- 03 11.28

- 191.27

2.28 169 n

1 -5.87 -7.63 -13 +8 = -5 +3 = -2 -3 9.97 949

2 -3.75 +1.35 -1 +5 = +4 -1 = +3 = 0.76837 n

3 +2.59 -8.09 +5 -3 = +2 +3 = +5

4 +7.36 +1.19 +10 -10 = 0 -1 = -1 = -5.8664

M -0.10 -0.49 0 0 -1 -13

16.1323

16.6391

+ 50.68

 $\Delta y$  -24 -12.5 0

-17 +15 = -2 +1 = -1

+ 0 0 = 0 +1 = +1

-17 +16 = +2 -1 = +1

+ 1 -0 = +1 -1 = 0

0 +1 +0 +1

+17 31 92.8

ag. 43.3

92.8

17 31 43.0

-3 25.5

17 28 17.5

18 27 46.

0 59 28.5

-35 68.9

3.55 25.4 n

0.88 36.9 n 3.71

9.4980

1.5367

8.0801

-7.6505 - 8

+ 0.0122

10.3617

10.5883

+ 2.266



8306	Standard Coordinates	25
Cape No 1241-Mg 6.5	Cape No. 1275-Mg 7.1	Cape No 1279-Mg 9.1
C 08 52 38.92	08 56 06.97	08 58 43.59
L 38.88	06.97	43.58
B 38.89	06.95	43.56
Mean 08 52 38.90	08 56 06.96	08 58 43.58
Prec. +51.02	+50.57	+50.89
$\alpha$ 08 53 29.92	08 56 57.53	08 59 39.47
A 8 55 33.	8 55 33.	8 55 33.
$\alpha-A$ -02 03.08	+01 24.53	+04 01.47
$\sin(\alpha-A)$ -123.08	+84.53	241.46
Log " 2.09029	1.92701	2.38285
Cosd 9.97661	9.97962	9.97666
$\Sigma_0$ 0.57404	0.41387	0.86675
$\Sigma_0$ -3.7501	+2.5934	+7.3578
$\Sigma_1$ -0	+5	+10
$\Sigma_2$ 18.2498	24.5939	29.3588
$\Sigma_3$ 18.6176	24.7001	29.1991
$\Sigma_4$ +3.677	+1.062	-1.597
C +18 41 41.0	+17 28 23.7	+18 40 31.8
L 41.0	24.0	31.4
B 41.0	23.7	31.0
Mean 18 41 41.0	17 28 23.7	18 40 31.4
Prec -03 26.1	-03 29.0	-03 31.8
$\delta$ 18 38 14.9	17 24 54.7	18 36 59.6
D 18 27 46	18 27 46.	18 27 46.
$\delta-D$ +10 28.9	-1 02 51.3	+09 13.6
$\tan(\delta-D)$ +628.9	-3771.7	+553.6
Log " 2.79858	3.57654	2.74320
$\eta_0$ 0.12973	0.90769	0.07435
$\tan \delta$ 9.5280	9.4965	9.5279
$\eta_1$ 1.148	0.8277	1.7335
$\eta_2$ 7.7295	7.3776	8.3143
$\eta_0$ +1.3481	-8.0852	+1.1867
$\eta_1$ +0.0054	+0.0024	+0.0206
$\eta_2$ 19.3535	9.9172	19.2073
$\eta_3$ 19.1593	10.2015	19.0717
$\eta_4$ -1.972	+2.843	-1.356







8306

## Standard Coordinates

25°

Cap No	1291-mg 6.5	Cap No	1295-mg 7.1	Cap No	1299-mg 9.
C	08 52 38.92	08 56 06.97	08 58 43.59		
L	38.88	06.97	43.58		
E	38.89	06.95	43.54		
mean	08 52 38.90	08 56 06.96	08 58 43.58		
sec	+51.02	+50.57	+50.89		
L	08 53 29.92	08 56 57.53	08 59 39.97		
A	8 55 33.	8 55 33.	8 55 33.		
-A	-02 03.08	+01 29.53	+09 01.97		
in (A-A)	-123.08	+84.53	291.96		
g	2.0701	1.9211	2.38285		
Cost	9.97661	9.97762	9.97662		
g <sub>0</sub>	0.57907	0.91397	0.86675		
g <sub>1</sub>	-3.7504	+2.5737	+7.3578		
g <sub>2</sub>	-0	+5	+10		
g <sub>3</sub>	18.29998	29.5731	29.3588		
g <sub>4</sub>	18.6174	29.7001	29.1991		
-g <sub>5</sub>	+3.6778	+1.062	-1.597		
C	+18 91 41.0	+17 28 23.7	+18 90 31.8		
L	91.0	29.0	31.9		
E	91.0	23.7	31.0		
mean	18 91.91.0	17 28 23.7	18 90 31.9		
sec	-03 26.1	-03 29.0	-03 31.8		
L	18 38 14.9	17 29 54.7	18 36 59.6		
D	18 27 46	18 27 46	18 27 46		
-D	+10 28.9	-1 02 51.3	+09 13.6		
in (D-D)	+628.9	-377.17	+523.6		
g	1.955	3.57659	2.77320		
g <sub>0</sub>	0.12973	0.90769	0.07935		
and	9.5280	9.9905	9.527.7		
g <sub>2</sub>	1.1481	0.8277	1.7335		
g <sub>3</sub>	7.7295	7.5716	8.3193		
g <sub>4</sub>					
g <sub>5</sub>	+1.5451	-2.0822	+1.1848		
g <sub>6</sub>	+0.0054	+0.0029	+0.0206		
g <sub>7</sub>	19.3535	9.9172	19.2073		
-g <sub>8</sub>	17.1573	10.2015	17.0717		
-g <sub>9</sub>	-1.992	+2.843	-1.356		



$$\alpha = 0$$

$$\beta = +1.2$$



8306

Moon's center

	$x$	$x - x_0$	$\Delta x$	$(x - x_0)^2$	$(x - x_0)^2$	$0 - e$
1	21,0000	- 1,1060	0	1,2232	3,7465	+ 84
2	20,7920	- 1,3140	0	1,7266	3,7373	- 8
3	20,2205	- 1,8855	0	3,5551	3,7298	- 83
4	- 20,1717	- 1,9343	0	3,7415	3,7415	+ 34
5	20,2626	- 1,8439	0	3,3981	3,7368	- 13
6	21,0000	- 1,1060	0	1,2232	3,7446	+ 65
7	22,0000	- 0,1060	0	0,0112	3,7384	+ 3
8	22,1060	0,0000	0	0,0000	3,7446	+ 65

 $R^2 = 3,7381$ 

	$y$	$y - y_0$	$\Delta y$	$(y - y_0)^2$	$(y - y_0)^2$	
1	15,8295	- 1,5885	0	2,5233	215	
2	16,0000	- 1,4180	0	2,0107	223	
3	17,0000	- 0,4180	0	0,1747	258	
4	17,9180	0,0000	0	0,0000	270	
5	18,0000	+ 0,5820	0	0,3387	287	
6	19,0059	+ 1,5879	0	2,5219	325	
7	19,3786	+ 1,9306	0	3,7272	357	
8	+ 19,3531	+ 1,9351	0	3,7446	360	1750

Approximate Center

$$x = 21 \quad y = 15,8295$$

$$\begin{array}{r} 19,0059 \\ \hline 34,8354 \end{array}$$

$$y_0 = 17,9177$$

$$y_{\max} = 19,3531$$

$$R = 1,9359$$

$$x_{\min} = 20,1717$$

$$x_0 = 22,1061$$

$$\text{Moon's Center} = \begin{cases} x_0 = 22,1060 \\ y_0 = 17,9180 \end{cases}$$







8306

Moon's Center

	$x$	$x - x_0$	$x^2$	$(x - x_0)^2$	$(x - x_0)^3$	$\sigma \cdot C$
1	21.0000	-1.1060	0	1.2232	37965	+ 89
2	20.7920	-1.3140	0	1.7266	31373	- 8
3	20.2200	-1.8860	0	3.5551	31298	- 83
4	20.1717	-1.9343	0	3.7415	37915	+ 39
5	20.2626	-1.8434	0	3.3981	37368	- 13
6	21.0000	-1.1060	0	1.2232	37946	+ 65
7	22.0000	0.1060	0	0.0112	37384	+ 3
8	22.1060	0.2060	0	0.0000	37446	+ 65

 $N = 3.7381$ 

	$y$	$y - y_0$	$y^2$	$(y - y_0)^2$	$(y - y_0)^3$	
1	15.8295	-1.5885	0	2.5233	215	
2	16.0000	-1.4180	0	2.0107	223	
3	17.0000	-0.4180	0	0.1747	258	
4	17.9180	0.0000	0	0.0000	270	
5	18.0000	+0.5820	0	0.3387	287	
6	+19.0059	+1.5879	0	2.5219	325	
7	19.3916	+1.9306	0	3.7272	357	
8	+19.3531	+1.7351	0	3.7996	360	

Approximate Center

$$\begin{aligned}
 x &= 21 & y &= 15.8295 \\
 & & & \underline{19.4059} \\
 & & & 34.8354 \\
 y_0 &= 17.9177
 \end{aligned}$$

$$\begin{aligned}
 y_{mean} &= 19.3531 \\
 R &= 1.9359 \\
 x_{mean} &= 20.1717 \\
 x_0 &= 22.1061
 \end{aligned}$$

$$\text{Moon's Center} = \begin{cases} x_0 = 22.1060 \\ y_0 = 17.9180 \end{cases}$$



# Formation of Normals.

1	+ 1.76	- 93.0	- 133.5
2	+ 1.86	+ 10.5	+ 11.5
3	+ 0.79	+ 157.0	+ 35.0
4	0.00	+ 65.5	00.0
5	- 1.07	+ 24.0	- 7.5
6	- 1.76	- 72.0	+ 103.5
7	- 0.33	- 00.2	+ 5.8
8	0.00	00.0	+ 126.5
	+ 4.41	+ 257.0	+ 282.3
	- 3.16	- 165.2	- 141.0
	+ 1.25	+ 91.8	+ 141.3

		a	b	c	new
a	- 10	+ 11	- 6	- 10	10-c = 4.88 ✓
b	+ 7	+ 13	- 6	- 8	+ 97.507 ✓
c	- 15	+ 19	- 2	+ 2	+ 7
		+ 19	0	+ 7	- 67
		+ 18	+ 2	+ 5	+ 79
		+ 11	+ 6	+ 2	- 3
		+ 1	+ 8	- 6	+ 59
		+ 0	+ 8	- 7	- 19
					+ 41 ✓

$$+ 17.88 + 1.25 = - 9.30$$

$$17.88 = - 9.56$$

$$+ 1.25 + 15.07 = + 2.61$$

$$+ [ ] + 0.10 = - 0.78$$

$$+ 14.97 = + 3.39$$



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## Conditional Equations

25

	0		L	0-C
1	-1.11 - 1.59 = +89	-6 - 14 = -	20	+109
2	-1.31 - 1.92 = -8	-7 - 13 = -	20	+12
3	-1.89 - 0.92 = -83	-10 - 9 = -	14	-69
4	-1.93 0.00 = +34	-11 0 = -	11	+75
5	-1.84 + 0.58 = -13	-10 + 5 = -	5	-8
6	-1.11 + 1.59 = +63	-6 + 14 = +	8	+57
7	-0.11 + 1.93 = +3	-1 + 17 = +	16	-13
8	0.00 + 1.99 = +65	0 + 17 = +	17	+48
			+ 266	-90

$$+14.88 + 1.25 = +91.8 - 9.30$$

$$+ 1.25 + 15.04 = +171.3 + 2.61$$

$$+ 1.25 + .10 = 7.7$$

$$+14.94 = +133.6$$

$$b = + 8.94 + .234$$

$$+ 14.88 = +91.8 - 11.2 = +80.6$$

$$a = + 5.4 - .672$$

Arc Measured  $175^\circ$ 

$$\frac{p}{h} \cdot 135$$

$$\frac{\Sigma v}{h} = +22$$

$$\text{In } \gamma \quad R \quad 1.933$$

$$\frac{+22}{135} = +192$$

$$\Delta P = +2.7$$

$$-2RC = -0.77$$

$$\text{Corr} = +0.2$$

$$\Delta b = -0.18$$

$$\Delta \delta = -0.1$$

$$\Delta R = +2.2$$

$$\Delta a = +0.99$$

$$\Delta \alpha = +0.02$$







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## Conditional Equations

25

	0		C		0-C	
-1.11	-1.59	+89	-6	-19	-20	+109
-1.31	-1.76	-8	-7	-13	-20	+12
-1.89	-0.92	-73	-10	-9	-19	-69
-1.93	0.00	+34	-11	0	-11	+75
-1.89	+0.58	-13	-10	+5	-5	-8
-1.11	+1.59	+65	-6	+19	+8	+57
-0.11	+1.93	+3	-1	+17	+16	-13
0.00	+1.99	+65	0	+17	+17	+98
					+266	-90

$$+19.88 + 1.25 = +91.8$$

$$+ 1.25 + 80.09 = +191.3$$

$$+ 1.25 + 10 = 7.7$$

$$+19.99 = +133.6$$

$$b = + 8.99$$

$$+19.88 = +91.8 - 11.2 = +80.6$$

$$a = + 5.9$$

are measured 1950

$$\frac{p}{q} = 195$$

$$\frac{EL}{h} = +22$$

$$\frac{+22}{195} = +192 \quad \Delta R = +21$$







8306

Moon's Mean Position

26

$$\begin{array}{r} \chi_0 = 22,1060 \\ \quad \quad \quad + 35 \\ \hline 22,10635 \end{array}$$

$$\begin{array}{r} 17.7180 \\ + 9 \\ \hline 17.4187 \end{array}$$

From Plate Constants

$$x = 21.9099 \%$$

$$y = 17,50 \text{ €}$$

$$\zeta = -0.09564$$

$$n = -0,7928 \frac{1}{2}$$

Long 3 8.98076 n ✓  
 Cross 9.97721 n ✓  
 8.50729 ✓  
 0.49601 n ✓

$\log \tan S$       9.5220 ✓  
      "     $z^2$       7.9609 ✓  
                        7.0534 ✓  
                        ————— ✓  
                        4.5383 ✓

$q-A = 3.13^{\circ}$

$$n, \quad 0, 000004$$

A 8 5-5- 33.0 4

no - 4928 ✓

2 8 5 5 29.8 7

$\log n_0 = 9.69 \overset{267}{\cancel{223}} n$

Red + 2.38 <sup>14</sup>

$$\begin{array}{r} 7.33115 \\ \underline{2.36108} \\ 2.36152 \end{array} \quad \checkmark = -229.9 \checkmark$$

$q' \quad 8 \quad 5^- \quad 5^- \quad 32 \quad 2 \quad 5^- \quad \checkmark$

$$S-D = -03.499$$

D 18 27 46 1

8 18 23 56, 7

Red - 3.2  $\equiv$

8' 18 23 52.9







8306

Moon's Mean Position

26

$$\begin{array}{r} \gamma_0 = 22.1060'' \\ + 3'' \\ \hline 22.1063'' \end{array}$$

$$\begin{array}{r} \mu_0 = 17.9180'' \\ + 9'' \\ \hline 17.9189'' \end{array}$$

From Plate Constants

$$\gamma = 21.9099''$$

$$\mu = 17.5077''$$

$$\gamma = -0.0956''$$

$$\mu = -0.9928''$$

$$\begin{array}{r} \log \gamma \quad 8.98096'' \\ \cos \delta \quad 9.97721'' \\ \hline 8.50729'' \\ 0.99601'' \end{array}$$

$$\begin{array}{r} \log \tan \delta \quad 9.5220'' \\ \gamma'' \quad 7.9609'' \\ \hline 7.0539'' \\ 9.5363'' \end{array}$$

$$\gamma - A = -3.13''$$

$$\mu = 0.0000''$$

$$A = 8 \ 55 \ 33.0''$$

$$\mu_0 = -0.9928''$$

$$\gamma = 8 \ 55 \ 29.87''$$

$$\log \mu_0 = 9.69223''$$

$$\text{Red} \quad + 2.38''$$

$$\begin{array}{r} 267 \\ 7.33115'' \\ \hline 2.26408'' \\ 2.36152'' \end{array}$$

$$\gamma' = 8 \ 55 \ 32.25''$$

$$\delta - D = -03 \ 499''$$

$$D = 18 \ 27 \ 46''$$

$$\delta = 18 \ 23 \ 56.7''$$

$$\delta = 18 \ 23 \ 52.8''$$

$$\delta = 18 \ 23 \ 52.8''$$



$$\begin{array}{r}
 8 \quad 53 \quad 52.68 \\
 \underline{50.72} \\
 + 2.28
 \end{array}$$

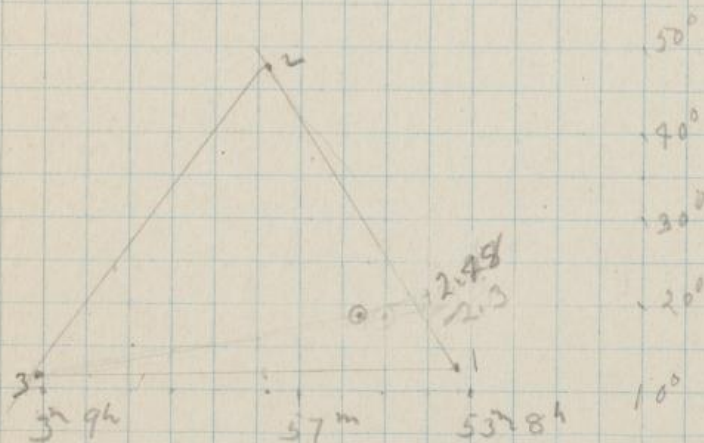
$$\begin{array}{r}
 12 \quad 10 \quad 69.8 \\
 \underline{11} \quad \underline{14.6} \\
 - 4.8
 \end{array}$$

$$\begin{array}{r}
 8 \quad 57 \quad 53.09 \quad 1.05 \\
 \underline{49.78} \quad .28 \\
 + 03.31
 \end{array}$$

$$\begin{array}{r}
 97 \quad 29 \quad 94.6 \\
 \underline{36.5} \\
 + 5.1
 \end{array}$$

$$\begin{array}{r}
 9 \quad 03 \quad 11.00 \\
 \underline{8.72} \\
 + 2.28
 \end{array}$$

$$\begin{array}{r}
 11 \quad 0 \quad 33.5 \\
 \underline{39.2} \\
 - 5.6
 \end{array}$$



50°  
40°  
30°  
20°  
10°



8306

## Reduction to Apparent Place

27

$38^\circ 03.0$   
 $H + \alpha$  26 32.2 ✓  
 $H$  17 36.75 ✓  
 $\alpha$  8 55.5 ✓  
 $G$  21 07.6 ✓  
 $G + \alpha$  29 63.1 ✓  
 $90^\circ$  98.5 ✓

$\log \cos (G + \alpha)$  8.1805 ✓  
 $"$  9 1.0696 ✓  
 $"$   $\sin "$  9.9999 ✓  
 $"$   $\tan \delta$  9.5220 ✓  
 $8.8239$

$\log q' 9.2401 \checkmark$   
 $9 9.4159 \checkmark$

$f + 1.305 \checkmark$   
 $g + 0.260 \checkmark$   
 $h + 0.817 \checkmark$   
 $+ 2.379$

$\delta$  18 23 56 ✓

$\log \cos \delta$  9.9772 ✓  
 $i$  0.9091 ✓  
 $i'$  0.8863 ✓

$\log \sin \delta$  9.9992 ✓  
 $"$   $\cos (H + \alpha)$  9.8963 ✓  
 $"$   $h$  1.2770 ✓  
 $"$   $\sin "$  9.7888 ✓  
 $"$   $\sec \delta$  0.0228 ✓  
 $8.8239$

$h' 0.6695 \checkmark$   
 $h 9.9104 \checkmark$

$q' - 0.152$   
 $h' + 4.670 \checkmark$   
 $i + 7.697 \checkmark$   
 $- 3.189 \checkmark$







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## Reductions To Apparent Place

$38^{\circ} \quad 03.0$   
 $H + a \quad 26 \quad 322^{\circ}$   
 $H \quad 17 \quad 36.75^{\circ}$   
 $a \quad 8 \quad 55.5^{\circ}$   
 $G \quad 21 \quad 07.6^{\circ}$   
 $G + a \quad 29 \quad 63.1^{\circ}$   
 $90^{\circ} \quad 96.5^{\circ}$

$\log \cos (G + a) \quad 8.1905^{\circ}$   
 $" \quad 9 \quad 1.0696^{\circ}$   
 $" \quad \text{Sum} \quad 9.9999^{\circ}$   
 $" \quad \text{tand} \quad 9.5220^{\circ}$   
 $8.8239$

$\log q \quad 9.2107^{\circ}$   
 $9 \quad 9.9159^{\circ}$

$f \quad +1.305^{\circ}$   
 $g \quad +0.260^{\circ}$   
 $h \quad +0.819^{\circ}$   
 $+2.379$

$\delta \quad 18 \quad 23 \quad 56^{\circ}$

$\log \cos \delta \quad 9.9772^{\circ}$   
 $" \quad 2 \quad 0.9091^{\circ}$   
 $" \quad 2 \quad 0.8863^{\circ}$

$\log \sin \delta \quad 9.9992^{\circ}$   
 $" \quad \cos (H + a) \quad 9.3963^{\circ}$   
 $" \quad h \quad 1.2790^{\circ}$   
 $" \quad \text{Sum} \quad 9.7698^{\circ}$   
 $" \quad \text{Sec} \delta \quad 0.0228^{\circ}$   
 $8.8239$

$h' \quad 0.6695^{\circ}$   
 $h \quad 9.9108^{\circ}$

$g' \quad -0.162$   
 $h' \quad +9.670^{\circ}$   
 $i \quad +7.697^{\circ}$   
 $-3.189^{\circ}$







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## Lunar Parallax

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$$\alpha' \quad 8 \quad 55 \quad 32.25''$$

$$\delta' \quad 18 \quad 23 \quad 53.4''$$

$$\theta \quad 8 \quad 30 \quad 43.70''$$

$$\theta - \alpha' \quad -24 \quad 48 \quad 55''$$

$$\pi \quad 56 \quad 59.58''$$

$$\quad -6^0 \quad 12'' \quad 8.25''$$

$$\quad -2 \quad 24.38''$$

$$9.86913''$$

$$8.21953''$$

$$9.03358''$$

$$0.02377''$$

$$7.19607''$$

$$9.95727''$$

$$0.00000''$$

$$0.00254''$$

$$\tan \gamma \quad 9.95978''$$

$$\alpha - \alpha' = -9 \quad 48.69''$$

$$= - \quad 19.25''$$

$$32.20''$$

$$\gamma = 42^0 \quad 21' \quad 2.7''$$

$$\delta = 18 \quad 23 \quad 52.9''$$

$$\delta - \delta' = 23 \quad 57 \quad 09.3''$$

$$9.82690''$$

$$8.21953''$$

$$9.60850''$$

$$0.17156''$$

$$7.82599''$$

$$23 \quad 01.7''$$

$$23 \quad 53.2''$$

$$+18 \quad 46 \quad 57.6''$$

$$08 \quad 55 \quad 13.00''$$

$$\text{Am Eph } \delta +18 \quad 46 \quad 59.9''$$

$$08 \quad 55 \quad 12.03''$$

$$0 - c \quad +.3''$$

$$0 - c \quad +.97''$$

$$2^{\text{nd}} \text{ Ord. Ref.} \quad 0.0$$

$$\text{Curv of Plate} \quad 0$$

$$\text{Irr Corr} \quad -0.1$$

$$+0.02$$

$$\delta \quad +18 \quad 46 \quad 57.5''$$

$$\gamma \quad 8 \quad 55 \quad 13.02''$$

$$0 - c \quad -0.7''$$

$$+0.99''$$



























1915phae.jpg.1

