

KG

11366
v. 992

C XL		
140		
Plate	Date	Page
9783	Nov. 22 '15	1
9785	Nov. 27 '15	11
9786	"	21

Harvard Lunar Plates
Measures and Reductions
Martha C. Borton.

1
2
9

2
2
2

3
1
8

8
1
1

3
3
2

1
2
1

2
2
1

9783

Star Measures

1,

1	17108	19704	15908	20782
21.9	8106	18716	19909	11776
4.1	02	14	10	76
	06	06	08	72
	<u>21.9002</u>	<u>21.9010</u>	<u>4.1001</u>	<u>4.1003</u>

2	16942	19292	15560	19890
22.9	8428	17798	19370	14080
29.1	28	92	78	40
	36	86	70	92
	<u>22.8509</u>	<u>22.8503</u>	<u>29.1188</u>	<u>29.1158</u>

3	15334	19638	16110	18670
12.4	11298	13670	10478	19272
4.6	302	68	72	70
	30	22	108	70
	<u>12.4032</u>	<u>12.4070</u>	<u>14.5634</u>	<u>12.5602</u>

4	20130	17428	18596	19812
14.8	12190	15393	17658	10734
11.1	88	87	52	32
	32	40	86	28
	<u>14.7973</u>	<u>14.7959</u>	<u>14.0979</u>	<u>14.0906</u>

5	16608		18620	
31.1	15568	19692	10952	19250
26.8	62	10740	58	16882
	14	36	18	82
	<u>31.1039</u>	<u>31.1054</u>	<u>26.7663</u>	<u>26.7631</u>

Moon Measures

1	20406	20226	
23.1	17462	91532	
16	48	28	
	12	20	
	<u>23.1352</u>	<u>23.1310</u>	

slant

2		19050	19602
27		13668	15792
15.6		6466	96
		40	592
		<u>155878</u>	<u>5896</u>

Star Measures			
1	9783	19704	15908
L	17108	19704	15908
21.9	8106	15716	19909
9.1	02	19	10
	06	06	08
	21.9002	21.9010	4.1001
			4.1003
2	16992	19292	15560
22.9	8928	17798	19370
29.1	28	92	78
	36	8.6	70
	22.8509	22.8503	29.1188
			29.1158
3	15339	19638	16110
12.4	11298	15670	10978
9.6	302	68	72
	30	22	108
	12.9032	12.9090	17.5639
			17.5602
4	20130	17428	18596
19.8	12190	15393	77658
11.1	88	87	52
	32	90	86
	14.7993	14.7958	14.0999
			14.0906
5	16608		18620
31.1	15568	19692	10952
26.8	62	10790	58
	14	36	18
	31.1039	82	26.7663
		31.1059	26.7631

Moon Measures (1)			
L	20406	20226	
23.1	17462	11532	
15	98	28	
	12	20	
	23.1352	23.1310	
2		19050	19602
28		13668	15792
15.6		6466	96
		40	592
		155878	5892

9783

Moon Measures

3	17514	20250
29.3	15034	12738
16	30	36
	14	46
	<u>29.2982</u>	<u>29.2990</u>
4	17600	20160
29.7	13590	19212
16.8	34	10
+X	04	62
	<u>29.4065</u>	<u>29.4099</u>

5
24
17.9

18712	18090
9798	16968
92	60
10	88
<u>17.8915</u>	<u>17.8875</u>

6
23.0
18.5

19908	18998
19650	13737
52	30
00	508
<u>18.5252</u>	<u>18.5230</u>

7
22.6
18.6
+7

19856	18950
19103	14197
10	88
50	56
<u>18.5797</u>	<u>18.5739</u>

8
22
18.5

19927	18498
15190	13216
2837	12
30	50
<u>18.4792</u>	<u>18.4767</u>

9783

Moon Measures

<u>3</u>	17519	20250
29.3	15039	12738
16	30	36
	19	46
	<u>29.2982</u>	<u>29.2990</u>
<u>4</u>	17600	20160
29.9	13590	19212
16.8	39	10
+X	09	62
	<u>29.9065</u>	<u>29.9099</u>

<u>5</u>	18712	18090
29	9798	16988
17.9	92	00
	10	88
	<u>17.8915</u>	<u>17.8875</u>

<u>6</u>	19908	18998
23.0	19650	13739
18.5	52	30
	00	508
	<u>18.5252</u>	<u>18.5230</u>

<u>7</u>	19856	18950
22.6	19103	19199
18.6	10	88
+9	50	56
	<u>18.5797</u>	<u>18.5739</u>

<u>8</u>	19929	18498
22	15190	13216
18.5	28	12
	30	50
	<u>18.9792</u>	<u>18.9769</u>

9783 Times & Etc.

3

Nov 22 '15

Exp. to Stars	5	39		5	76
" Moon	5	39	77.6	5	39 77.8
Clock fast		7	17.8		

H. Sid Time	5	35	29.9	$\delta - \alpha = +0^h$	3 6
H. Long	7	79	31.05		
G. Sid Time	10	20	00.95		
Sid. J. M. Noon	16	01	33.85		
Interval	18	18	27.10		
Reduction		2	59.95		
G. M. T.	18	15	27.15		

From Naut Alman	P. A.	hloc.
Moon 18 ^h 4 59	05.50	+26 99 01.7
Motion m/m	+2.2095	+1.574
" 15.4525	37.17	27.3
Tabular Place 7 59	39.69	+26 99 26.0

Moon's Age 16 days

Parallax	53' 59.48
Semid.	17 79.3
R	884.3
Aug	13.7
Err 3	0.3
R	897.4
R	1.9237
AR	-919
1+AR	1.8318
R	3.3555

$$939 = 17.95$$

$$\begin{array}{r}
 a - 501.6 \\
 \underline{27} \\
 - 477.6
 \end{array}$$

31.1099
32.2238
- 11794

26.7697
27.8690
1-11043

9783

Lunares

L. Etc.

Nov 22 '13

Exp. to Stars	5	39		5	96
" Moon	5	39	97.6 -	5	39 97.8 -
Clock fast		9	19.8 -		

H. Sid Time	5	35	29.9 -	8-4-10 ^h	36
H Long	9	99	31.05 -		
G. Sid Time	10	20	00.95 -		
Sid J M. Moon	16	01	33.85 -		
Interval	18	19	27.10 -		
Reduction		2	59.95 -		
G M. T	18	13	27.15 -		

From Naut Alman			H. A.		Dec.
Moon 18 ^h	9	59	05.50	+26	99 01.7
Motion 1 ^h			12.2095		1.579 -
" 15.9525			39.19		29.3 -
Tubular Place	9	59	39.69	+26	99 26.0 -

Moons Age 16 days

Parallax 53' 59.48

Semi-d. 17 99.3

R 889.3

Aug 13.9

hr 3 0.3

R 897.4

R 1.9237

AR - 919

1+AR 18318

R² 3,3555

939 = 19.95

a - 501.6

27

- 477.6

χ 31.1099
 χ 32.2538
 $\chi - 11894$

η 26.7697
 η 27.8690
 $\eta - 11043$

χ
 21.9006
 22.8506
 12.4036
 14.7951
 31.1099

η
 7.1002
 29.1173
 7.5618
 11.0925
 26.7697

9783 Plate constants

x

X	21.9006	22.8506	12.9036	19.7951
Y	22.4355	23.5683	12.7671	15.0199
(X-Y)	-5379	-7177	-605	-2248

α	8.1002	28.1173	7.5618	11.0925
η	8.1275	25.1882	7.6707	11.5155
(α-η)	-293	-40269	-1086	-9230

X-Y	+500Y	+68Y	+1.6X	-5927
-5399	+ 10950 =	+ 5601 + 279 =	+ 5880 + 35 =	+ 5915 - 9
- 7177	+ 11725 =	9248 + 1690 =	5888 + 36 =	5929 0
- 605	+ 6202 =	5597 + 310 =	5907 + 20 =	5927 + 3
- 2298	+ 7398 =	5150 + 759 =	5909 + 29 =	5928 + 9
- 11794	+ 15552 =	4058 + 1820 =	5878 + 50 =	5928 + 9
22.5781	+ 11287 =	+ 1138 =	+ 36 =	23.2278

$\alpha - \eta$	+500Y	-65.9X	+3.8Y	-385			
-293	+2050	=+1807	-1993	=+369	+16	=+380	-5
-10269	+12059	=1790	-1506	=284	+92	=376	-9
-1086	+2281	=1195	-817	=378	+17	=395	+10
-9230	+5576	=1316	-975	=341	+72	=383	-2
-11093	+13382	=2339	-2079	=290	+101	=391	+6
16.7712	+8371	-1488	+67	17.3979			

Tables	a	-0.3	e	-.6	q	-e	+1.3	b+d	-0.
lbr		-501.6		-503.8		+2.2		-2.1	
0-C		-501.3		-503.2				-2.1	

9783 Plate Constants

8

λ	21.9006	22.8506	12.9036	19.7951
η	22.9355	23.5683	12.9690	15.0199
$(\lambda - \eta)$	- 5349	- 7177	- 605	- 2248

η	9.1002	29.1173	19.5618	14.0925
η	9.1295	25.1992	9.6707	11.5155
$\eta - \eta$	- 293	- 10269	- 1086	- 9230

$\lambda - \eta$	+5004	+684	+1.64	-592
-5349	+ 10920	= + 3601 + 279	= + 5880 + 35	= + 5915 -
-7177	+ 11425	= 9248 + 1690	= 5888 + 36	= 5929
-605	+ 6202	= 5597 + 310	= 5907 + 20	= 5927 +
-2298	+ 7398	= 5150 + 739	= 5909 + 29	= 5928 +
-11799	+ 13332	= 9058 + 1820	= 5878 + 50	= 5928 +
22.5791	+ 11287	+ 1138	+ 36	23.227

$\eta - \eta$	+5004	-65.94	+3.84	-380
-293	+ 2030	= + 1807 - 1993	= + 369 + 16	= + 380 - 5
-10269	+ 12059	= 1790 - 1506	= 289 + 92	= 376 - 9
-1086	+ 2281	= 1195 - 817	= 378 + 17	= 395 + 10
-9230	+ 5396	= 1316 - 975	= 341 + 92	= 393 - 2
-11093	+ 13382	= 2339 - 2079	= 290 + 101	= 391 + 6
16.7912	+ 8371	- 1488	+ 64	17.3979

Tables a = -0.3 e = -.6 a - e = +.3 b + d = -0.
 (lbs) = -561.6 = -503.8 = +2.2 = -2.1

$A = 0$ $B = +.3$

9783

	x	$x-x_0$	Δx	$(x-x_0)^2$	$(x-x_0)(y-y_0)$	$(y-y_0)^2$
1	23.1331	+0.5601	0	0.3137	3.3381	-1.74
2	29.0000	+1.4270	✓	2.0363	3.3595	+4.0
3	29.2986	+1.6756		2.8076	3.3537	-1.8
4	29.7057	+1.8327		3.3588	3.3588	+3.3
5	29.0000	+1.4270		2.0363	3.3599	+4.4
6	23.0000	+0.4270		0.1823	3.3685	+13.0
7	22.5730	0.0000		0.0000	3.3679	+12.4
8	22.0000	-0.5730		0.3283	3.3513	-7.2

 $R^2 = 3.3555$

	y	$y-y_0$	Δy	$(y-y_0)^2$	$(x-x_0)(y-y_0)$
1	15.0000	-1.7390	-1	3.0244	+1.62
2	15.5887	-1.1503	-0	1.3232	1.29
3	16.0000	-0.7390	-0	0.5461	1.17
4	16.7390	0.0000	-0	0.0000	9.0
5	17.8895	+1.1505	-0	1.3236	5.1
6	18.5291	+1.7851	-1	3.1862	13.5
7	18.5793	+1.8353	-1	3.3679	0
8	18.9778	+1.7388	-1	3.0230	-18.342

180°

Approx.
 $x = 28$

Center

y	15.5887
	17.8895
	33.7782
y_0	16.7391
y_{max}	18.5793
x_{max}	18.352
x_{max}	29.7057
x_0	22.5705

Moon's Center $\begin{cases} x_0 22.5730 \\ y_0 16.7390 \end{cases}$

1
2
3
4
5
6
7
8

1
2
3
4
5
6
7
8

9783

Moon's center

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	
1	23.1331	+0.5601	0	0.3137	3.3381	-179
2	29.0000	+1.4270	✓	2.0363	3.3595	+90
3	29.2986	+1.6756		2.8076	3.3537	-18
4	129.9057	+1.8327		3.3588	3.3588	+33
5	29.0000	+1.4270		2.0363	3.3599	+94
6	23.0000	+0.4270		0.1823	3.3685	+130
7	22.5730	0.0000		0.0000	3.3679	+129
8	22.0000	-0.5730		0.3283	3.3513	-92

 $R = 3.3555$

	y	$y - y_0$	Δy	$(y - y_0)^2$	$(x - x_0)(y - y_0)$	
1	15.0000	-1.7390	-1	3.0299	+1.62	
2	15.5887	-1.1503	-0	1.3232	1.29	
3	16.0000	-0.7390	-0	0.5461	1.17	
4	16.7390	0.0000	-0	0.0000	90	
5	17.8895	+1.1505	-0	1.3236	51	
6	18.5291	+1.7851	-1	3.1862	13.5	
7	18.5793	+1.8353	-1	3.3679	0	
8	18.9778	+1.7388	-1	3.0230	-18	180°

Approx

Center

 $x = 29$ $y = 15.5887$

17.8895

33.9782

 $y_0 = 16.7391$ $y_{max} = 18.5793$ $x_{max} = 18.352$ $x_{max} = 29.9057$ $x_0 = 22.5705$

Moon's Center $\left\{ \begin{array}{l} x = 22.5730 \\ y = 16.7390 \end{array} \right.$

Formation of Normals

1	- 0.97	- 97.5	+ 303.0
2	- 1.65	+ 57.0	- 46.0
3	- 1.29	- 30.0	+ 13.3
4	- 0.0	+ 60.5	- 0.0
5	+ 1.65	+ 63.0	+ 38.0
6	+ 0.76	+ 56.0	+ 231.5
7	+ 0.0	+ 0.0	+ 227.0
8	- 0.99	+ 24.0	- 73.0
	+ 2.81	+ 260.5	+ 812.8
	- 4.85	- 127.5	- 119.0
	- 2.74	+ 133.8	+ 693.8

	a	b	c
-20 Δ a	-8	-4	+4
" " " b	-4	+11	+5
+ " c	+15	-13	+3
	-15	+0	0
	-11	-5	-1
	-3	-5	+7
	-0	-7	+8
	+5	-7	+13

$$-2.44 + 15.79 = +2.87$$

$$+ [] - 1.59 = +1.50$$

$$+ 15.25 = +9.37$$

$$+ 11.06 = +6.79 - 0.45 = +6.34$$

9783

 $k - x_0$

Conditional Equations

 $q - y_0$ 6
new
0-c 0-c

1	+0.56 -	1.74 = -	174	+ 12 - 76 = -64	-110	-92
2	+1.73 -	1.15 = +	40	+31 - 50 = -19	+59	+68
3	+1.68 -	0.74 = -	18	+36 - 32 = +4	-22	-17
4	+1.83 -	0.00 = +	33	+40 - 0 = +40	-7	-7
5	+1.43 +	1.15 = +	44	+31 + 50 = +81	-37	-38
6	+0.93 +	1.78 = +	130	+9 + 77 = +86	+44	+51
7	+0.00 +	1.83 = +	124	+0 + 80 = +80	+44	+52
8	-0.57 +	1.74 = -	42	-12 + 76 = +64	-106	-93

+ 147 - 282
Average 5.3

$$+11.06 - 2.99 = +133 + 6.79$$

$$-2.99 + 15.792 = +693.8 + 2.87$$

$$+2.99 - 0.54 = +29.9$$

$$+15.25 = +667.9$$

$$b = +0.29 \Delta$$

$$b = +93.5$$

$$+11.06 = +133 + 106. = +239$$

$$a = +21.6$$

$$+0.57$$

Arc Measured 1800

$$\frac{p}{h} = .32$$

$$\frac{\Delta p}{h} = -17$$

$$\text{Inr } 3 \quad R \quad 1.83$$

$$-2RC = +.73$$

$$\frac{-17}{.32} = -53$$

$$\Delta R = -0.7$$

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

$$\Delta b = +0.21$$

$$\Delta \delta = +0.1$$

$$\Delta p = -0.5$$

$$\Delta q = +0.42$$

$$\Delta \alpha = +0.02$$

9783

Conditional Equations

6

O-C

1	+0.56	-	1.79	=	-	1.79	+ 12	- 76	=	-64	-110
2	+1.93	-	1.15	=	+	90	+31	-50	=	-19	+59
3	+1.68	-	0.79	=	-	18	+36	-32	=	+4	-22
4	+1.83	-	0.00	=	+	33	+40	-0	=	+40	-7
5	+1.43	+	1.15	=	+	99	+31	+50	=	+81	-37
6	+0.93	+	1.78	=	+	130	+9	+77	=	+86	+99
7	+0.00	+	1.83	=	+	127	+6	+80	=	+80	+98
8	-0.57	+	1.79	=	-	92	-12	+76	=	+64	-106

+ 197 - 282
Average 53

$$+11.06 - 2.99 = +133$$

$$-2.99 + 10.792 = +693.8$$

$$+2.99 - 0.54 = +29.9$$

$$+15.25 = +667.9$$

$$b = +93.5$$

$$+11.06 = +133 + 106 = +239$$

$$a = +21.6$$

Arc measured 1700

$$\frac{p}{h} = .32$$

$$\frac{2v}{h} = -17$$

$$\frac{-17}{.32} = -53$$

$$2R = -0.9$$

+13.7 M

+5.8 X

$$\begin{array}{rclclcl}
 13527 + 9525 & = & 23079 + 288 & = & 23337 + 111 & = & 23448 \\
 12870 + 10711 & = & 23251 + 75 & = & 23326 + 121 & = & 23447 \\
 6999 + 13955 & = & 22954 + 321 & = & 23275 + 185 & = & 23460 \\
 10508 + 12665 & = & 23173 + 139 & = & 23312 + 147 & = & 23459
 \end{array}$$

-8.4 X

+1.8 M

$$\begin{array}{rclclcl}
 -2777 + 10745 & = & 8268 - 160 & = & 8108 + 39 & = & 8147 \\
 +5509 + 2802 & = & 8311 - 175 & = & 8136 + 10 & = & 8146 \\
 -3573 + 11983 & = & 8770 - 268 & = & 8172 + 43 & = & 8215 \\
 +3209 + 5200 & = & 8709 - 213 & = & 8196 + 19 & = & 8215
 \end{array}$$

$$\begin{array}{rcl}
 19.05 & + & 21.79 & = \\
 20.82 & + & 5.60 & = \\
 31.91 & + & 23.97 & = \\
 25.33 & + & 10.70 & =
 \end{array}$$

$$52.73 + 29.57 = 76205 + 16751$$

$$77.38 + 31.89 = 76222 + 16677$$

$$\begin{array}{rclcl}
 8.35 & - & 2.32 & = & -17 & + & 77 \\
 & & & = & -31.1 & - & 7.1 \\
 & & & = & -48.1 & + & 69.9 \\
 & & & = & -5.8 & + & 8.7
 \end{array}$$

$$50.96 + 75.46 = 76003 + 16708$$

$$76.15 + 16.00 = 76727 + 16720$$

$$+7.81 + 2976 = -721 - 12$$

$$+ [] - 1.37 = -9.7 + 42.7$$

$$\begin{array}{rcl}
 +30.80 & = & -711.3 \\
 & & -13.7
 \end{array}$$

$$a = -505.8 \quad e = -501.8 \quad a - e = -4.0 \quad b + d = -5.0$$

$$1.05^{\circ}08' + 12666'' = 23173' + 176'' + 66'' = 23387''$$

$$+3209' + 5200'' = 8409' - 519' + 56'' = 7951''$$

$$\begin{array}{r} a.g. 2633 \\ 6.2 \end{array} \quad \begin{array}{r} 6 \ 77 \ 29.58'' \\ 1 \ 31.22'' \end{array} \quad \begin{array}{r} +23 \ 77 \ 50.6 \\ -1 \ 38.1 \end{array}$$

$$\begin{array}{r} 6 \ 76 \ 35.80'' \\ +23 \ 73 \ 12.5 \end{array}$$

$$\begin{array}{r} a.g. 35367.2 \\ \text{Cape} \end{array} \quad \begin{array}{r} 6 \ 73 \ 17.17'' \\ 1 \ 32.77'' \\ 6 \ 74 \ 49.88'' \\ 6 \ 77 \ 49.77'' \end{array} \quad \begin{array}{r} +25 \ 57 \ 33.3'' \\ -1 \ 35.8'' \\ 25 \ 52 \ 57.5'' \\ 25 \ 52 \ 52.3'' \end{array} \quad \begin{array}{r} 1878.7 \\ 1901.5 \\ \hline 23.1 \end{array}$$

$$\begin{array}{r} - .17 \\ - .09 \\ \hline 3 \\ - .27 \end{array} \quad \begin{array}{r} - 5.2 \\ - 3.6 \\ .2 \\ - 72 \end{array}$$

$$\begin{array}{r} P.M. \text{ for } 15 \text{ yrs} = \\ - .09 \\ \hline 3 \\ - .27 \end{array} \quad \begin{array}{r} - 3.6 \\ .2 \\ - 72 \end{array}$$

9783 Moon's Mean Position

$$\begin{array}{r} \lambda_0 \quad 22.5730'' \\ \quad + 11'' \\ \hline 22.5741'' \end{array}$$

$$\begin{array}{r} \gamma_0 \quad 16.7390'' \\ \quad + 22'' \\ \hline 16.7412'' \end{array}$$

From Plate Constants

$$\lambda \quad 23.2278''$$

$$\gamma \quad 17.3977''$$

$$\eta \quad +1.2278''$$

$$n_1 \quad -0.6026''$$

$$\log \zeta \quad 0.08913''$$

$$\log \tan \delta \quad 9.6993''$$

$$\cos \delta \quad 9.95153''$$

$$\zeta \quad 0.1783''$$

$$8.50727''$$

$$7.0527''$$

$$1.63038''$$

$$6.9310''$$

$$\delta - A \quad + 42.69''$$

$$n_1 \quad +.0009''$$

$$A \quad 7 \quad 58 \quad 24.0''$$

$$\log H_0 \quad 9.78068''$$

$$7.33115''$$

$$\delta_0 \quad 7 \quad 59 \quad 06.69''$$

$$2.44953''$$

$$28.15''$$

$$\text{Red} \quad + 5.57''$$

$$\delta - D \quad - 7 \quad 41.5''$$

$$\delta' \quad 7 \quad 59 \quad 12.25''$$

$$D \quad + 26 \quad 39 \quad 11.0''$$

$$\delta_0 \quad + 26 \quad 34 \quad 29.5''$$

$$\text{Red} \quad + 13.1''$$

$$\delta' \quad 26 \quad 34 \quad 42.6''$$

9783 Moon's Mean Position

$$\begin{array}{r} \lambda_0 \quad 22.5730'' \\ + 11'' \\ \hline 22.5771'' \end{array}$$

$$\begin{array}{r} \gamma_0 \quad 16.7340'' \\ + 22'' \\ \hline 16.7912'' \end{array}$$

From + late constants

$$\lambda \quad 23.2278''$$

$$\gamma \quad 17.3979''$$

$$\delta \quad +1.2278''$$

$$n \quad -0.6026''$$

$$\log \zeta \quad 0.08913''$$

$$\log \tan \delta \quad 9.6993''$$

$$\cos \delta \quad 9.95153''$$

$$\zeta'' \quad 0.1743''$$

$$8.50729''$$

$$7.0539''$$

$$1.63038''$$

$$6.9310''$$

$$\lambda - A \quad + 72.69''$$

$$n_1 \quad +.0009''$$

$$A \quad 9 \quad 58 \quad 29.0''$$

$$\log H_0 \quad 9.78068''$$

$$7.33115''$$

$$\lambda_0 \quad 9 \quad 59 \quad 06.69''$$

$$2.94953''$$

$$2 \times 1.3$$

$$Red \quad + 5.57''$$

$$\delta - D \quad - 9 \quad 71.0''$$

$$\lambda' \quad 9 \quad 59 \quad 12.26''$$

$$D \quad + 26 \quad 39 \quad 11.0$$

$$\delta_0 \quad + 26 \quad 39 \quad 29.5''$$

$$Red \quad + 13.1$$

$$\delta' \quad 26 \quad 39 \quad 72.6''$$

9783 Reduction to app. place

8

$$H + \alpha \quad 6 \quad 51.2 = 102 \quad 98.05 + 26^\circ 37' \quad 29.5$$

$$H \quad 1 \quad 52.1$$

$$L \quad 4 \quad 59.1$$

$$G \quad 23 \quad 2.1$$

$$G + \alpha \quad 7 \quad 01.2 = 60 \quad 18.0$$

$$\log \cos 89.9515$$

$$= 0.6115$$

$$W 0.5630$$

$$\log \cos G + \alpha \quad 9.6950$$

$$g \quad 1.3673$$

$$\sin \quad 9.9388$$

$$\tan \delta \quad 9.6992$$

$$8.8239$$

$$\log \sin \delta \quad 9.6507$$

$$\cos (H + \alpha) \quad 9.3955$$

$$h \quad 1.3023$$

$$\sin \quad 9.9891$$

$$\sec \delta \quad 0.0485$$

$$8.8239$$

$$\log g' \quad 1.0593$$

$$g \quad 9.8262$$

$$\log h' \quad 0.2985$$

$$h \quad 0.1638$$

$$f \quad + 3.770$$

$$g \quad + 0.670$$

$$h \quad + 1.758$$

$$+ 5.568$$

$$g' + 11.965$$

$$h' - 1.988$$

$$i + 3.656$$

$$+ 13.133$$

9783 Reduction to app. place

$$H + L \quad 6 \quad 51.2 = 102 \quad 98.05 + 26^\circ \quad 37 \quad 29$$

$$H \quad 1 \quad 52.1$$

$$L \quad 9 \quad 59.1$$

$$G \quad 23 \quad 2.1$$

$$L + L \quad 9 \quad 01.2 = 60 \quad 18.0$$

$$\log \cos 29.9515^\circ$$

$$= 0.6115$$

$$= 0.5630$$

$$\log \cos G + L \quad 9.6950$$

$$q \quad 1.3693$$

$$\text{Sum } = \quad 9.9388$$

$$\text{Tan } \delta \quad 9.6992$$

$$8.8239$$

$$\log \text{Sum } = \quad 1.6507$$

$$\cos (H + L) \quad 9.3955^h$$

$$L \quad 1.3023$$

$$\text{Sum } = \quad 9.9891$$

$$\text{Sec } \delta \quad 0.0985$$

$$8.8239$$

$$\log q' \quad 1.0593$$

$$q \quad 9.8262$$

$$\log L' \quad 0.2985^h$$

$$L \quad 0.1638$$

$$f \quad + 3.970$$

$$g \quad + 0.670$$

$$L \quad + 1.958$$

$$+ 5.568$$

$$g' \quad + 11.965$$

$$L' \quad - 1.988$$

$$L \quad + 3.656$$

$$+ 13.133$$

9783

Lunar Parallax

9

$$\begin{array}{r}
 \alpha' \quad 9 \quad 59 \quad 12.26 \\
 \alpha \quad 5 \quad 35 \quad 29.9 \\
 \alpha' - \alpha \quad 0 \quad 36 \quad 17.64 \\
 = +90 \quad 4 \quad 24.60 \\
 1/2 \text{ (d-d')} \quad 3 \quad 31.83 \\
 +9 \quad 0 \quad 52.78
 \end{array}$$

$$\begin{array}{r}
 \pi \quad 53' \quad 59''.48 \\
 9.86913 \\
 8.19603 \\
 9.19799 \\
 0.04944 \\
 \hline
 7.31259
 \end{array}$$

$$\begin{array}{r}
 9.95727 \\
 0.00000 \\
 0.00570 \\
 \hline
 9.96267
 \end{array}$$

$$\begin{array}{r}
 \alpha - \alpha' \quad 7' \quad 03''.65 \\
 = \quad +28.29
 \end{array}$$

$$f + 92 \quad 32 \quad 26.7$$

$$d + 26 \quad 37 \quad 42.6$$

$$f - d + 13 \quad 37 \quad 43.8$$

$$\begin{array}{r}
 9.82670 \\
 8.19603 \\
 9.43734 \\
 0.16998 \\
 \hline
 7.63175
 \end{array}$$

$$d - d' \quad 17 \quad 73.7$$

$$s + 26 \quad 79 \quad 26.0$$

$$\alpha \quad 9 \quad 59 \quad 40.59$$

$$\text{Eph} d + 26 \quad 79 \quad 26.0$$

$$\text{Eph} \alpha \quad 9 \quad 59 \quad 39.67$$

$$O-C \quad 0.0$$

$$O-C \quad +0.85$$

$$\text{Curv. of Plate} \quad +0.3$$

$$-0.01$$

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

$$\text{Fin Corr} \quad +0.1$$

$$+0.02$$

$$s \quad 26 \quad 79 \quad 26.1$$

$$\alpha \quad 9 \quad 59 \quad 40.52$$

$$O-C \quad +0.1$$

$$+0.88$$

9783

Lunar Parallax

9

λ 1 9 59 12.25"
 μ 5 35 29.9"
 $\lambda - \mu$ 0 36 17.69"
 $= +90$ 9 24.60"
 $\lambda - \mu$ 3 31.83"
 $= +9$ 0 32.78"

π 3.3' 59.98"
 9.86913
 8.19603"
 9.19799"
 0.04999"
 7.31259"

9.95727"
 0.00000"
 0.00590"
 9.96267"

$\lambda - \mu$ 7' 03.65"
 $= +28.29"$

λ 192 32 26.9"

μ 126 37 42.6"

$\lambda - \mu$ 115 57 43.8"

9.82690"
 8.19603"
 9.93739"
 0.16998"
 7.63175"

$\lambda - \mu$ 17 73.9"

λ 126 79 26.0"

μ 9 59 40.59"

$\lambda - \mu$ 116 19 26.0"

$\lambda - \mu$ 9 59 39.67"

$\mu - \lambda$ 0.0"

$\mu - \lambda$ +0.86"

Error of Plate +0.3
 2nd Miller 144 0.0

-0.01

15
2

2
20

3
2

1
2

2
2
13

3
2
1

9785

Star Measures.

11

	d	r	d	r
L	19879	14796	19952	14222
19.0	19389	5292	15040	18110
21.5	81	96	46	08
	80	92	42	22
	<u>19.0990</u>	<u>19.0502</u>	<u>21.9908</u>	<u>21.9888</u>

2	19056	20968	19098	20918
20.8	10830	18680	12980	16956
5.6	38	90	96	50
	52	72	43	06
	<u>20.8219</u>	<u>20.8217</u>	<u>5.6052</u>	<u>5.6036</u>

3	18880	19438	19818	18500
31.9	9786	18522	10148	18150
23.9	90	26	98	92
	86	42	24	02
	<u>31.9098</u>	<u>31.9086</u>	<u>23.9676</u>	<u>23.9696</u>

Moon Measures.

L	19054	20382
22.8	10900	18582
15	002	78
	62	90
	<u>22.8451</u>	<u>22.8187</u>

2		18718	19762
23		18264	10202
13.1		60	92
			68
		28	

3	16840	19828
29.2	15580	11300
16	70	298
	82	922
	<u>29.1305</u>	<u>29.1377</u>

15.0456 15.0430

1
19
212
20
53
31
231
2
12
2
133
29
1

7685

Star Measures.

11

	d	1	d	2
1	19879	19796	19954	19222
19.0	19389	5292	15040	19618
21.5	81	96	96	08
	80	92	92	22
	<u>190990</u>	<u>19.0502</u>	<u>21.9909</u>	<u>21.9888</u>

2	19056	20968	19098	20918
20.8	10830	18680	12980	16956
5.6	38	90	96	50
	52	72	93	46
	<u>208219</u>	<u>20.8217</u>	<u>5.6052</u>	<u>5.6036</u>

3	18880	19438	19818	18500
31.7	9786	18522	10198	18150
23.9	90	26	98	92
	86	92	29	02
	<u>319098</u>	<u>31.9086</u>	<u>23.9676</u>	<u>23.9696</u>

Moon Measures.

1	19064	20382
22.8	10900	18582
15	002	78
	62	90
	<u>22.8151</u>	<u>22.8187</u>

2		18718	19762
23		18269	10202
15.1		60	92
			68

		28	
		<u>15.0456</u>	<u>15.0430</u>

3	16930	19928
29.2	15580	11300
16	70	298
	82	922
	<u>29.1365</u>	<u>29.1377</u>

7
29
16
+
5
29
1
6
29
1
7
29
18
9
29
18
8
20
18
5

9785

Moon Measures

12

7	17050	18836
24.7	13730	12128
16.7	28	32
+X	59	40
	<u>24.3322</u>	<u>24.3290</u>

5	16077	18802
24.7	12858	12012
17	50	16
	78	17
	<u>24.3221</u>	<u>24.3203</u>

6	16180	17780
23.9	7290	16662
18	90	68
	78	82
	<u>23.8892</u>	<u>23.8889</u>

7	16408	17519
23	10708	13208
18.6	706	18
	12	16
	<u>18.5703</u>	<u>18.5703</u>

8	15459	17436
22.6	9058	13898
18.7	50	38
+7	60	92
	<u>18.6700</u>	<u>18.6707</u>

8th Star

26.2	20
18.7	

5th	20032	18692	19978	20190
	16728	12003	15922	14188
	28	06	22	88
	36	06	98	96
	<u>25.3307</u>	<u>25.3302</u>	<u>15.9026</u>	<u>15.3997</u>

9785

Moon Measures

12

2	17050	18836
29.9	13730	12128
16.7	28	32
+8	59	40
	<u>29.3822</u>	<u>29.3290</u>

2	16079	18802
29.9	12858	12012
17	50	16
	78	19
	<u>29.3221</u>	<u>29.3203</u>

6	16180	17780
23.9	7290	16662
18	90	68
	78	82
	<u>23.8892</u>	<u>23.8889</u>

2	16908	17519
23	10708	13208
18.6	706	18
	12	16
	<u>18.5703</u>	<u>18.5703</u>

4	15459	17936
22.6	9058	13898
18.7	50	38
+7	60	92
	<u>18.6700</u>	<u>18.6709</u>

9th Star

26.2	20
18.7	

5th	20032	18692	19998	20190
	16728	12003	15922	14188
	28	06	22	88
	36	206	98	96
	<u>25.3309</u>	<u>25.3302</u>	<u>25.4026</u>	<u>25.3999</u>

9785- Times & Etc.

Nov. 29 '15

Exp. to Stars	7	05		7	17
" " Moon	7	11	12.5	7	11 12.7
Clock fast		4	20.6		

H Sid. Time	7	06	52.0	$\theta - \alpha = +0^h 19^m$
H. Long	7	44	31.03	
G. Sid. T	11	50	83.03	
Bid T.M.N.	16	09	26.96	
Interval	19	41	56.09	
Reduction		3	13.63	
G.M.T.	19	38	72.96	

From Naut alms	R. A.	Dec
Moon 19 ^h 06	76	76.02 + 25 32 27.8
Motion		2.1582 - 7.674
38.7077	1	23.57 - 3 0.09
Tabular Place 06	78	09.56 25 29 26.9

corrected over
getting 26.96

Moon's Age 18 days

Parallax	54'	02.94
Semidiameter	14	45.5
R		88.5.5
Aug.		13.5
Gr. 2		-0.1
R		898.9
R		1.9269
AR		-922
(1+1)R		1.8397
R		3.3661

9342 15

$a = -502.6$
 $\frac{29}{-478.6}$

9785-

Times & Etc.

Nov 29

Exp. L Stars	7	05		7	17
Moon	7	11	12.5	7	11 12.7
Clock fast		9	20.6		

H Sid. Time	7	06	52.0	E-L = +0 ^h 19 ^m
H Long	9	49	31.05	
9 Sid J	11	50	83.05	
Sid J M H.	16	09	26.96	
Interval	19	41	56.09	
Reduction		3	13.63	
9 M J	19	38	92.96	

Transit alt	R. 4			Dec
Moon 19 ^h	06	46	76.02	+25° 32 27.8
Motion			2.1582	- 1.677
38.7077	1	23.39		-3 0.0.9
Tabular Place	06	48	09.36	25° 29 26.9

Moon's Age 18 days

Parallax	59'	02.97
Semidiameter	14	45.5
IC		885.5
Aug		13.5
Tr		-0.1
IC		898.9
IC		1.2269
AR		722
11/14/12		1.8377
12		3.3661

939 = 1.5

9 = -50 2.6

$$\begin{array}{r} 2.4 \\ -478.6 \end{array}$$

ξ	η	$\Delta \xi$	-5ξ	-5η	0
1	+2.28	-7.92	+9	-112	-7 +9 = +3
2	-9.30	+3.73	-3	+212	+18 -2 = +16
3	+2.76	-12.95	-11	+122	+1 -6 = -5
4	+9.21	+6.27	+27	-762	-19 +3 = -16
11	-0.69	-1.18	+3	+1	<u>+8</u>

$$\begin{array}{rcl}
 \Delta \eta & -7\eta & 0 \\
 -13 & +32 & = +19 \\
 +03 & -15 & = -12 \\
 -53 & +52 & = -1 \\
 +19 & -25 & = -6 \\
 0 & +5 & \underline{+5}
 \end{array}$$

9785-

Plate Center & Constants

17

X	Y	α	δ
19.0996	21.4896	6 45 45.39	25 51 53.1
20.8218	5.6072	6 46 50.45	23 42 11.7
31.9092	23.9661	6 53 33.12	26 11 37.3
3) 71.7806	51.05993	18 14 128.96	74 104 101.8
23.9269	17.0200	6 48 42.99	25 15 13.9
22	18	-28.73	+7 37.2
-0.9269	+0.9800	6 48 14.26	25 22 51.1
315	766.5		
-28.73	+7' 37.17		
25,3303	10,4010		

$$\begin{array}{rclcl}
 X - \gamma & +500 X & +13.9 \gamma & +216 X & -23370 \\
 +13797 + 9525 & +23022 + 299 & = +23321 + 99 & = +23370 & = 0 \\
 +12828 + 10711 & = +23239 + 78 & = +23317 + 37 & = 71 & = +1 \\
 +6999 + 15935 & = +22959 + 333 & = +23287 + 83 & = 70 & = 0 \\
 22.7955 & +11278 & +239 & +58 & = 21.3125
 \end{array}$$

$$\begin{array}{rclcl}
 Y - \eta & +500 Y & -19.9 X & +317 Y & -7933 \\
 -2599 + 10725 & = +8196 - 379 & = +7817 + 116 & = +7933 & = 0 \\
 +5315 + 2802 & = +8317 - 919 & = +7903 + 30 & = 7933 & 0 \\
 -3573 + 11983 & = +8470 - 635 & = +7805 + 129 & = 7939 & +1 \\
 16.8067 & +8903 & - 798 & + 91 & = 16.8181
 \end{array}$$

$$\begin{array}{rclcl}
 \text{Tables } a = -.6 & e = -.6 & a - e = 0 & b + d = 0 \\
 \text{lbs} & = -502.6 & = -505.4 & = +2.8 & = +6.0
 \end{array}$$

$$\begin{array}{rclcl}
 O - C & -502.0 & -504.8 & & +6.0
 \end{array}$$

Apr 11w 982 - Mag 6.9

Cape 992 - Mag 6.7

Cape 990 - Mag 5.8

6 98 36.93

Barnes 1760

36.96

36.96

6 99 99.77

6 98 36.95

6 95 55.74

59.85

59.67

6 99 31.80

6 96 50.91

6 98 19.00

98 19.00

+ 1 17.80

- 1 23.59

+ 17.80

- 83.59

1.89 0.98

1.92 2.15

9.95 9.53

9.96 1.73

0.35 7.75

0.39 1.12

+ 2.2 7.91

- 2.96 1.1

+ 7

- 1.1

17.69 7.2

+ 2.9 2.7 9.5

1.95 3.78

19.09 9.6

25.33 0.3

20.82 1.8

+ 1.35 2.9

+ 1.05 0.8

+ 1.28 4.0

+ 2.9 2.2 20.9

21.8

20.6

2.9 2.2 21.0

+ 2.3 9.3 11.8

- 1 05.5

- 1 00.1

2.9 2.1 15.5

+ 2.3 9.2 11.7

2.5 2.2 5.10

+ 2.5 2.2 31.0

- 1 0.1 35.5

- 1 9.0 39.3

- 36.95.9

- 60.81.0

3.56 7.72

3.78 1.11

0.89 8.87

1.11 2.26

9.65 5.7

9.69 2.5

0.71 5.5

0.78 2.2

7.92 9.6

7.97 8.1

- 7.9 2.2 6

- 1.2 9.9 9.7

+ 0.0 0.2 7

+ 0.0 0.3 0

10.0 8.0 0

5.05 3.3

10.9 0.1 0

5.60 8.2

+ 3.2 0.9

+ 5.5 0.9

21.73 7.3

21.98 9.6

- 2.9 7.9

9785		Plate Center & Constants		H		
x	y	x		y		
19.0796	21.9896	6	95	95.39	25	51 53.1
20.9218	5.6092	6	96	50.75	23	42 11.9
31.9092	23.9661	6	23	33.12	26	11 37.3
2) 71.7806	51.0299	3) 18	199	128.76	79	109 101.8
23.9269	17.0200	6	98	42.99	25	15 13.9
22	152			-28.73	m	+7 37.2
-0.9269	+0.9800	6	48	19.26	25	22 51.1
315	766.2					
-28.73	+7' 7.17					

$$22.9955 + 11.298 \quad + 239. \quad + 58 = 21.312$$

$$16.8067 + 8903 \quad - 997 \quad + 91 = 16.8181$$

$$\begin{array}{llll} \text{Tables } a = -.6 & e = -.6 & a - e = 0 & b + d = 0 \\ \text{Obs } \quad \quad \quad = -500.6 & \quad \quad \quad = -505.4 & \quad \quad \quad = +2.8 & \quad \quad \quad = +4.0 \end{array}$$

Cape No 982 - Mg 6.9

6 77 79.77

17.6972
19.0896
+ 13528

21.7373
21.4896
- 2477

Cape 992 - Mg 6.7

6 78 36.93^v
36.96^v
PM 36.96^v

6 78 36.93^v
59.85^v6 79 31.80^v6 78 19.00^v+ 1 17.80^v+ 77.80^v1.89098^v9.95953^v0.35775^v+ 2.2791^v+ 4^v+ 24.2795^v25.3303^v+ 1.0508^v+ 24 22 20.9^v21.8^v20.6^v24 22 21.0^v- 1 05.3^v24 21 15.5^v25 22 5.10^v- 1 01 35.3^v- 3695.9^v3.56772^v0.89887^v9.655.7^v0.7155^v7.4246^v- 7.9226^v+ 0.0027^v10.0800^v20.4010^v+ 3209^v

1901.7

Cape 990 - Mg 5.8

Rose 1760

6 75 35.74

57.67

6 76 50.41

6 78 19.00

- 1 23.59

- 83.59

1.92.215^v

9.96173

0.39112^v- 2.4611^v- 11^v193.378^v

20.8218

+ 12840^v

+ 23 73 11.8

- 1 00.1

+ 23 72 11.7

+ 25 22 51.0

- 1 70 39.3

- 6081.0

3.48111^v1.11226^v9.6725^v

0.7822

7.4781

- 12.9497

+ 0.0030

5.0533^v

5.6082

+ 5509^v

9783 Standard Coordinates

15

Capellu 982-Mag 6.9	Capellu 990-Mag 6.8	Capellu 997-Mag 6.2
C 6 49 49.77 55.73	6 45 55.73	6 52 37.67
L 17.81	55.75	37.63
E 49.77	55.73	37.61
Mean 6 49 49.77 55.74	6 45 55.74	6 52 37.63
Prec 55.62	54.71	+55.49 51
d 6 45 45.39	6 46 50.45	6 53 33.12
A 6 48 14.00	6 48 14.00	6 48 14.00
d-A -2 28.61	-1 23.55	+5 19.12
Sum -1 48.61	-83.55	+319.09
logu 2,17205 n	1,92195 n	2,50392
cos 9,95416	9,96173	9,95294
sin 0.63345 n	0,39092 n	0,96410

Σ -4,2998	-2,4599	+9,2066
Σ -3	-11	+27
Σ 17,6999 -27	19,5390 -12	31,2093
Σ 19,0996	20,8218	31,9092
Σ +1,3897	+1,2828	+6,999

1902.9

191.68

C +25 52 52.3	+23 43 11.8	+26 12 45.1
L 52.2	12.1	49.7
E 52.2	11.6	45.7
Mean 25 52 52.2	23 43 11.8	+26 12 45.1
Prec -59.1	-1 00.4	-1 -07.8 9
d 25 31 53.1	23 42 11.4	26 11 37.3
D 25 22 51.0	23 22 51.0	25 22 51.0
d-D +29 02.1	-1 80 39.6	+0 48 46.3
tan d-D +17 42.1	-60 41.3	+29 26.5
logu 3,24107	3,78113 n	3,46634
cos 0,37222	1,11228 n	0,79749

logtan d 9,6856	9,6425	9,6919
Σ 1,2669	0,7818	1,9282
Σ 8,0059	7,7777	8,6735

Σ +3,7374	-12,9509	+6,27321
Σ +0,0101	+0,0030	+0,0472
Σ 21,7445 -72	5,0527 +6	24,32073
Σ 21,7896	5,6074	23,9661
Σ -25,79	+5,575	-3,542

Standard Coordinates											
Cape No 982 Mag 6.4 Cape No 990 Mag 8.2 Cape No 997 Mag 6.2											
C	6	99	99.77	6	95	55.73	6	52	37.67		
I			19.81			55.75			37.63		
C			49.77			55.73			37.61		
Mean	6	99	99.77	6	95	55.74	6	52	37.63		
True			55.62			57.71			155(49)	51	
L	6	95	95.39	6	96	50.95	6	53	33.12		
A	6	98	19.00	6	98	19.00	6	98	19.00		
A-A			-2.28.61			-1.23.55			+5.19.12		
Sum			-198.61			-83.55			+319.09		
Log	2.17	205	n	1.92	195	n	2.50	392			
Mod	9.95	916		9.96	115		9.95	294			
σ_0	0.63	395	n	0.39	092	n	0.96	410			
σ	-9.29	98		+2.95	99		+1.20	66			
σ_0	-3			-11			+27				
σ_1	17.69	99		19.53	90		31.20	93			
σ_2	19.07	96		20.82	18		31.90	92			
X- σ	+1.34	97		+1.28	28		+6.97	99			
C	+25	52	52.3	+23	93	11.8	+26	12	95.1		
L			52.2			12.1			99.7		
C			52.2			11.6			45.9		
Mean	25	52	52.2	23	93	11.8	+26	12	95.1		
True			-59.1			-1.00.9			-1-07.8	9	
σ	25	51	53.1	23	92	11.9	26	11	37.3		
D	25	22	51.0	23	22	51.0	25	22	51.0		
$\sigma-D$	+29	02.1		-1	80	39.6	+0	98	463		
Sum $\sigma-D$	+177	2.1		-60	91.3				127	26.5	
Log	3.27	107		3.78	113	n	3.96	639			
σ_0	0.57	22.2		1.11	228	n	0.79	799			
Log σ_0	9.68	56		9.69	25		9.69	19			
σ_1	1.28	69		0.78	18		1.92	72			
σ_2	8.00	57		7.77	77		8.67	35			
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$B - + .3$ 1
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8

9785 - Moon's Center

	X	$Y - Y_0$	ΔX	$(X - X_0)^2$	$(X - X_0)(Y - Y_0)$	$(Y - Y_0)^2$	$O - C$	
1	22,8169	+0.3209	0	0.1029	3.3685		+24	
2	23,0000	+0.5040	↓	0.2540	3.3615		-46	
3	29,1371	+1.6411		2.6932	3.3447	$\frac{1}{2}w$	-216	
4	+29,3306	+1.8346		3.3658	3.3658		-3	
5	29,3212	+1.8262		3.3313	3.3685		+24	
6	23,8888	+1.3928		1.9399	3.3631		-30	
7	23,0000	+0.5040		0.2540	3.3636		-25	
8	22,4960	-0.0000		0.0000	3.3610		-51	

	Y	$Y - Y_0$	ΔY	$(Y - Y_0)^2$	R	3.3661	\angle
1	15,0000	-1.8070	-1	3.2656			+170°
2	15,0743	-1.7627	-1	3.1075			164°
3	16,0000	-0.8070	0	0.6512			116°
4	16,8070	0.0000	0	0.0000			90°
5	17,0000	+0.1930	+0	0.0372			84°
6	18,0000	+1.1930	+0	1.4232			49°
7	18,5703	+1.7633	+1	3.1096			16°
8	+18,6402	+1.8332	+1	3.3610			0° 170°

Approx. Center

$X = 23$	$Y = 15.0743$
	18.5703
	33.6146
	$Y_0 = 16.8073$
Y_{max}	18.6402
R	1.8329
X_{max}	27.3306
X_0	22.4977

Moon's Center

X_0	22.4960
Y_0	16.8070

9785 - Moon's Center

	X	Y - Y ₀	ΔX	(X - X ₀) ²	(X - X ₀) + (Y - Y ₀) ²	0 - C	16
1	22.8169	+0.3209	0	0.1029	3.3685	+24	
2	23.0000	+0.5040	6	0.2590	3.3615	-46	
3	29.1371	+1.6411		2.6932	3.3444	-216	
4	+29.3306	+1.8346		3.3658	3.3658	-3	
5	29.3212	+1.8232		3.3313	3.3685	+24	
6	23.8888	+1.3928		1.9399	3.3631	-30	
7	23.0000	+0.5040		0.2590	3.3636	-25	
8	22.9960	-0.0000		0.0000	3.3610	-51	

	X	Y - Y ₀	ΔY	(Y - Y ₀) ²	R	3.3661	C
1	15.0000	-1.8070	-1	3.2656		+17.0	
2	15.0993	-1.7629	-1	3.1075		169	
3	16.0000	-0.8070	0	0.6512		116	
4	16.8070	0.0000	0	0.0000		90	
5	17.0000	+0.1930	+0	0.0372		89	
6	18.0000	+1.1930	+0	1.4232		49	
7	18.5703	+1.7633	+1	3.1096		16	
8	+18.6902	+1.8332	+1	3.3610		0	170°

App. Center

X = 23	Y = 15.1443
	18.5703
	3.36196
	Y ₀ 16.8073
	18.6402
	R 1.8329
X _{max}	27.3306
X ₀	22.9977

Moon's Center

X ₀	22.9960
Y ₀	16.8070

Formation of Normals.

1	- 0.58	+	7.5	-	43.5
2	- 0.88	-	23.0	+	81.0
3	- 0.33	-	88.5	+	44.0
4	0.0	-	5.5		0.0
5	+ 0.35	+	44.0	+	4.5
6	+ 1.63	-	41.5	-	35.7
7	+ 0.88	-	12.5	-	44.0
8	+ 0.0	+	0.0	-	93.0
	<u>+ 2.88</u>		<u>+ 51.5</u>		<u>+ 129.5</u>
	<u>- 1.79</u>		<u>- 171.0</u>		<u>- 216.2</u>
	<u>+ 1.09</u>		<u>- 119.5</u>		<u>- 86.7</u>

	a	b	c
- 200 a	- 29	0	+ 35 ^v
- " " b	0	↓	+ 30 ^v
+ " " c	+ 47		- 4 ^v
	- 9		- 9 ^v
	- 14		- 9 ^v
	- 48		+ 7 ^v
	- 53		+ 30 ^v
	- 53		+ 44 ^v
	- 90		
	- 14		
	- 0		

$$+1.09 + 14.95 = +0.59$$

$$+2.7 + 1.10 = +0.73$$

$$+14.85 = -0.14$$

$$+25^{\circ}$$

9785-

Conditional Equation.

							U-C	new U-C
1	+ 0.32	- 1.81	= + 29	- 3	+ 9	= + 6	+ 18	+ 53
2	+ 0.50	- 1.76	= - 96	- 5	+ 9	= + 4	- 50	- 20
3	+ 1.68	- 0.81	= - 216	- 16	+ 7	= - 12	- 209	- 208
4	+ 1.83	0.00	= - 3	- 17	0	= - 17	+ 17	+ 3
5	+ 1.83	+ 0.19	= + 29	- 17	- 1	= - 18	+ 72	+ 33
6	+ 1.39	+ 1.19	= - 30	- 13	- 6	= - 19	- 11	- 7
7	+ 0.50	+ 1.76	= - 25	- 5	- 9	= - 14	- 11	+ 19
8	+ 0.00	+ 1.83	= - 51	- 0	- 9	= - 9	- 72	+ 12
							+ 79	- 163

Average

$$11.94 + 1.09 = -119.5 + 8.01$$

$$+1.09 + 19.95 = -86.7 + 0.59$$

$$+1.09 + +1.10 = -10.9$$

$$- 0.0099 \Delta$$

$$+19.85 = -75.8$$

$$b = -5.1$$

$$11.94 = -119.5 + 5.6 = -113.9$$

$$a = -9.5$$

$$+ 0.67 \Delta$$

Arc Measured 170°

$$\frac{P}{h} = .25$$

$$\frac{\Sigma V}{h} = -11$$

$$\text{Inv } 2 \quad R \quad 1.83$$

$$-2RC = +2.20$$

$$\frac{-11}{2.5} = -4.4 \quad \Delta R = -.5$$

$$\Delta b = 0$$

$$\Delta S \quad 0.0$$

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

$$\Delta R = +0.1$$

$$\Delta a = +1.77$$

$$\Delta d = +0.05$$

9785

Conditional equation

17

6-C

1	+ 0.32	- 1.81	= + 29	- 3	+ 9	- + 6	+ 18
2	+ 0.50	- 1.76	= - 96	- 5	+ 9	- + 9	- 30
3	+ 1.69	- 0.81	= - 216	- 16	+ 9	- - 12	- 209
4	+ 1.83	0.00	= - 3	- 17	0	= - 17	+ 19
5	+ 1.83	+ 0.19	= + 29	- 17	- 1	= - 18	+ 92
6	+ 1.39	+ 1.19	= - 30	- 13	- 6	= - 19	- 11
7	+ 0.50	+ 1.76	= - 25	- 5	- 9	= - 19	- 11
8	+ 0.00	+ 1.83	= + 51	- 0	- 9	= - 9	- 92

+ 79 - 465 (avg 1/3)
Average 97

$$11.99 + 1.09 = -119.5$$

$$+ 1.09 + 19.93 = -86.7$$

$$+ 1.09 + 7.10 = -10.9$$

$$+ 19.83 = -75.8$$

$$b = -5.1$$

$$11.99 = -119.5 + 5.6 = -113.9$$

$$a = -9.5$$

Arc Measured 170°

$$\frac{P}{h} = .25$$

$$\frac{2V}{h} = -11$$

$$\frac{-11}{2.5} = -2.9, \quad \Delta R = -.5$$

9783- Moon's Mean Position

18

$$\begin{array}{r} X \quad 22.4960^{\circ} \\ \quad -5^{\circ} \\ \hline 22.4955^{\circ} \end{array}$$

$$\begin{array}{r} Y \quad 16.8070^{\circ} \\ \quad -3^{\circ} \\ \hline 16.8067^{\circ} \end{array}$$

From Plate Constants.

$$\begin{array}{r} X \quad 21.3125^{\circ} \\ \quad 22 \\ \hline \xi \quad -0.6875^{\circ} \end{array}$$

$$\begin{array}{r} Y \quad 16.8181^{\circ} \\ \quad 18 \\ \hline \eta \quad -1.1819^{\circ} \end{array}$$

$$\begin{array}{r} \log \xi \quad 9.83727^{\circ} \\ \cos \xi \quad 9.93647^{\circ} \\ \hline \quad 8.50727^{\circ} \\ \hline \quad 7.37336^{\circ} \end{array}$$

$$\begin{array}{r} \log \tan \delta \quad 9.6733^{\circ} \\ \xi^2 \quad 9.6745^{\circ} \\ \hline \quad 7.0537^{\circ} \\ \hline \quad 6.4012^{\circ} \end{array}$$

$$\eta_i + .0002^{\circ}$$

$$\alpha - A \quad -23.64^{\circ}$$

$$A \quad 6 \quad 48 \quad 14.00^{\circ}$$

$$\alpha_0 \quad 6 \quad 47 \quad 50.36^{\circ}$$

$$\text{Red} \quad +5.36^{\circ}$$

$$\alpha' \quad 6 \quad 47 \quad 55.72^{\circ}$$

$$\begin{array}{r} \log h_0 \quad 0.07266^{\circ} \\ \hline \quad 7.33113^{\circ} \\ \hline \quad 2.74151^{\circ} \end{array}$$

$$S-D \quad -9 \quad 11.7^{\circ}$$

$$D+25 \quad 22 \quad 51^{\circ}$$

$$S_0+25 \quad 13 \quad 39.6^{\circ}$$

$$\text{Red} \quad -0.9^{\circ}$$

$$S'+25 \quad 13 \quad 38.7^{\circ}$$

9785⁺ Moon's Mean Position

18

$$\begin{array}{rcl}
 1 & X & 22.9960^{\circ} \\
 & & -5^{\circ} \\
 2 & & \hline
 & & 22.9955^{\circ}
 \end{array}
 \qquad
 \begin{array}{rcl}
 1 & Y & 16.8070^{\circ} \\
 & & -3^{\circ} \\
 2 & & \hline
 & & 16.8067^{\circ}
 \end{array}$$

From Plate Constants

$$\begin{array}{rcl}
 X & 21.3125^{\circ} & \\
 Y & 16.8181^{\circ} & \\
 \eta & -0.6875^{\circ} & \\
 \eta & -1.1819^{\circ} &
 \end{array}$$

$$\begin{array}{rcl}
 \log \xi & 9.83727^{\circ} & \\
 \cos \delta & 9.95647^{\circ} & \\
 & 8.50727^{\circ} & \\
 & \hline
 & 9.39356^{\circ} &
 \end{array}$$

$$\begin{array}{rcl}
 \log \tan \delta & 9.6733^{\circ} & \\
 \xi^2 & 9.6745^{\circ} & \\
 & \hline
 & 7.0539^{\circ} & \\
 & 6.4012^{\circ} & \\
 \eta_1 & +0.0002^{\circ} &
 \end{array}$$

$$x-A \quad -23.64^{\circ}$$

$$A \quad 6 \quad 48 \quad 19.00^{\circ}$$

$$x_0 \quad 6 \quad 47 \quad 50.36^{\circ}$$

$$\text{Red} \quad +5.36$$

$$x' \quad 6 \quad 47 \quad 55.72$$

$$\begin{array}{rcl}
 \log \mu_0 & 0.07266^{\circ} & \\
 & 7.33115^{\circ} & \\
 & \hline
 & 2.79151^{\circ} &
 \end{array}$$

$$d-D \quad -9 \quad 11.9^{\circ}$$

$$D+25 \quad 22 \quad 51^{\circ}$$

$$S_0+25 \quad 13 \quad 39.6^{\circ}$$

$$\text{Red} \quad -0.9$$

$$S'+25^{\circ} \quad 13 \quad 38.9^{\circ}$$

$$\begin{array}{r}
 6 \quad 38 \quad 47.60 \\
 \underline{42.20} \\
 + 5.40
 \end{array}$$

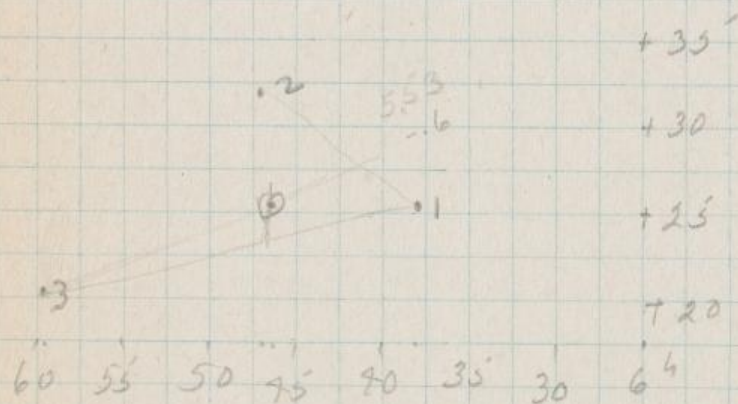
$$\begin{array}{r}
 +25 \quad 12 \quad 59.1 \\
 \underline{58.7} \\
 + 0.4
 \end{array}$$

$$\begin{array}{r}
 6 \quad 47 \quad 17.12 \\
 \underline{11.33} \\
 + 5.79
 \end{array}$$

$$\begin{array}{r}
 37 \quad 03 \quad 50.6 \\
 \underline{53.3} \\
 - 2.7
 \end{array}$$

$$\begin{array}{r}
 6 \quad 59 \quad 9.26 \\
 \underline{4.13} \\
 + 5.13
 \end{array}$$

$$\begin{array}{r}
 20 \quad 41 \quad 43.9 \\
 \underline{45.3} \\
 - 1.4
 \end{array}$$



+ 35'

+ 30

+ 25

+ 20

6h

$H + \alpha$ 8 31.9 = $127^{\circ} 58.5'$ 25 13. 39.6
 H 01 47.1
 α 6 47.8 $\log \cos$ 9 95 65
 G 23 02.9 $\log \sin$ 0 58 28
 $G + \alpha$ 5 50.7 = $87^{\circ} 40.5'$ 0 53 93

log cos A + L	9.6082
g	1.3678
Sum "	9.9996
tan 8	9.6732
	8.8239

Log Sund	9.6296
" Eus Htd	9.7891 n
" h	1.3037
Sun "	9.8967
Secd	0.0435
	8.8239

log 9 9.9760
9 9.8845

$\log h'$	0,8221 n
h	0,0675

$$\begin{array}{r} f + 3.463 \\ g + 0.732 \\ h + 1.168 \\ + 5.363 \end{array}$$

$$\begin{array}{r} g' \pm 0.976 \\ h' - 5.273 \\ i + 3.763 \\ + \underline{-2.231} \\ - 0.864 \end{array}$$

9783 Reduction to Apparent Place

19

$$\begin{array}{rcl}
 H + \alpha & 8 & 31.9 = 127^{\circ} 38.2^{\circ} \quad 25^{\circ} \quad 13. \quad 39.6 \\
 H & 01 & 99.1 \\
 \alpha & 6 & 77.8 \\
 G & 23 & 02.9 \\
 G + \alpha & 5 & 50.7 = 87^{\circ} 40.5^{\circ}
 \end{array}$$

$$\log \cos 9.9065$$

$$+ 0.5828$$

$$+ 0.5393$$

$$\log \cos G + \alpha 9.6082$$

$$g 1.3678$$

$$\sin 9.9996$$

$$\tan \delta 9.6732$$

$$8.8239$$

$$\log \sin \delta 9.6276$$

$$\cos H + \alpha 9.1871$$

$$h 1.3059$$

$$\sin 9.8967$$

$$\sec \delta 0.0932$$

$$8.8239$$

$$\log g 9.9760$$

$$g 9.98685$$

$$\log h 0.7221$$

$$h 0.0675$$

$$f + 3.963$$

$$g + 0.732$$

$$h + 1.168$$

$$+ 5.868$$

$$g' + 0.996$$

$$h' - 5.273$$

$$i + 3.763$$

$$+ 22.225$$

$$- 0.869$$

9783-

Lunar Parallax

20

α' 6 47 55.72 ✓
 ϕ 7 06 52.0 ✓
 $\phi - \alpha'$ 0 18 56.28 ✓
 $=$ 70 44 09.20 ✓
 $\frac{1}{2}(\phi - \alpha')$ 1 79.7 ✓
 $\frac{1}{2}$ 70 42 14.5 ✓

π 54' 02.94 ✓
 9.86913 ✓
 8.19679 ✓
 8.91665 ✓
 0.04778 ✓
 7.02675 ✓

9.95727 ✓
 0.00000 ✓
 0.00176 ✓
 9.95873 ✓

$\alpha - \alpha'$ + 3' 39.38 ✓

$=$ + 14.62 ✓

δ 42 16 55.2 ✓
 $\delta + 25$ 13 38.7 ✓
 $\delta + 17$ 03 16.5 ✓

7.82670 ✓
 8.19679 ✓
 9.76728 ✓
 0.17213 ✓
 7.66230 ✓

$\delta - \delta'$ 13 47.8 ✓

δ 25 29 26.5 ✓

Ephs 25 29 26.9 ✓

$\phi - C$ - 0.7 ✓

Cur. of Plate + 0.2

2nd Order Ref 0.0

Irr Corr 0.0

$\delta + 25$ 29 26.7

$\phi - C$ - 0.2

α 6 48 10.37 ✓

Ephd 6 48 09.56 ✓

$\phi - C$ + 0.78 ✓

+ 0.01

+ 0.05

α 6 48 10.39

+ 0.83

9783-

Lunar Parallax

20

α 6 47 55.72"
 δ 7 06 52.0"
 γ 0 18 56.28"
 ϵ 90 44 09.20"
 ζ 1 1 79.7"
 η 70 42 14.5"

π 54' 02.94"
 9.86913"
 8.19699"
 8.91665"
 009998"
 7.02675"

9.95727"
 0.00000"
 0.00196"
 9.95873"

$\gamma - \alpha$ + 3' 39.88"
 ϵ + 19.612"

γ 72 16 55.2"
 δ + 25 13 38.9"
 $\gamma - \delta$ + 17 03 16.5"

9.82670"
 8.19699"
 9.76728"
 0.17213"
 7.66230"

$\delta - \gamma$ 15 97.8"

δ 25 29 26.5"

Ephs 25 29 26.9"

U-C = 0.4"

Curv. of Plate + 0.2
 2nd Order Ref 0.0

α 6 48 10.08"

Ephd 6 48 09.56"

U-C + 0.78"

+ 0.01

9786

Star Measures 9

21.

1	19954	19926	19370	20260
18.5	15822	14066	14387	15220
21.5	27	60	92	17
	58	70	82	57
	<u>18.7132</u>	<u>18.9128</u>	<u>21.7988</u>	<u>21.9960</u>

2	19772	20052	20098	20370
20.2	18876	12960	13808	16632
5.7	76	68	08	32
	77	67	98	80
	<u>20.2897</u>	<u>20.2901</u>	<u>5.6290</u>	<u>5.6258</u>

3	19800	19460	19382	19610
31.2	17348	12024	18750	10192
29.0	42	22	62	97
	912	67	62	07
	<u>31.2558</u>	<u>31.2560</u>	<u>29.0587</u>	<u>29.0589</u>

Moon Measures

1		20738	19135
22.5		12116	17762
17.9		12	70
01		60	67
		<u>17.8682</u>	<u>17.8626</u>

2	20383	19960	20212
23	10886	10956	19698
19.9	74	52	8.8
	86	77	30
	<u>17.9516</u>	<u>17.9520</u>	<u>17.9780</u>

3	20982	19850
29.1	19312	11037
16	02	26
	92	52
	<u>29.1176</u>	<u>29.1178</u>

9186

Star Measures

21

L	19954	19926	19370	20260
18.5	15822	14066	19387	15220
21.5	29	60	72	19
	58	90	82	59
	<u>187132</u>	<u>189128</u>	<u>217988</u>	<u>219960</u>
2	19772	20052	20098	20370
20.2	16876	12960	13808	16632
5.7	76	68	08	32
	79	67	78	80
	<u>202897</u>	<u>202901</u>	<u>56290</u>	<u>56258</u>
3	19900	19460	19382	19610
31.2	17398	12024	18750	10192
29.0	92	22	62	99
	912	69	62	09
	<u>312558</u>	<u>312560</u>	<u>290587</u>	<u>290589</u>

Moon Measures

L			20738	19135
22.5			12116	17762
19.9			12	70
21			60	69
			<u>198692</u>	<u>178626</u>
2		20383	19960	20212
23		10886	10926	19698
19.9		79	52	88
		96	79	30
	<u>199516</u>		<u>179520</u>	<u>179980</u>
3	20982	19850		
29.1	19312	11039		
16	02	26		
	92	52		
	<u>291176</u>	<u>291178</u>		

Moon Measures

22

2	20550	20788
24.3	17927	13908
16.6	31	08
+X	60	800
	<u>24.2624</u>	<u>24.2610</u>

2
24
17.6

20081	18836
13718	15232
08	30
98	60
<u>17.6378</u>	<u>17.6386</u>

6	20082	18784
23.7	12932	15960
18	72	50
	86	92
	<u>23.7148</u>	<u>23.7168</u>

7
23
18.5

19600	20232
15222	14638
12	30
10	40
<u>18.4387</u>	<u>18.4397</u>

8
22.5
18.6
+Y

19650	20167
17383	15458
78	48
60	82
<u>18.5277</u>	<u>18.5281</u>

KUMAR MEASUREMENT

44

2	20550	20788
24.3	17927	13908
16.6	31	08
+X	60	800
	<u>29.2629</u>	<u>29.2610</u>

2	20081	18836
24	13718	15232
17.6	08	30
	98	60
	<u>17.6378</u>	<u>17.6386</u>

10	20082	18784
23.7	12932	12960
18	92	50
	86	92
	<u>23.7198</u>	<u>23.7168</u>

1	19600	20232
23	12222	19638
18.5	12	30
	10	90
	<u>18.9387</u>	<u>18.9397</u>

8	19650	20167
22.0	17383	15958
18.6	73	98
+Y	60	82
	<u>18.5277</u>	<u>18.5281</u>

9786 Times & Etc.

23

Nov. 24/15

Exp. to Stars	7	09		7	34	
" " Moon	7	25	02.4	7	25	02.6
Clock fast		9	20.6			

H. Sid Time	7	20	41.9	$\phi - \alpha = +0^h 32$
H Long	4	44	31.05	
G. Sid T.	12	05	12.95	
Sid T. M. H.	16	09	26.96	
Interval	19	55	45.99	
Reduction		3	15.90	
G. M. T.	19	52	30.09	

From Naut Alm.	R. A.	Dec.
Moon - $h 19^h$	6 46 46.02	25 32 27.8
Moon in 1^m		2.1579
" " 52.5015	+1 53.29	-9 06.1
Tabular Place	6 48 39.31	25 28 21.7

Moon's Age 18 days

Pallax	54' 3" 77
Semid.	14 45.5
R.	88 55.5
Aug	13.4
Δn 4	-0.6
R.	898.3
R	1.9256
ap	-921
(1+a)R	1.8335
R ²	3.3617

934 - 14.95

$a = -502.3$
 $\frac{24}{-}$
 $- 478.3$

9786 *Mercury* x *unc*

Nov. 29 '15

Eye to stars	7	19		7	31	
" Moon	7	25	02.4"	7	25	02.6"
Clock fast		9	20.6"			
H. Sid Time	7	20	91.9"	8-4	+0"	32
H Long	4	44	31.05"			
G. Sid T.	12	05	12.95"			
Sid T M.H.	16	09	26.96"			
Interval	19	55	45.99"			
Reduction		3	15.90"			
G M. T	19	52	30.09"			

from Naut Alman.	R. A.		Dec.			
" Moon. h 19 ^h	6	46	46.02"	25	32	27.8
" Moon in ^m			2.1579"			- 9.7910
" " 52.5612"		+1	53.29"		-9	06.1
Julian Place	6	48	39.31"	25	28	21.7

Mercury's Age 18 days

Perihelion	54' 3" 77
Semi-d.	19 45.5"
R.	88 55.5"
Aug	13.4"
tr	-0.6"
R	89 8.3"
R	1.9 25.6"
are	-9 21"
(1+4)R	1.8 33.5"
R	3.3 61.7"

939 - 19.95"

a = -502.3

24

- 478.3

9786

Plate Constants.

27

x	18.4130	20.2899	31.2559
y	17.6999	19.5390	31.2093
$x-y$	+ 7131	+ 7509	+ 466

y	21.7977	5.6277	27.0588
η	21.7975	5.0527	27.3207
$y-\eta$	-2771	+5777	-2616

$x-y$	+500x	+83.3y	+2.3x	-18170
+7131	+9206	= +16337	+1791	= +18128
+7509	+10175	= +17654	+468	= +18128
+466	+15628	= +16094	+2009	= +18128
22.4273	+11217	+1391	+51	21.8769

$y-\eta$	+500y	-89.8x	+7.2y	-6779
-2771	+10779	= +8278	-1653	= +6625
+5777	+2817	= +8561	-1822	= +6739
-2616	+12029	= +9713	-2807	= +6606
16.6946	+8397	-2019	+120	16.6620

Tables $a = -.6$ $e = -1.1$ $a-e = +.5$ $b+d = -.5$
 Obs $+502.3$ -507.2 $= +7.9$ $= +6.5$
 $O-C$ -501.7 -506.1 $+7.0$

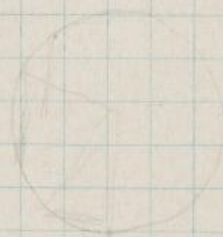
X	18.9130	20.2899	31.2559
Y	17.6999	19.5390	31.2093
$X-Y$	+ 7131	+ 7509	+ 466

Y	21.9979	5.6279	29.6588
η	21.7995	5.0527	29.3209
$Y-\eta$	- 2971	+ 5797	- 2616

$X-Y$	+520X	+83.37	+2.3X	-15176
+7131	+9206	= +16337	+1791	= +15128
+7509	+10173	= +17659	+968	= +122
+466	+15628	+16092	+2009	= 098
22.9273	+11219	+1391	+51	21.8759

$Y-\eta$	+520Y	-29.8X	+7.2Y	-671
-2971	+10799	= +8278	-1653	= +6625
+5797	+2819	= +8561	-1822	= +6739
-2616	+12029	= +9713	-2807	= +6606
16.6996	+8397	-2019	+120	16.6626

Tables	$a = -.6$	$e = -1.1$	$a-e = +.5$	$b+d = -.5$
Units	+502.3	-507.2	+9.9	+6.5

$A \approx 0$ $B \approx +3$ 

9786 Moon's center

25

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(y - y_0 + (y - y_0)^2)$	$(y - y_0)$
1	22,7283	0,0000	0	0,0000	3,3533	-87
2	23,0000	+0,5717		0,3268	3,3711	+94
3	24,1177	+1,6894		2,8541	3,3364	-253
4	+24,2617	+1,8334		3,3514	3,3514	-103
5	24,0000	+1,5717		2,4702	3,3607	-10
6	23,7158	+1,2875		1,6576	3,3619	+2
7	23,0000	+0,5717		0,3268	3,3711	+94
8	22,7283	0,0000		0,0000	3,3617	0

 $\Sigma = 33617$

	y	$y - y_0$	Δy	$(y - y_0)^2$	Σ
1	-17,8637	-18,311	-1	3,3533	+180 ^v
2	19,9998	-17,497	-1	3,0443	162 ^v
3	16,0000	-0,6975	0	0,4823	112 ^v
4	16,6975	0,0000	0	0,0000	90 ^v
5	17,6382	+0,9437	0	0,8905	59 ^v
6	18,0000	+1,3055	0	1,7043	43 ^v
7	18,4392	+1,7447	+1	3,0443	18 ^v
8	+18,5279	+1,8334	+1	3,3617	0 ^v

180°

$x = 23$ y 19,9998
 18,4392
 33,3890
 y_0 16,6975
 y_{max} 18,5279
 R 1,8334
 x_{max} 24,2617
 x_0 22,7283

17,8637
 18,5279
 33,3933
 16,6966

Moon's center $\begin{cases} x_0 22,7283 \\ y_0 16,6975 \end{cases}$

9786

Munroe

center

25

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	$y - y_0$
1	22.9283	0.0000	0	0.0000	3.3533	-89
2	23.0000	+0.5717		0.3268	3.3711	+99
3	29.1177	+1.6894		2.8541	3.3369	-253 $\frac{1}{2}w$
4	29.2617	+1.8334		3.3514	3.3519	-103
5	29.0000	+1.5717		2.4702	3.3607	-10
6	23.7158	+1.2875		1.6576	3.3619	+2
7	23.0000	+0.5717		0.3268	3.3711	+99
8	22.9283	0.0000		0.0000	3.3617	0

 $R^2 = 3.3617$

	y	$y - y_0$	Δy	$(y - y_0)^2$	
1	12.8639	-1.8311	-1	3.3533	+180
2	19.9998	-1.7997	-1	3.0993	162
3	16.0000	-0.6995	0	0.9823	112
4	16.6995	0.0000	0	0.0000	90
5	17.6382	+0.9437	0	0.8905	57
6	18.0000	+1.3055	0	1.7093	95
7	18.9392	+1.7997	+1	3.0993	18
8	18.5279	+1.8334	+1	3.3617	0

1800

$x = 23.7$	19.9998
	18.9392
	33.3890
y_0	16.6995
y_{max}	18.5279
R	1.8334
x_{max}	29.2617
x_0	22.9283

19.9639
18.5279
33.3933
16.6966

Munroe center $\left\{ \begin{array}{l} x_0 22.9283 \\ y_0 16.6995 \end{array} \right.$

Formation of Normals.

1 - 0,0	- 0,0	+ 154,
2 - 0,99	+ 53,5	- 163,5
3 - 0,29	- 106,5	+ 77,0
4 0,0	- 188,5	- 0,0
5 + 1,98	- 15,5	- 9,5
6 + 1,69	+ 2,5	+ 2,5
7 + 0,99	+ 53,5	+ 163,5
8 + 0,00	+ 0,0	+ 0,00
+ 7,16	+ 108,5	+ 264,0
- 1,28	- 310,5	- 273,0
+ 2,88	- 201,0	- 9,0

	a	b	c
a + 10	+ 0	0	- 15 [✓]
b + 0	+ 6		- 9 [✓]
c - 15 ⁻	+ 17		+ 2 [✓]
	+ 18		+ 3 [✓]
	+ 16		+ 1 [✓]
	+ 13		- 2 [✓]
	+ 6		- 9 [✓]
	+ 0		- 15 [✓]

$$+ 2,88 + 15,88 = + 1,56$$

$$+ [] + 108 = + 0,20$$

$$+ 15,80 = + 1,36$$

$$10,98 = + 7,52 - 0,25 = + 7,27$$

25⁰

9786 Conditional Equations

							0-e	26 new 0-e
1	+0.00	-1.83	= -	89	-0	-5' = -5'	-79	-99"
2	+0.57	-1.74	= +	94	-11	-5' = -16	+110	+101"
3	+1.69	-0.69	= -	25.8 ^{1/2 W}	-32	-2 = -39	-219	-217"
4	+1.83	0.00	= -	103	-35	0 = -35	-68	-65"
5	+1.57	+0.94	= -	10	-30	+3 = -27	+17	+18"
6	+1.29	+1.31	= +	2	-23	+4 = -21	+23	+21"
7	+0.57	+1.74	= +	94	-11	+5' = -6	+140	+91"
8	+0.00	+1.83	= +	0	-0	+5' = +5'	-5	-20"

$$+250 - 207$$

Average 9.0

$$+10.98 + 2.88 = -201.0 + 7.52$$

$$+2.88 + 15.88 = -9.0 + 1.56$$

$$+2.88 + .76 = -52.8$$

$$+0.086 \Delta$$

$$+15.12 = +73.8$$

$$b = +2.9$$

$$10.98 = -201. - 8.3 = -209.3$$

$$a = -19.1$$

$$+0.66$$

Arc measured 180°

$$\frac{p}{n} .33$$

$$\frac{\sum v}{n} = +5'$$

$$\text{In } 4 \quad R 1.83$$

$$-2RC = -0.73$$

$$\frac{+5}{33} = +15'$$

$$\Delta R = +0.2$$

$$\Delta b = -0.06$$

$$\Delta \delta = 0.0$$

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

$$\Delta a = -0.48$$

$$\Delta \gamma = -0.02$$

$$\Delta P = 0$$

9786 Conditional Equations

1	+ 0.00	- 1.83	= - 89	- 0	- 5	= - 5	- 79	0.6
2	+ 0.57	- 1.79	= + 99	- 11	- 5	= - 16	+ 110	
3	+ 1.69	- 0.69	= - 253	- 32	- 2	= - 34	- 219	$\frac{1}{4} = -50$
4	+ 1.83	0.00	= - 103	- 35	0	= - 35	- 68	
5	+ 1.57	+ 0.99	= - 10	- 30	+ 3	= - 27	+ 17	
6	+ 1.29	+ 1.31	= + 2	- 25	+ 9	= - 21	+ 23	
7	+ 0.57	+ 1.79	= + 99	- 11	+ 5	= - 6	+ 100	
8	+ 0.00	+ 1.83	= + 0	- 0	+ 5	= + 5	- 5	

$$+ 250 - 207$$

Average 9.0

$$+ 10.98 + 2.88 = - 201.0$$

$$+ 2.88 + 15.88 = - 9.0$$

$$+ 2.88 + 76 = - 52.8$$

$$+ 15.12 = + 93.8$$

$$b = + 2.9$$

$$10.98 = - 201. - 83 = - 209.3$$

$$a = - 19.1$$

Arc Measured 150°

$$\frac{p}{n} = .33$$

$$\frac{\Sigma v}{n} = + 5$$

$$\frac{+ 5}{.33} = + 15$$

$$aR = + 0.2$$

9786 Moon's Mean Position

27

$$\begin{array}{r} \chi_0 \ 22.9283^{\circ} \\ -10^{\circ} \\ \hline 22.9273^{\circ} \end{array}$$

$$\begin{array}{r} \gamma_0 \ 16.6945^{\circ} \\ +1^{\circ} \\ \hline 16.6946^{\circ} \end{array}$$

From Plate Constants

$$\chi \ 21.8759^{\circ}$$

$$\gamma \ 16.6620^{\circ}$$

$$\xi + 0.1271^{\circ}$$

$$\eta - 1.3380^{\circ}$$

$$\begin{array}{r} \log \xi \ 9.09377^{\circ} \\ \log \eta \ 9.95659^{\circ} \\ \hline 8.50724^{\circ} \\ 0.62999^{\circ} \end{array}$$

$$\begin{array}{r} \log \tan \delta \ 9.6726^{\circ} \\ \xi^2 \ 8.1875^{\circ} \\ \hline 7.0539^{\circ} \\ 9.9135^{\circ} \end{array}$$

$$\delta - A \quad + 0.26^{\circ}$$

$$\eta_1 + 0.0005^{\circ}$$

$$A \ 6 \ 48 \ 17.00^{\circ}$$

$$\begin{array}{r} \log \eta_0 \ 0.12676^{\circ} \\ \hline 7.33115^{\circ} \\ 2.79534^{\circ} \end{array}$$

$$\gamma_0 \ 6 \ 48 \ 09.74^{\circ}$$

$$\text{Red} \quad + 5.36^{\circ}$$

$$\begin{array}{r} \delta - D \quad - 10 \ 29.2^{\circ} \end{array}$$

$$\gamma_1 \ 6 \ 48 \ 15.10^{\circ}$$

$$D + 25 \ 22 \ 51.0^{\circ}$$

$$S_0 + 25 \ 12 \ 26.8^{\circ}$$

$$\text{Red} \quad - 0.9^{\circ}$$

$$S' \ 25 \ 12 \ 25.9^{\circ}$$

9786 *Moon's Mean Position*

2;

$$\begin{array}{r} \gamma_0 \ 22.9283'' \\ -10'' \\ \hline 22.9273'' \end{array}$$

$$\begin{array}{r} \gamma_0 \ 16.6995'' \\ +1'' \\ \hline 16.6996'' \end{array}$$

from Plate Constants

$$\gamma \ 21.8759''$$

$$\gamma \ 16.6620''$$

$$\delta + 0.1271''$$

$$\delta - 1.3380''$$

$$\log \gamma \ 9.09377''$$

$$\log \tan \delta \ 9.6726''$$

$$\log \delta \ 9.95609''$$

$$\gamma'' \ 81815''$$

$$8.50729''$$

$$7.0039''$$

$$0.62999''$$

$$9.9135''$$

$$\gamma - A \quad + 09.26''$$

$$\eta \quad + 0.0000''$$

$$A \ 6 \ 98 \ 19.00''$$

$$\log \eta \ 0.012698''$$

$$\gamma_0 \ 6 \ 98 \ 09.79''$$

$$7.33115''$$

$$2.79531''$$

$$\text{Red} \quad + 5.36''$$

$$\delta - D \quad - 10 \ 29.2''$$

$$\gamma_1 \ 6 \ 98 \ 1510''$$

$$D \ + 25 \ 22 \ 51.0''$$

$$D_0 \ + 25 \ 12 \ 26.8''$$

$$\text{Red} \quad - 0.9''$$

$$\delta' \ 25 \ 12 \ 25.9''$$

28

$$H + \alpha \quad 8 \quad 33.3 \quad = \quad 128^\circ \quad 19.5' \quad S \quad 26^\circ \quad 12 \quad 26.1$$

1 24.1

8	6	49,21	?
---	---	-------	---

G	23	29
---	----	----

$G + \alpha \quad 5^- \quad 52 \quad 1 \quad 2 \quad 88^0 \quad 1,5^-$

Long Cond 9.9365

2	0	5	8	2	8
---	---	---	---	---	---

$$4 \quad 0.5393$$

$\log_{10}(G+1)$ 8,53 7 7

9	1	3	6	7	9
---	---	---	---	---	---

Sim 11 99997

 $\tan 9.6728$

8 8 2 3 9

$\log \sin \delta$ 9.6293

 $\cos(\pi/4) = 9.7925$ h 13039

$\sum (H + d) = 9.89 \times 6$

Seed 0.0435

8.8239

$\log q' \quad 9.9053$

9 9.8 6 4 3

log h: 0.7252 n

 $\frac{1}{2} 0.0654$

2 + 3 > 6 3

 $2 + 0.731$

$\frac{1}{6}$	+	1	1	6	3
---------------	---	---	---	---	---

$$+ 5357$$
 $91 + 0.804$

$L' = 5311$

$$1 + 3 = 6 \quad 2$$

1045

See plate 9786

9186 Red. to App. Place

2

$$H + x \quad 8 \quad 33.3 = 125^\circ 19.5' S \quad 25^\circ 12' 26.1$$

$$b \quad 1 \quad 94.1$$

$$x \quad 6 \quad 99.212.19$$

$$\log \cos \delta \quad 99.565$$

$$G \quad 23 \quad 2.9$$

$$+ \quad 0.5828$$

$$G + x \quad 3^\circ \quad 52.1 = 88^\circ 1.5$$

$$+ \quad 0.5393$$

$$\log \cos (G + H) \quad 8.5379$$

$$\log \sin \delta \quad 9.6293$$

$$y \quad 1.3679$$

$$\cos (H + x) \quad 9.7925 \quad n$$

$$\sin \dots \quad 9.9997$$

$$h \quad 1.3039$$

$$\tan \quad 9.6728$$

$$\sin (H + x) \quad 9.8996$$

$$8.8239$$

$$\sec \delta \quad 0.0435$$

$$8.8239$$

$$\log q' \quad 9.9053$$

$$\log h' \quad 0.7252 \quad n$$

$$q \quad 9.8698$$

$$h \quad 0.0659$$

$$f \quad +3.963$$

$$g' \quad +0.809$$

$$g \quad +0.731$$

$$h' \quad -5.311$$

$$h \quad +1.163$$

$$i \quad +3.762$$

$$+5.357$$

$$-1.045$$

9786

Lunar Parallax

29

$$\begin{array}{rcl}
 \alpha' & 6 \ 78 & 13.10'' \\
 + & 7 \ 20 & 41.9'' \\
 \hline
 \delta - \alpha' & 0 \ 32 & 26.80'' \\
 = & 80 \ 06 & 42.00'' \\
 & + 3 & 7.66'' \\
 & 8 \ 03 & 34.34'' \\
 9.95727'' \\
 0.00000'' \\
 0.00731'' \\
 \hline
 9.96158''
 \end{array}$$

$$\begin{array}{rcl}
 \pi & 59 & 3.77'' \\
 \delta - \alpha' & + 6 & 15.33'' \\
 = & & + 25.02''
 \end{array}$$

$$\delta \ 72 \ 28 \ 07.2''$$

$$\delta \ 25' \ 12 \ 26.9''$$

$$\delta - \delta' \ 17 \ 15 \ 41.3''$$

$$\begin{array}{rcl}
 9.82640'' \\
 8.19660'' \\
 9.97236'' \\
 0.17057'' \\
 \hline
 7.66593''
 \end{array}$$

$$\delta - \delta' \ 15' \ 55.8''$$

$$\delta \ 25' \ 28 \ 21.7''$$

$$\text{Cphd} \ 25' \ 28 \ 21.7''$$

$$\text{W-C} \ -0.0$$

$$\begin{array}{rcl}
 \text{Curv. of Plate} & +0.2 & \\
 \text{2nd Order Ref} & 0.0 &
 \end{array}$$

$$\text{In low} \ 0.0$$

$$\delta \ +25' \ 28 \ 21.7$$

$$\text{W-C} \ 0.0$$

$$\alpha \ 6 \ 78 \ 40.12''$$

$$\text{Cphd} \ 6 \ 78 \ 39.31''$$

$$\text{W-C} \ +0.81''$$

$$+0.01$$

$$-0.02$$

$$\begin{array}{rcl}
 \alpha \ 6 \ 78 & 40.10'' \\
 & +0.79''
 \end{array}$$

9786 Lunar + parallel

1'	6	98	15.10"	π	59	3.77"
+	7	20	91.9"			
$\delta - \lambda'$	0	32	26.80"		9.86913"	
=	80	06	92.00"		8.19660"	
		+3	786"		9.19952"	
	8	03	38.39"		0.09991"	
			9.95727"		7.25866"	
			0.00000"			
			0.00931"			
			9.96158"			

$\lambda - \lambda'$ + 6 15.83"

= 125.02"

 δ 92 28 07.2" δ 25 12 25.8" $\delta - \delta'$ 17 15 91.3"

9.82690"

8.19660"

9.97236"

0.17057"

7.66593"

 $\delta - \delta'$ 15 55.8" δ 25 28 21.8" α 698 90.12"

Ephd 25 28 21.7"

Ephd 6 98 39.31"

U-C -0.0

U-C +0.85"

row of Plate +0.2

+0.01

2nd Order 144 0.0

In Cor 0.0

-0.012

 δ + 25 28 21.7 δ 698 90.10

U-C 0.0

+0.79

