

1911phae, prof. 8

KG
11366
v. 877

I

863

872

873

Formulae for computing standard coords.

$$\xi = [8.50724] \sin(\alpha - A) \cos \delta + \frac{\xi(\xi^2 + \eta^2)}{391000}$$

$$\eta = [7.33115] \tan(\delta - D) + [7.0534] \xi^2 \tan \delta.$$

(See page 13 in Prof. Russell's
book of reductions. Nov. 1910.)

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No. 18588

Harvard Lunar Plates.

Measurements and Reductions.

Mary Fowler.

Septemter 1912.

Vol. I

Plate no.	Date	Page
863	1911 Jan. 12	
872	1911 Jan. 16	35
873	1911 Jan 11	57

1912 Sept. 20.

Plate MC 863.

Comparison stars.

Δ no. mag.
 Cape 817 7.2
 $x = 30.7$ $y = 20.7$
 Q 5^A 38^m 42.35^s
 L 42.39
 E 42.35
 mean 42.36
 Prec. to 1911 41.03
 Pos. for 1911
 R.A. 5^h 39^m 23.39^s
 $A = 5$ 46 42
 $Q - A =$

Δ no. mag.
 Cape 838 9.1
 $x = 16.4$ $y = 10.9$
 h m s
 C 5 46 53.17
 L not given
 E
 Prec. to 1911 41.47 ✓
 R.A.
 (1911) 5 47 34.64 ✓

C +26° 17' 54.0
 L 54.3
 E 54.2
 mean 54.2
 Prec. to 1911 +20.1
 Pos. 1911
 Decl. = +26° 18' 14.3

C +27° 36' 1.2
 Prec. to 1911 +12.3 ✓
 Decl?
 1911 +27° 36' 13.5

Plate MC 823.

Comparison stars.

Star	Mag.	RA	Dec.	Star	Mag.	RA	Dec.
1	3.0	12 17 10	+12 17 10	1	3.0	12 17 10	+12 17 10
2	3.5	12 17 10	+12 17 10	2	3.5	12 17 10	+12 17 10
3	4.0	12 17 10	+12 17 10	3	4.0	12 17 10	+12 17 10
4	4.5	12 17 10	+12 17 10	4	4.5	12 17 10	+12 17 10
5	5.0	12 17 10	+12 17 10	5	5.0	12 17 10	+12 17 10
6	5.5	12 17 10	+12 17 10	6	5.5	12 17 10	+12 17 10
7	6.0	12 17 10	+12 17 10	7	6.0	12 17 10	+12 17 10
8	6.5	12 17 10	+12 17 10	8	6.5	12 17 10	+12 17 10
9	7.0	12 17 10	+12 17 10	9	7.0	12 17 10	+12 17 10
10	7.5	12 17 10	+12 17 10	10	7.5	12 17 10	+12 17 10

Star	Mag.	RA	Dec.	Star	Mag.	RA	Dec.
11	8.0	12 17 10	+12 17 10	11	8.0	12 17 10	+12 17 10
12	8.5	12 17 10	+12 17 10	12	8.5	12 17 10	+12 17 10
13	9.0	12 17 10	+12 17 10	13	9.0	12 17 10	+12 17 10
14	9.5	12 17 10	+12 17 10	14	9.5	12 17 10	+12 17 10
15	10.0	12 17 10	+12 17 10	15	10.0	12 17 10	+12 17 10

Lunar Plate MC 863

Comparison Stars - continue next

1912 Sept. 20.

Plate MC 863

Comparison Stars

L. no. mag.
 Cape 817 7.2
 $x = 30.7$ $y = 20.7$
 G 5 38 42.35
 L 42.39
 E 42.35
 mean 42.36
 Prec. to 1911 41.03
 Pos. for 1911
 R.A. 5 39 23.39
 A : 5 46 42
 -A :

2 no. mag.
 Cape 838 9.1
 $x = 16.4$ $y = 10.9$
 C 5 46 53.17
 L not given
 E
 Prec. to 1911 41.47
 R.A.
 (1911) 5 47 34.64

C +26° 17' 54.0
 L 54.3
 E 54.2
 mean 54.2
 Prec. to 1911 +20.1
 Pos. 1911
 Decl. +26° 18' 14.3

C +27° 36' 1.8
 Prec. to 1911 12.3
 Decl?
 1911 +27° 36' 13.5

Comparison Stars - continued.

3. no. mag
 Cape 825 6.5
 $x = 26.1$ $y = 26.7$
 C $5^h 41^m$ 23.61
 L 23.60
 E 23.62
 mean 23.61
 Prect 1911 40.80
 R.A. 5 42 4.41

4. no. mag
 Cape 841 7.9
 $x = 15.8$ $y = 30.6$
 C $5^h 47^m$ 20.51
 L 20.60
 E 20.55
 mean 20.55
 5 48 1.21

C + 25° 31' 51.9
 L 52.1
 E 51.2
 mean 51.7
 Prect 1911 17.5
 S + 25 32 9.2

C + 25° 3' 0.3
 L 0.8
 E 0.7
 mean 0.6
 11.8
 + 25 3 12.4

Comparison Stars - continued.

3. no. mag
 Cape 825 6.5
 $x = 26.1$ $y = 26.7$
 C 5 41^m 23.61
 L 23.60
 E 23.62
 mean 23.61
 P. A. 1911 40.80
 P. A. 5 42 4.41

4. no. mag
 Cape 841 7.9
 $x = 15.8$ $y = 30.6$
 C 5 47^m 20.51
 L 20.60
 E 20.55
 mean 20.55
 40.66
 5 48 1.21

C + 25° 31' 51.9
 L 52.1
 E 51.7
 mean 51.7
 P. A. 1911 17.5
 S + 25 32 9.7

C + 25° 3' 0.3
 L 0.8
 E 0.7
 mean 0.6
 11.8
 + 25 3 12.4

Roman Plate MC 863
Comparison Stars - continued

1912 Sept 21. 3

5.	no.	mag.
cape	856	6.1
	$x = 3.0$	$y = 11.2$
C. 5	54	43.37
L		43.43
E		43.37
mean		43.39
Prec. to 1911		+ 41.48 ✓
R.A. 5	55	24.86 ✓

C. +27	34	2.0
L		1.4
E		1.9
mean		1.8 ✓
Prec to 1911		+ 4.8 ✓
8 +27	34	6.6 ✓

Lunar Plate MC 863

Comparison stars - continued

1912 Sept 21. 3

5.	no.	mag.			
cape	856	6.1			
	$x = 3.0$	$y = 11.2$			
C. 5	54	43.37	40.50	1097836	9590.00
L		43.43		50	00
E		43.37	90	40	00
mean		43.39			
Preceding 1911	41.48	0.6955	30.6398		30.6418
RA 5	55	24.87			

15317	15267	15325	14956
640048	1437579	924042	1103040
90	79	40	90
16	65	92	45

109719 109712 183857 183868

For remainder of 1912 see page 5

16302	15422	15432	15365
906440	1275549	661210	1219444
52	45	16	00
10	94	48	75

267243 267232 267166 267170

C. +27	34	2.0			
L		1.4	5447	15172	14915
E		1.9	17840	1316824	6922.00
mean		1.8	70	67	26.00
Preceding 1911	4.8	92	36		23
δ +27	34	6.6			

305972 305932 157970 157987

15260	14742	15029	15750
1337270	674396	1010446	598070
7570	86	94	71
60	07		60

211927 211907 29777 29783

Lunar Plate MC 863.

1912 Sept 21 4

measured.

Star

<u>1.</u>	<u>d</u>	<u>y</u>	<u>n</u>	<u>d</u>	<u>x</u>	<u>n</u>
30.7	139	64	15588	144	45	16005
20.7	70	1509	1254050	1083836		959000
	05		45	50		00
	55		90	40		22

20.6949

20.6955

30.6398

30.6418

<u>2.</u>	15512	15267	15385	14950
16.4	640098	1437579	924042	1108080
10.9	90	79	40	80
	16	65	92	45

10.9119✓

10.9112

18.3852

18.3868

For remeasure of 142 see page 5

<u>3.</u>	16308	15484	15438	15365
26.1	906460	1275548	661210	1419494
26.7	58	45	16	00
	10	94	48	75

26.7248

26.7262

26.1166

26.1170

<u>4.</u>	15672	15297	15172	14915
15.8	969892	1117880	1316862	693840
30.6	92	70	62	36
	75	92	96	28

30.5979

30.5982

15.7989

15.7987

<u>5.</u>	15360	14796	18029	15750
3.0	1337270	679896	1080496	598070
11.2	75	06	04	78
	60	03		60

11.1987

11.1997

2.9772

2.9783

Runar Plate MC 863.

1912 Sept 21 4

measured.

Star

L	d	y	n	d	n
30.7	13964		15588	14445	16005
20.7	701509		1254050	1083836	959000
	05		45	50	00
	55		90	40	22
	<u>20.6949</u>		<u>20.6955</u>	<u>30.6398</u>	<u>30.6418</u>

16.4	15512	15267	15385	14950
10.9	640098	1437579	924042	1108080
	90	79	40	80
	16	65	92	45
	<u>10.9119</u>	<u>10.9112</u>	<u>18.3852</u>	<u>18.3868</u>

For remeasure of 172 see page 5

26.1	16308	15484	15438	15365
26.7	906460	1275548	661210	1419494
	58	45	16	00
	10	94	48	75
	<u>26.7248</u>	<u>26.7262</u>	<u>26.1166</u>	<u>26.1170</u>

5.8	15672	15277	15172	14915
30.6	969892	1117880	1316862	693840
	92	70	62	36
	75	92	96	28
	<u>30.5979</u>	<u>30.5982</u>	<u>15.7989</u>	<u>15.7987</u>

3.0	15360	14796	18029	15750
1.2	1337270	679896	1080496	598070
	75	06	04	78
	60	03		60
	<u>11.1987</u>	<u>11.1997</u>	<u>2.9772</u>	<u>2.9783</u>

MC 863

1912 Oct. 1. 5

Mean measured coordinates

star	x	y	R.A.	Decl.
1	30.6408	20.6952	5h 55m 25s	27° 34' 07"
2	16.3860	10.9116	42 04	25 32 09
3	26.1168	26.7255	48 01	25 03 12
4	15.7988	30.5980	39 23	26 18 14
5	2.9778	11.1992	47 35	27 36 14
<hr/>				
5	191.9202	1100.1295	57 232 28	57 32 356
	18.3840	20.0259	56 46" 308	26 24 47
	31	1.9741	+ 12	- 15 18
	3860	465		
	11520	98705		
	119040	118446		
		78964		
		917.9565		
		15' 18"		

$A = 5^h 46^m 42^s$
 $D = 26^\circ 09' 29''$ } centre of plate.

Re-measures of stars 1 and 2

1912 Oct 11.

1	x	y	N	x	y	N
	15937	14023		15118	17030	
	899801	1097480		1152025	1062614	
	02	74		30	20	
	50	23		34	30	
	<u>20.6946</u>	<u>20.6953</u>		<u>30.6401</u>	<u>30.6410</u>	
<hr/>						
2	14980	13397		15500	12700	
	585755	1251012		937072	983832	
	52	12		70	38	
	80	97		06	00	
	<u>10.9125</u>	<u>10.9114</u>		<u>16.3867</u>	<u>16.3864</u>	

MC 863

1912 Oct. 1. 5.

Mean measured coordinates

Star	α	δ	R.A.	Decl.
1	30.6408	20.6952	5 ^h 45 ^m 25 ^s	27° 34' 07"
2	16.3860	10.9116	5 ^h 42 ^m 04 ^s	25° 32' 09"
3	26.1168	26.7255	5 ^h 48 ^m 01 ^s	25° 03' 12"
4	15.7988	30.5980	39 23	26 18 14
5	2.9778	11.1992	47 32	27 36 14
			232 28	32 3 56
5	91.9202	100.1295	5 ^h 46 ^m 30 ^s	26 24 47
	18.3840	20.0259	+ 12	- 15 18
	31	1.9741		
	3800	465		
	11.520	78705		
	11.9040	118446		
		78964		
		917.9565		
		15' 18"		

$A = 5^{\text{h}} 46^{\text{m}} 42^{\text{s}}$
 $D = 26^{\circ} 09' 29''$ } center of plate.

Re-measures of stars 1 and 2

1912 Oct 11.

Star	α	δ	Star	α	δ
1			1		
	α	δ		α	δ
	15937	14023		15118	17030
	899801	1097480		1152025	1062614
	02	74		30	20
	50	23		34	30
	<u>20.6946</u>	<u>20.6953</u>		<u>30.6401</u>	<u>30.6410</u>
2			2		
	14980	13397		15500	12700
	585755	1251012		937072	983832
	52	12		70	38
	80	97		06	00
	<u>10.9125</u>	<u>10.9114</u>		<u>16.3867</u>	<u>16.3864</u>

Standard Coordinates

Star 1	2	3
α 5 ^h 46 ^m 42 ^s	5 47 34.64 ^v	5 42 04.41
$\alpha - A$ - 7 18.61	+ 0 52.64 ^v	- 4 37.59
$\sin(\alpha - A)$ - 438.54	+ 52.64 ^v	- 277.61
\log 2.64201 ^v	1.72132 ^v	2.44344 ^v
\cos 9.95253	9.94752 ^v	9.95536
ξ_0 1.10178 ^v	0.17608 ^v	0.90604 ^v
$\xi_0 -$ 12.6409 ^v	+ 1.5000 ^v	- 8.0545 ^v
ξ_1 - 49	+ 5 ^v	- 15 ^v
ξ 30.6458 ^v	16.4995 ^v	26.0560
η 30.6408	16.3860 ^v	26.1168
$\alpha - \xi =$ + 50	+ 1135 ^v	- 608
δ 26° 09' 29"	27 36 13.5 ^v	25 32 09.2
$\delta - D$ + 8 45.3	+ 1 26 44.5 ^v	- 37 19.8
$\tan \delta - D$ + 525.3	+ 5205.6 ^v	- 2239.9
\log 2.72041	3.71647 ^v	3.35023 ^v
η_0 0.05156	1.04762 ^v	0.68138 ^v
$2 \log \xi$ 2.2036	0.3522 ^v	1.8121
$\tan \delta$ 9.6940	9.7184 ^v	9.6792
η_1 8.9510	7.1240 ^v	8.5447
$\eta_0 +$ 1.1261	11.1590^v	- 4.8015
$\eta_1 +$ 893	+ 11.2879^v	+ 351
η 20.7846	10.8397 ^v	26.7664
y 20.6952	10.9116	26.7255
$y - \eta$ + 894	719	+ 409

Research put on upside down so signs of $\xi + \eta$ are ^{changed} reversed

Standard Coordinates

Star 1	2	3
A 5 ^h 46 ^m 42 ^s	5 47 34.64	5 42 04.41
$\alpha - A$ - 7 18.61	+ 0 52.64	- 4 37.59
$\tan(\alpha - A)$ - 438.54	+ 52.64	- 277.61
log 2.64201	1.72132	2.44344
cos 9.95253	9.94752	9.95536
ξ_0 1.10178	0.17608	0.90604
$\xi_0 -$ 12.6409	+ 1.5000	- 8.0545
ξ_1 - 49	+ 5	- 15
ξ 30.6458	16.4995	26.0560
α 30.6408	16.3860	26.1168
$\alpha - \xi =$ + 50	+ 1135	- 608
D 26° 09' 29"	27 36 13.5	25 32 09.2
δ 26 18 14.3	+ 1 26 44.5	- 37 19.8
$\delta - D$ + 8 45.3	+ 5205.6	- 2239.9
$\tan \delta - D$ + 525.3		
log 2.72041	3.71647	3.35023
η_0 0.05156	1.04762	0.68138
2 log ξ 2.2036	0.3522	1.8121
$\tan \delta$ 9.6940	9.7184	9.6792
η_1 2.9510	7.1240	8.5447
$\eta_0 +$ 1.1261	11.1590	- 4.8015
$\eta_1 +$ 893	+ 13	+ 351
η 20.7846	10.8397	26.7664
y 20.6952	10.9116	26.7255
$y - \eta$ + 894	+ 719	+ 409

Reverse first on upside down so signs of $\xi + \eta$ are reversed.

MC863

1912 Oct. 1.

7

Standard Coordinates

- continued

Star	4	5
A	5 ^h 46 ^m 42 ^s	5 ^h 55 ^m 24.86 ^s
α	5 48 01.21	5 55 24.86
$\alpha - A$	+ 1 19.21	+ 8 42.86
$\sin(\alpha - A)$	+ 79.21	+ 522.98
\log	1.89878	2.71848
$\cos \delta$	9.95709	9.94766
" ξ_0	0.36311	1.17338
ξ_0	+2.3074	+14.9066
ξ_1	+ 3	+ 125
ξ	15.6923	3.0809
χ	15.7988	2.9778
$\chi - \xi$	- 1065	+ .1031
D	+26 09 29	27° 34' 06.6"
δ	25 03 12.4	+ 1 24 37.6
$\delta - D$	- 1 06 16.6	+ 5078.7
$\tan \delta - D$	- 3.977.1	
\log	3.59957 ^m	3.70575
" η_0	0.93072 ^m	1.03690
" $\tan \delta$	9.66973	9.7177
2" ξ_0	0.7262	2.3467
" η_1	7.4493	9.1178
η_0	-8.5255	+10.8868
η_1	+ 28	+ 1312
η	30.5227	10.9820
y	30.5980	11.1992
$y - \eta$	- 753	- 2172

Reseau was put on up side down so signs of ξ and η must be changed.

1911phae.pae.18

Standard Coordinates

Coordinates

2 4 2 2
28.4 7.3 2
28.4 3. +
28.4 2. +

24.1 1.5
24.1 1.5

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24.1 1.5

24.1 1.5

Standard Coordinates

Standard Coordinates

- continued

Star	4	5.
A	5 ^h 46 ^m 42 ^s	5 ^h 55 ^m 24.86 ^s
α	5 45 01.21	5 55 24.86
$\alpha - A$	+ 1 19.21	+ 8 42.86
$\sin(\alpha - A)$	+ 79.21	+ 522.98

log 1.89878
cos δ 9.95709

2.71848
9.94766

δ_0 0.36311

1.17338

δ_0 +2.3074

+14.9066

δ_1 + 3

+ 125

δ 15.6923

3.0809

α 15.7988

2.9778

$\alpha - \delta$ - 1065

- 1031

D +26 09 29
 δ 25 03 12.4
 $\delta - D$ - 1 06 16.6
tand-D - 3977.1

27° 34' 06.6
+ 1 24 37.6
+ 5078.7

log 3.59957m

3.70575

η_0 0.93072m

1.03690

tand 9.66973

9.7177

2 δ_0 0.7262

2.3467

η_1 7.4493

9.1178

η_0 -8.5255

+10.8868

η_1 + 28

+ 1312

η 30.5227

10.9820

η 30.5980

11.1992

$\eta - \eta$ - 753

- 2172

Recess was put on up side down so signs of δ and η must be changed.

MC863

1912 Oct 10.

8

Preliminary Reduction

Star $x-3 + 1104$ $+2200$ -226 -75

$$\begin{array}{rclclcl}
 1 & +50 & +2276 & =+2326 & =+126 & -61 & =+65 & =-10 \\
 2 & +1135 & +1200 & =+2335 & =+135 & -33 & =+102 & =+27 \\
 3 & +608 & +2940 & =+2332 & =+132 & -52 & =+80 & =+5 \\
 4 & +1065 & +3366 & =+2301 & =+101 & +32 & =+69 & =-6 \\
 5 & +1031 & +1232 & =+2263 & =+63 & -6 & =+57 & =-18 \\
 \text{Moon} & -18.5819^h & +2230^v & = & = & = & = & =-18.5901^h
 \end{array}$$

mean reversed

$y-\eta$ $-110(x-20)$ $-4x$ $+4$ $+332$

$$\begin{array}{rclclcl}
 1 & +894 & +1170 & =+216 & =+128 & =+339 & +21 & =+318 & =+14 \\
 2 & -719 & +397 & =-322 & =66 & =-388 & +11 & =-377 & =-45 \\
 3 & +409 & -672 & =-263 & =164 & =-367 & +27 & =-340 & =-8 \\
 4 & +753 & +462 & =-291 & =63 & =-354 & +31 & =-323 & =-9 \\
 5 & +2172 & +1872 & =-3007 & =12 & =-312 & +11 & =-301 & =+31 \\
 \text{Moon} & -20.2716 & +156 & = & = & = & = & =-20.2282
 \end{array}$$

	$x-3$	$y-\eta$
1	$30.64a + 20.69b + c = -10$	$+14$
2	$26.11a + 26.73b + c = +5$	-8
3	$16.39a + 10.91b + c = +27$	-45
4	$15.80a + 30.60b + c = +6$	$+9$
5	$2.98a + 11.20b + c = -18$	$+31$

$$\begin{array}{rclcl}
 24.58 & +19.44 & +c & = & -7.33 & +13.00 \\
 9.39 & +20.90 & +c & = & +12.00 & -20.00 \\
 20.96 & +28.66 & +c & = & +0.50 & -0.50 \\
 16.67 & +14.27 & +c & = & +0.50 & 0.00
 \end{array}$$

$$\begin{array}{rclcl}
 +14.99 & -1.45 & = & -19.33 & +33.00 \\
 +4.29 & +14.39 & = & 0.00 & -0.50 \\
 +4.29 & -0.41 & = & -5.53 & +9.44 \\
 & +14.80b & = & +5.53 & -9.44 \\
 & & = & +0.37 & -0.67 \\
 +14.99a & = -19.33 + 0.54 & = & -18.79 & +33.00 - 0.97 = +32.03 \\
 & & = & -1.25 & a = +2.14
 \end{array}$$

-7.3	+12.0	+0.5	+0.5	+13.0	-20.0	-0.5	0.0
+30.5	+11.7	+26.2	+20.9	-52.2	-20.1	-44.9	-35.7
-7.2	-7.7	-10.6	-5.3	+13.0	+14.0	+19.2	+9.6
+16.0	+16.0	+16.1	+16.1	-26.2	-26.1	-26.2	-26.1

c from $x-3$ c from $y-\eta$

MC863

1912 Oct 10.

8

Preliminary Reduction

Star $x-3$ +1104

+2200 +250

+75

$$1 - 50 - 2276 = -2326 = -126 + 61 = -65 = +10$$

$$2 - 1135 - 1200 = -2335 = -135 + 33 = -102 = -27$$

$$3 + 608 - 2940 = -2332 = -132 + 52 = -80 = -5$$

$$4 + 1065 - 3366 = -2301 = -101 + 32 = -69 = +6$$

$$5 - 1031 - 1232 = -2263 = -63 + 6 = -57 = +18$$

$$18.5819 + 2230 = 18.8049 \quad 18.58 + 9 = 37 \quad 18.5737$$

$$18.5847$$

y-y +110(x-20)

+4x -

-4 =

-332

$$1 - 894 + 1170 = +276 + 128 = +339 - 21 = +318 = -14$$

$$2 + 719 - 397 = +322 + 66 = +388 - 11 = +377 = +45$$

$$3 - 409 + 672 = +263 + 104 = +367 - 27 = +340 = +8$$

$$4 + 753 - 462 = +291 + 63 = +354 - 31 = +323 = -9$$

$$5 + 2172 - 1872 = +300 + 12 = +312 - 11 = +301 = -31$$

$$20.2716 + 156 = 20.2872 - 74 = 20.2798 + 20 = 20.2150$$

$$20.2290$$

	$x-3$	$y-y$
$30.64a + 20.69b + c =$	+10	-14
$26.11a + 26.73b + c =$	-5	+8
$16.39a + 10.91b + c =$	-27	+45
$15.80a + 30.60b + c =$	+6	-9
$2.98a + 11.20b + c =$	+18	-31

three
signs
should all
be changed

24.38	$+19.44$	$+c$	$= -7.33$	$+13.00$
9.39	$+20.90$	$+c$	$= +12.00$	-20.00
20.96	$+28.66$	$+c$	$= +0.50$	-0.50
16.67	$+14.87$	$+c$	$= +0.50$	0.00

$+14.99$	-1.45	$= -19.33$	$+33.00$
$+4.29$	$+14.39$	$= 0.00$	-0.50
$+4.29$	-0.41	$= -3.53$	$+9.44$
	$+14.80$	$= +5.53$	-9.44

$+14.99a$	$= -19.33 + 0.54 = -18.79$	$+33.00 - 0.97 = +32.03$
a	$= -1.25$	$a = +2.14$

-7.3	$+12.0$	$+0.5$	$+0.5$	$+13.0$	-20.0	-0.5	0.0
$+30.5$	$+11.7$	$+26.2$	$+20.9$	-52.2	-20.1	-44.9	-35.7
-7.2	-7.7	-10.6	-5.3	$+13.0$	$+14.0$	$+19.2$	$+9.6$
$+16.0$	$+16.0$	$+16.1$	$+16.1$	-26.2	-26.1	-26.2	-26.1

c from $x-3$ c from $y-y$

ML 863

1912 Oct 10 9

Residuals.

$m X.$

Star					C	O	O - C
1	-38	+8	+16	=	-14	+10	+24
3	-33	+10	+16	=	-7	-5	+2
2	-20	+4	+16	=	0	-27	-27
4	-20	+11	+16	=	+7	+6	-1
5	-4	+4	+16	=	+16	+18	+2

-1	+2
<hr/>	
+2	+24
	-27

$m Y.$

1	+65	-14	-26	=	+25	-14	-39
3	+56	-18	-26	=	+12	+8	-4
2	+35	-7	-26	=	+2	+45	+43
4	+34	-20	-26	=	-12	-9	+3
5	+6	-7	-26	=	-27	-31	-4

+3	-4
<hr/>	
-4	-39
	+43

MC 863

1912 Oct 10 9

Residuals.

in λ .

Star					C	O	O - C		
1	-38	+8	+16	=	-14	+10	+24	-1	+2
3	-33	+10	+16	=	-7	-5	+2		
2	-20	+4	+16	=	0	-27	-27		
4	-20	+11	+16	=	+7	+6	-1	+2	+24
5	-4	+4	+16	=	+16	+18	+2		-27

in γ .

1	+65	-14	-26	=	+25	-14	-39	+3	-4
3	+56	-18	-26	=	+12	+8	-4		
2	+35	-7	-26	=	+2	+45	+43		
4	+34	-20	-26	=	-12	-9	+3	-4	-39
5	+6	-7	-26	=	-27	-31	-4		+43

$$\begin{array}{r|l}
 5+ & 1- \\
 \hline
 40+ & 5+ \\
 5- &
 \end{array}$$

$$\begin{array}{r|l}
 5-0 & 0 \\
 \hline
 45+ & 51+ \\
 5+ & 2- \\
 5- & 5- \\
 1- & 5+ \\
 5- & 51+
 \end{array}$$

$$\begin{array}{r|l}
 4- & 2+ \\
 \hline
 45- & 4- \\
 20+ &
 \end{array}$$

$$\begin{array}{r|l}
 45- & 41- \\
 \hline
 4- & 5+ \\
 45+ & 20+ \\
 5+ & 51- \\
 4- & 15-
 \end{array}$$

MC 863

1912 Oct 25.10

Times etc

Exp. to stars 1911 Jan. 12 $5^h 47^m 22.5^s$ ✓ - $5^h 57^m 22.5^s$ ✓
 " " moon $5 52 21.6$ ✓ $5 52 21.9$ ✓
 clock fast $2 21.4$ ✓

H. Sid. T $5 50 00.35$ ✓
 " Long. $4 44 31.05$ ✓
 G. Sid. T $10 34 31.40$ ✓
 Sid. T. M. noon $19 23 26.69$ ✓
 Interval $15 11 04.71$ ✓
 Reduction $- 2 29.26$ ✓
 G. M. T. $15 08 35.45$ ✓

From Am. Eph. $R.A.$ Decl.
 moon $15^h 5^m 46^s 00.76^s$ $+26^\circ 39' 22.2''$
 motion in $1^m = 2.7597'$ $= 3.408$
 " " 8.39 $+ 23.71''$ $+ 29.3''$ ✓
 Tabular place $5 46 24.47$ $+ 26 39 51.5$ ✓
 Moon's parallax $60' 32.6''$ $60 32.8$
 " semidiam. $16 31.4$

Center of plate $A = 5^h 46^m 42^s$
 $D = 26^\circ 09' 29''$

MIC 863

1912 Oct 25.10

Times etc

Exp. to stars 1911 Jan. 12 $5^h 47^m 22^s$ - $5^h 57^m 22^s$
 " " moon $5 52 21.6$ - $5 52 21.9$
 clock to fast $2 21.4$

H. Sid. T $5 50 00.35$

" Long. $4 44 31.05$

G. Sid. T $10 34 31.40$

Sid. T. M. noon $19 23 26.69$

Interval $15 11 04.71$

Reduction $- 2 29.26$

G. M. T. $15 08 35.45$

Form Ann. Eph.

moon 15^h $5^h 46^m$ R. A. 00.76 Decl. $+26.^\circ 39' 22.2$

Mohr's 1^m 2.7547 3.459

" " 8.39 $+ 23.70$ $+ 29.2$

Tabular place $5 46 24.40$ $26 39 51.8$

Moon's parallax $60' 32.6$

" semidiam. $16 31.2$

Pt.	Pos. L	Residual
9	10.0	-4
5	348.8	-46
11	347.2	+2
6	319.0	+42
4	306.0	+86
3	277.0	-27
8	270.0	-102
2	250.3	+20
7	220.0	+68
1	207.0	-35
LD	197.8	-200] not used in solution.

MC 863

1912 Nov. 1.

11

Approximate center of moon.

$$\begin{aligned}
 x &= 20.0 & y &= 18.6386 \\
 & & y &= 21.9054 \\
 & & & \hline
 & & & 40.5440 \\
 \text{mean} &= 20.2720 \\
 Y = \text{min} &= 18.1098 \\
 R &= 2.1622
 \end{aligned}$$

$$\begin{aligned}
 x = \text{max} &= 20.7414 \\
 & \hline
 & 2.1622 \\
 & \hline
 & 18.5792
 \end{aligned}$$

Point	x	$x - X$	$(x - X)^2$	$(y - X)^2 + (y - Y)^2$	$0 - c$
1	19.8790	-1.2998	1.6895	4.6755	-57
2	20.6178	-2.0386	4.1559	4.6859	+47
3	20.7260	-2.1468	4.6087	4.6827	+15
4	20.3327	-1.7535	3.0748	4.6928	+116
5	19.0000	-0.4208	0.1771	4.6732	-80
6	20.0000	-1.4208	2.0186	4.6866	+54
7	20.0000	-1.4208	2.0186	4.6866	+54
8	20.7414	-2.1622	4.6751	4.6751	-61
9	18.5792	-0.0000	0.0000	4.6751	-61
10	19.2418	-0.6626	0.4390	4.6554	(-258)
11	19.0574	-0.4782	0.2287	4.6783	-29
Rem. 10				4.6632	

mean (except 10) 4.6812

There is no $\Delta x + \Delta y$, the moon being so near the meridian and the decl. being so large.

	y	$y - Y$	$(y - Y)^2$
1	22.0000	+1.7280	2.9860
2	21.0000	-0.7280	0.5300
3	20.0000	+0.2720	0.0740
4	19.0000	+1.2720	1.6180
5	18.1516	+2.1204	4.4961
6	18.6386	+1.6334	2.6680
7	21.9054	-1.6334	2.6680
8	20.2720	0.0000	0.0000
9	18.1098	+2.1622	4.6751
10	22.3254	-2.0534	4.2164
11	18.1626	+2.1094	4.4496
Rem. 10	22.3273	+2.0553	4.2242

Signs of $(x - X) + (y - Y)$ are changed because moon is put on backwards.

1912 Nov. 1.

11

MC 863

Approximate center of moon.

$x = 20.0$

" "

$y = 18.6386$

$y = 21.9054$

$y = 40.5440$

mean = 20.2720

$y = \min = 18.1098$

$R = 2.1622$

$x = \max = 20.7414$

2.1622

18.5792

(mean (x) + 10) 4.6812

Point	x	$x - X$	$(x - X)^2$	$(y - X)^2 + (y - Y)^2$	$0 - c$
1	19.8790	+1.2498	1.6895	4.6755	-57
2	20.6178	+2.0386	4.1559	4.6859	+47
3	20.7260	+2.1468	4.6087	4.6827	+15
4	20.3327	+1.7535	3.0748	4.6928	+116
5	19.0000	+0.4208	0.1771	4.6732	-80
6	20.0000	+1.4208	2.0186	4.6866	+54
7	20.0000	+1.4208	2.0186	4.6866	+54
8	20.7414	+2.1622	4.6751	4.6751	-61
9	18.5792	0.0000	0.0000	4.6751	-61
10	19.2418	+0.6626	0.4390	4.6554	(-258)
11	19.0574	+0.4782	0.2287	4.6783	-29
10				4.6632	

There is no $\Delta x + \Delta y$, the moon being so near the meridian and the decl. being so large.

	y	$y - Y$	$y - Y^2$
1	22.0000	+1.7280	2.9860
2	21.0000	+0.7280	0.5300
3	20.0000	-0.2720	0.0740
4	19.0000	-1.2720	1.6180
5	18.1516	-2.1204	4.4961
6	18.6386	-1.6334	2.6680
7	21.9054	+1.6334	2.6680
8	20.2720	0.0000	0.0000
9	18.1098	-2.1622	4.6751
10	22.3254	+2.0534	4.2164
11	18.1626	-2.1094	4.4496
Rem			
10	22.3273	+2.0553	4.2242

Summation of normals.

	[aa]	[ab]	[an]	[bb]	[bn]
1	1.69	-2.25	+74.10	2.99	+98.6
2	4.16	-1.49	-95.88	0.53	-34.3
3	4.62	+0.58	-32.25	0.07	+4.0
4	3.06	+2.22	-203.00	1.61	+146.2
5	0.18	+0.89	+33.60	4.49	-169.6
6	2.02	+2.31	-76.68	2.66	+88.0
7	2.02	-2.31	-76.68	2.66	-88.0
8	4.67	0.00	+131.76	0.00	00.0
9	0.00	+0.00	+0.00	4.67	+131.8
10	---	---	---	---	---
11	<u>0.23</u>	<u>+1.01</u>	<u>+13.92</u>	<u>4.45</u>	<u>-61.2</u>
	22.65	+0.96	-274.31	24.13	-104.9

Signs of a and b in cond. eq. should be changed because rescan was put on back wards. This changes signs of [an] and [bn], [ac] and [bc] \leftarrow

MC 863.

1912 Nov. 1

1912 Nov. 15

12

Uranus Runb.

Equations of Condition.

				ϕ	C	$\phi - C$
1	$-1.30a + 1.73b + c =$	-57	-22	-35		
2	$-2.04 - 0.73 + c =$	$+47$	$+27$	$+20$		
3	$-2.15 + 0.27 + c =$	$+15$	$+42$	-27		
4	$-1.75 + 1.27 + c =$	$+116$	$+30$	$+86$		
5	$-0.42 + 2.12 + c =$	-80	-34	-46		
6	$-1.42 + 1.63 + c =$	$+54$	$+12$	$+42$		
7	$-1.42 - 1.63 + c =$	$+54$	-14	$+68$		
8	$-2.16 0.00 + c =$	-61	$+41$	-102		
9	$0.00 + 2.16 + c =$	-61	-57	-4		
10	$[-0.66 - 2.05 + c =$	-258	-58	-200		
11	$-0.48 + 2.11 + c =$	-29	-31	$+2$		

Normals.

$$\begin{array}{rcl}
 +22.65 & - & 0.96 & -13.14 & = & -231 \\
 - & 0.96 & +24.13 & +5.47 & = & -148 \\
 + & 13.14 & + & 5.47 & + & 10.00 & = & -32
 \end{array}$$

$$\begin{array}{rcl}
 + & 0.96 & - & 0.04 & - & 0.52 & = & -9 \\
 + & 13.14 & - & 0.52 & - & 7.62 & = & +134
 \end{array}$$

$$\begin{array}{rcl}
 + & 24.09 & + & 4.95 & = & -157 \\
 + & 4.95 & + & 2.38 & = & -136 \\
 + & 4.95 & - & 102 & = & +32 \\
 & & + & 1.36 & = & -104
 \end{array}$$

$$\begin{array}{rcl}
 - & 10.29 & - & 4.95 & = & +283 \\
 + & 73.80 & & & = & +126
 \end{array}$$

$$\begin{array}{rcl}
 - & 17.28 & + & 719 & + & 13.14 & = & -3 \\
 + & 719 & - & 299 & - & 5.47 & = & +1
 \end{array}$$

$$\begin{array}{rcl}
 + & 5.37 & + & 6.23 & = & -234 \\
 + & 6.23 & + & 21.14 & = & -147
 \end{array}$$

$$\begin{array}{rcl}
 - & 184 & - & 6.23 & = & +43 \\
 + & 3.53 & & & = & -191
 \end{array}$$

$$+566a - 324c =$$

should be

Signs of a and b are changed to correspond to change in sign of x and y (on account of reversal)

MC 863.

1912 Nov. 1
1912 Nov. 15

12

Woonsocket

Equations of Condition.

				O	C	O-C
1	+1.30a	+1.73b	+c	= -57	-22	-35
2	+2.04	+0.73	+c	= +47	+27	+20
3	+2.15	-0.27	+c	= +15	+42	-27
4	+1.75	-1.27	+c	= +116	+30	+86
5	+0.42	-2.12	+c	= +80	-34	-46
6	+1.42	-1.63	+c	= +54	+12	+42
7	+1.42	+1.63	+c	= +54	-14	+68
8	+2.16	0.00	+c	= -61	+41	-102
9	0.00	-2.16	+c	= -61	-57	-4
10	[+0.66	+2.05	+c	= -258]	-58	-200]
11	+0.48	-2.11	+c	= -29	-31	+2

Normals.

$$\begin{array}{rcl}
 +22.65 & - & 0.96 & +13.14 & = & +231 \\
 - & 0.96 & +24.13 & + & 5.47 & = & -148 \\
 +13.14 & + & 5.47 & + & 10.00 & = & +2
 \end{array}$$

$$\begin{array}{rcl}
 + & 0.96 & - & 0.04 & - & 0.52 & = & - & 9 \\
 +13.14 & - & 0.52 & - & 7.62 & = & -134
 \end{array}$$

$$+24.09 + 4.95 = -157$$

$$+4.95 + 23.8 = -136$$

$$+4.95 - 10.2 = +32$$

$$+1.36 = -104$$

$$-10.29 - 4.95 = +283$$

$$+23.80 = +126$$

$$+17.28 + 719 + 13.14 = -3$$

$$+719 - 299 - 5.47 = +1$$

$$+5.37 + 6.23 = -234$$

$$+6.23 + 21.14 = -147$$

$$-184 - 6.23 = +43$$

$$+3.53 = -191$$

+21.14

Average = 43
R2 = 143

$$\frac{\Delta x}{\Delta y} = 2.16 \times 21 = 45.36$$

$$\frac{\Delta x}{\Delta y} = 2.16 \times 57 = 123.12$$

$$c = -76 \pm 37$$

$$b = +9 \pm 12$$

$$a = -54 \pm 23$$

MC863

1912 Nov. 15.

13

Residuals

					C
1	+70	-	16	-76	= -22
2	+110	-	7	-76	= +27
3	+116	+	2	-76	= +42
4	+95	+	11	-76	= +30
5	+23	+	19	-76	= -34
6	+77	+	15	-76	= +12
7	+77	-	15	-76	= -14
8	+117		0	-76	= +41
9	0	+	19	-76	= -57
10	+36	-	18	-76	= -58
11	+26	+	19	-76	= -31

$$\text{New } X = -18.5901 \pm 12$$

$$Y = -20.2282 \pm 6$$

$$R = 21603 \pm 18$$

Position for 1911.0

$$\xi = -0.5901$$

$$\log \xi = 9.77093$$

$$\cos \delta = 9.95222$$

$$\cos t = 8.50724$$

$$\alpha - A = 1.31147$$

$$\alpha - A = -20.49$$

$$A = 5^h 46^m 42^s$$

$$\alpha = 5^h 46^m 21.51^s$$

$$\eta = +1.7718$$

$$\tan \delta = 9.694$$

$$\log \xi^2 = 9.518$$

$$\cos t = 7.053$$

$$\log \eta_0 = 6.265$$

$$\eta_1 = +2$$

$$\eta_0 = +1.7716$$

$$\log \eta_0 = 0.24836$$

$$\cos t = 7.33115$$

$$\log \tan (\delta - D) = 2.91727$$

$$\delta - D = 826.4$$

$$= +13^{\circ} 46.4'$$

$$D = +26^{\circ} 09' 29''$$

$$\delta = +26^{\circ} 23' 15.4''$$

$$X_0 = -18.5792$$

$$\frac{1}{2}a = -27$$

$$-18.5819$$

Prelim correction gives

$$X = -18.5901$$

$$ax = -23$$

$$by = +7$$

$$c = +16$$

$$X = -18.5901$$

$$X_0 = -20.2720$$

$$\frac{1}{2}b = +4$$

$$Y = -20.2716$$

from table

$$-20.2282$$

$$+40$$

$$-14$$

$$-26$$

$$-20.2282$$

Residuals

				C
1	+170	-	16	-76 = -22
2	+110	-	7	-76 = +27
3	+116	+	2	-76 = +42
4	+95	+	11	-76 = +30
5	+23	+	19	-76 = -34
6	+77	+	15	-76 = +12
7	+77	-	15	-76 = -14
8	+117		0	-76 = +41
9	0	+	19	-76 = -57
10	+36	-	18	-76 = -58
11	+26	+	19	-76 = -31

$$18.5737 \pm 12$$

$$20.3151 \pm 6$$

$$R = 2.1603 \pm 18$$

Position for 1911.0.

$$\bar{\alpha} = -0.5737$$

$$\log \bar{\delta} = 9.75868$$

$$\cos \bar{\delta} = 9.95226$$

$$\cos \alpha = 8.50724$$

$$\alpha - A = 1.29918^m$$

$$\alpha - A = -19.92$$

$$A = 5^h 46^m 42^s$$

$$\alpha = 5^h 46^m 22.08^s$$

$$\alpha = 5^h 46^m 21.57^s$$

$$\eta = +1.6849$$

$$\tan \delta = 9.694$$

$$\log \bar{\delta} = 9.518$$

$$\cos \delta = 7.053$$

$$\log \eta = 6.265$$

$$\eta_1 = +2$$

$$\eta_0 = +1.6848$$

$$\log \eta_0 = 0.22655$$

$$\cos \delta = 7.33115$$

$$\log \tan (\delta - D) = 2.89537$$

$$\delta - D = 7.859$$

$$= +13' 05.9''$$

$$D = +26^\circ 09' 29''$$

$$\delta = +26^\circ 22' 34.9''$$

$$\delta = +26^\circ 23' 15.4''$$

20-	25-	31-	074	1
22+	27-	7-	011	2
24+	29-	2-	014	3
26+	31-	11	201	4
28-	33-	19	024	5
30+	35-	71	05	6
32-	37-	71	07	7
34+	39-	0	011	8
36-	41-	19	0	9
38-	43-	21	024	10
40-	45-	19	05	11

15 12 31
 0 4 2 10 20
 21 20 12 5

20014	24520	2
20015	24521	3
20016	24522	4
20017	24523	5
20018	24524	6
20019	24525	7
20020	24526	8
20021	24527	9
20022	24528	10
20023	24529	11
20024	24530	12
20025	24531	13
20026	24532	14
20027	24533	15
20028	24534	16
20029	24535	17
20030	24536	18
20031	24537	19
20032	24538	20
20033	24539	21
20034	24540	22
20035	24541	23
20036	24542	24
20037	24543	25
20038	24544	26
20039	24545	27
20040	24546	28
20041	24547	29
20042	24548	30
20043	24549	31
20044	24550	32
20045	24551	33
20046	24552	34
20047	24553	35
20048	24554	36
20049	24555	37
20050	24556	38
20051	24557	39
20052	24558	40
20053	24559	41
20054	24560	42
20055	24561	43
20056	24562	44
20057	24563	45
20058	24564	46
20059	24565	47
20060	24566	48
20061	24567	49
20062	24568	50
20063	24569	51
20064	24570	52
20065	24571	53
20066	24572	54
20067	24573	55
20068	24574	56
20069	24575	57
20070	24576	58
20071	24577	59
20072	24578	60
20073	24579	61
20074	24580	62
20075	24581	63
20076	24582	64
20077	24583	65
20078	24584	66
20079	24585	67
20080	24586	68
20081	24587	69
20082	24588	70
20083	24589	71
20084	24590	72
20085	24591	73
20086	24592	74
20087	24593	75
20088	24594	76
20089	24595	77
20090	24596	78
20091	24597	79
20092	24598	80
20093	24599	81
20094	24600	82
20095	24601	83
20096	24602	84
20097	24603	85
20098	24604	86
20099	24605	87
20100	24606	88
20101	24607	89
20102	24608	90
20103	24609	91
20104	24610	92
20105	24611	93
20106	24612	94
20107	24613	95
20108	24614	96
20109	24615	97
20110	24616	98
20111	24617	99
20112	24618	100

MC863. (1911, Jan 12)

1912 Nov. 18.

14

Reduction to Apparent Position

$\alpha(1911.0) = 5^h 46^m 22.08$

$\delta_0 = +26^\circ 23' 15.4$

$G = 15^h 48^m 42.$

$339\ 48\ 48\ (22^h\ 59^m)$

$G + \alpha = 21^h 35^m 04.5$

$H + \alpha_0 = 28^h 25^m 28.5$

$(3230\ 46')$

$660\ 22'$

$f = -0.590$

$\log f = 8.8239$

$\log \frac{1}{f} = 8.8239$

$q = 5^h 46^m 21.51$

$h = 1.3058$

$\log \frac{1}{h} = 0.8495$

$t = -0.59$

$\sin(H + \alpha_0) = 9.9620$

$\sin(G + \alpha_0) = 9.7716$

$(q) = -0.14$

$\sec \delta_0 = 0.0477$

$\tan \delta_0 = 9.6954$

$(q) = +1.38$

$\log h = 0.1394$

$\log(g) = 9.1404$

$\alpha = 5^h 46^m 22.76$

$\log h = 1.3058$

$\log g = 0.8495$

$\cos(H + \alpha_0) = 9.6030$

$\cos(G + \alpha_0) = 9.9067$

$\sin \delta_0 = 9.6476$

$\log(g') = 0.7562$

$\log(h) = 0.5564$

$\delta_0 = +26^\circ 23' 15.4$

$+5.8$

$+3.6$

-2.7

$\delta = +26^\circ 23' 22.7$

$\log i = 0.4808$

$\log \delta_0 = 9.9522$

$\log(l) = 0.4330$

$(i) = -2.7$

$5\ 46\ 22.16$

$+9.4$

$+1.38$

-2.7

-7.3

$+6.7$

$+0.65$

Calculation to find the
 (1) 2.25×10^{-10} (2) 2.25×10^{-10}

(1) 2.25×10^{-10} (2) 2.25×10^{-10}
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MC863.

1912 Nov. 18

14

Reduction to Apparent Position
 $\alpha(11.0) = 5^h 46^m 22.0^s$ $\delta_0 = +26^\circ 22' 34.9''$

$$G = 15^h 48^m 42^s \quad 339^\circ 48' 48'' (22^\circ 39' 1'')$$

$$G + \alpha = 21^h 35^m 04^s \quad H + \alpha = 28^h 25^m 28^s$$

$$(323^\circ 46')$$

$$f = -0.590 \quad \log r = 8.8237 \quad \log \frac{1}{r} = 8.5239$$

$$r = 5^h 46^m 22.0^s \quad \log h = 1.3058 \quad \log s = 0.8495$$

$$t = -0.59 \quad \cos(H + \alpha) = 9.9620 \quad \sin(G + \alpha_0) = 9.7716 m$$

$$q = 0.14 \quad \sec \delta_0 = 0.0477 \quad \tan \delta_0 = 9.6254$$

$$p = +1.38 \quad \log h = 0.1394 \quad \log s = 9.1404 m$$

$$x = 5^h 46^m 22.9^s$$

$$\log h = 1.3058 \quad \log s = 0.8495$$

$$\cos(H + \alpha) = 9.9620 \quad \cos(G + \alpha_0) = 9.9067$$

$$\sin \delta_0 = 9.6476 \quad \log s = 0.7562$$

$$\log h = 0.5564$$

$$\delta_0 = +26^\circ 22' 34.9''$$

$$\begin{array}{r} + 5.8 \\ + 2.6 \\ - 3.0 \end{array}$$

$$\delta = +26^\circ 22' 41.3''$$

Lunar Parallax

$$\alpha' = 5^h 46^m 22.16''$$

$$\delta = 5 \quad 50 \quad 00.35''$$

$$\delta' = +26^\circ 23' 22.1''$$

$$\pi = 60' 32.6''$$

$$\alpha' - \theta = 0^\circ 3' 38.19''$$

$$\theta - \alpha' = 0^\circ 54' 32.8''$$

$$(\theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = +54' 00''$$

$$\log p \cos \phi' = 9.86913$$

$$\sin \pi = 8.24579$$

$$\sin(\theta - \alpha') = 8.20047$$

$$\cos \delta = 9.95222$$

$$\sin(\alpha - \alpha') = 6.36377$$

$$(\alpha - \alpha') = +0^\circ 0' 47.5''$$

$$\cos(\alpha - \alpha') = 47.7'' = 3.18''$$

$$\tan \phi = 9.95727$$

$$\cos \frac{1}{2}(\alpha - \alpha') = 0.00000$$

$$\cos(\theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = 9.99995$$

$$\tan \gamma = 9.95732$$

$$\log p \sin \phi = 9.82640$$

$$\sin \pi = 8.24577$$

$$\sin(\gamma - \delta') = 9.43532$$

$$\sin \gamma = 9.82710$$

$$\sin(\delta - \delta') = 7.68039$$

$$\delta - \delta' = +16' 28.1''$$

$$\gamma = +42^\circ 11' 21.6''$$

$$\delta' = +26^\circ 23' 41.4''$$

$$\gamma - \delta' = 15^\circ 48' 40.2''$$

$$\alpha = 5^h 46^m 25.34''$$

$$\delta = +26^\circ 39' 50.2''$$

Tabular place

$$5^h 46^m 24.47'' \quad \text{Diff} = +0.87$$

$$+26^\circ 39' 51.5'' \quad = -1.3''$$

Correction to standard radius:

$$-0.02 \text{ m } \Delta \alpha$$

$$+0.1 \text{ m } \Delta \delta$$

$$\text{Final } (o-c) = \Delta \alpha \quad \Delta \delta$$

$$+0.85 \quad -1.2$$

21

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MC 863.

1912 Nov 29.

15

Lunar Parallax

$$\begin{array}{r} \alpha' \quad 5^h 46^m 22.73 \\ \theta \quad 5 \quad 50 \quad 00.35 \end{array}$$

$$\begin{array}{r} \delta' = +26^\circ 22' 41.3 \\ \pi \quad 60' 32.6 \end{array}$$

$$\alpha' - \theta = 3^\circ 37.62$$

$$\theta - \alpha' = 0^\circ 54' 24''$$

$$(\theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = +54' 00''$$

$$\log p \cos \phi' = 9.86913$$

$$\sin \pi = 8.24577$$

$$\sin(\theta - \alpha') = 8.19931$$

$$\cos \delta = 9.95325$$

$$\sin(\alpha - \alpha') = 6.36196$$

$$(\alpha - \alpha') = +0^\circ 0' 47.5 = 3.18$$

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

$$\tan \phi' = 9.95727$$

$$\cos \frac{1}{2}(\alpha - \alpha') = 0.00000$$

$$\cos(\theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = 9.99995$$

$$\tan \gamma = 9.95722$$

$$\log p \sin \phi = 9.82640$$

$$\sin \pi = 8.24577$$

$$\sin(\gamma - \delta') = 9.43532$$

$$\sin \gamma = 9.82710$$

$$\sin(\delta - \delta') = 7.68039$$

$$\delta - \delta' = +16' 28.8$$

$$\gamma = +42^\circ 15' 21.6$$

$$\delta = +26^\circ 22' 41.3$$

$$\gamma - \delta' = 15^\circ 48' 40.3$$

Tabular place.

$$\alpha = 5^h 46^m 25.34$$

$$5^h 46^m 24.47 \quad \text{D.H.} = +1.4 + 0.87$$

$$\delta = +26^\circ 39' 50.2$$

$$+26^\circ 39' 51.5 \quad = +42.8 - 1.3$$

Correction to standard position:

$$-0.02 \quad -0.01$$

$$+0.1 \quad -0.0$$

$$\text{Final } (\theta - \alpha) = \Delta \alpha \quad \Delta \delta$$

$$+0.85 \quad -1.2$$

measures of points on known limb.

$$y = 22.0 \quad x = 19.35$$

d	n
14.630	139.62
134.1620	816.570
10	65
30	67
<u>14.8725</u>	<u>14.8796</u>

$$y = 21.0 \quad x = 20.62$$

d	n
14.108	157.18
127.2572	90.3730
60	76
67	14
<u>20.6170</u>	<u>20.6187</u>

$$y = 20.0 \quad x = 20.77$$

d	n
12.715	16.114
99.6560	98.52
67	96.40
69	18
<u>20.7250</u>	<u>20.7269</u>

$$y = 19.0 \quad x = 20.22$$

d	n
15.592	134.74
89.2578	102.5440
17	41
70	75
<u>20.3327</u>	<u>20.3327</u>

$$y = 19.32 \quad x = 19.0$$

d	n
15.718	143.40
141.8196	78.5040
69	45
68	25
<u>18.1525</u>	<u>18.1525</u>

Plate MC 863

1912 Sept. 23¹⁸

Measures of points on Moon's limb.

1/ $y = 22.0$ $x = 19.8 \pm$
 d n

d
 14630
 1341620
 10
 30

19.8785

n
 13968
 516570
 6570
 67

19.8796

2/ $y = 21.0$ $x = 20.6 \pm$

14108
 1027572
 80
 02

20.6170

15218
 905730
 7630
 14

20.6187

3/ $y = 20.0$ $x = 20.7 \pm$

12715
 996660
 62
 09

20.7250

16114
 8858
 4640
 18

20.7269

4/ $y = 19.0$ $x = 20.3 \pm$

15592
 892518
 12
 90

20.3327

13974
 1065440
 4840
 75

20.3327

5/ $y = 18.2 \pm$ $x = 19.0$

15718
 1418886
 98
 08

18.1525

16340
 785040
 4540
 38

18.1507

Page MC 802
 Treasurer of Account for Treasurer's Fund.

12982
 116230
 22
 40

1482391

14220
 1241481
 10
 20

285891

12418
 004809
 20
 41

004182

14141
 1241481
 20
 40

004180

11112
 8288
 20
 81

004182

11112
 8288
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 80

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Plate MC 863

1912 Sept 23 18

measures of points on Moon's limb.

1/ $y = 22.0$ $x = 19.8 \pm$
 d N

d	N
14630	13968
1341620	516570
10	6570
30	62
<u>19.8785</u>	<u>19.8796</u>

2/ $y = 21.0$ $x = 20.6 \pm$

d	N
14108	15218
1027572	903230
80	7630
02	14
<u>20.6170</u>	<u>20.6187</u>

3/ $y = 20.0$ $x = 20.7 \pm$

d	N
12715	16114
996660	8858
62	4640
09	18
<u>20.7250</u>	<u>20.7269</u>

4/ $y = 19.0$ $x = 20.3 \pm$

d	N
15592	13974
892518	1065440
12	4840
70	75
<u>20.3327</u>	<u>20.3327</u>

5/ $y = 18.2 \pm$ $x = 19.0$

d	N
15718	16340
1418886	785040
98	4540
08	38
<u>18.1525</u>	<u>18.1507</u>

MC 863

1912 Sept 23. 19

measures of points on Moon's limb
- continued -

6/ $y = 18.7 \pm$ $x = 20.0$

d	N
15320	15001
893522	1138480
20	70
16	90

18.639218.6381

7/ $y = 21.9 \pm$ $x = 20.0$

d	N
15710	15404
661820	1445048
18	44
00	02

21.908221.9043

7/ - Remeasure Sept. 24.

d	N
16337	15616
726862	1465838
5658	4036
25	06

21.906521.9062 21.9028

1912 Sept 30

8/ $y = 20.2$ $x = 20.7$

d	N
15950	14948
1335560	753032
5556	2030
45	54

20.740220.7422

MC 803

Measure of force on ...
- ...

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Measure of force on ...

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MC 863

1912 Sept 23. 19

Measures of points on Moon's limb
- Continued -

$$6/ \quad y = 18.7 \pm \quad x = 20.0$$

d	N
15320	15001
893522	1138480
20	70
16	40

13968
516570
6570
62

19479618.639218.6381

$$7/ \quad y = 21.9 \pm \quad x = 20.0$$

15710	15404
661820	1445048
18	1633744
00	727505

21.908221.9043

15366

7 - Remearure Sept. 17, 1912

16337
726867
5658
25

1561686
1468938
4036
062

.0962

21.906521.906221.9028

1912 Sept 30

$$8/ \quad y = 20.2 \pm \quad x = 20.0$$

d	N
15950	14948
13355	753032
5556	20730
45	5498

20.740720.7422

11C863

1912 Sept. 30

20

Points on Moon's limb.
measures continued.

9/ $\theta = 18.9$ $\chi = 18.6$ min. in y.

μ	χ
14460	14090
1336052	519084
6254	8282
62	92

18.1103

18.1092

1912 Oct. 3

10 scratch (1) on South limb.

19.2	17955	15458
22.3	1470298	870020
	0492	0412
	52	56

18062

14696

1048068

1227876

7068

8085

50

92

19.2420

19.2415

23.3255

3252

11 scratch on north limb.

19.0	17314	16143
18.1	1569085	777868
	8890	6870
	15	44

17130

16268

769604

1569490

0090

9498

22

70

19.0575

19.0574

18.1626

18.1627

Probably
a valley.

Remeasure pt. 10

1912 Nov. 1,

17538	16905
1425861	1017183
5856	7978
40	17

17348	16284
977070	1387672
6871	7577
58	98

22.3280

3265

19.2414

2412

110863

1912 Sept 30

20

Points on Uvov's limb.
 Measures continued.

9/ $y = 18.4$ $z = 18.6$ min in y .

α	y	z
14560		14090
1336052		519084
6254		8282
62		92

18.110318.1092

1912 Oct. 3

10/ scratch (1) on South limb.

18062	14696
1048068	1227876
7068	8085
50	92

19.2	17955	15458
22.3	1470298	870020
	0492	0412
	52	56

19.2420 19.2415

18.325518.3252

11/ scratch on north limb.

17130	16268
769604	1569490
0090	9498
22	70

19.0	17314	16143
18.1	1569085	777868
	8890	6870
	15	44

18.162618.162719.057519.0574

Lunar Plate MC 872 Comparison stars.

1912 Sept 24. 10^h 35^m
1912 Oct 4.

Moon's Center $x = 15$ $y = 24$.

$\frac{1}{2}$	no.	mag
Cape	1384	7.2
	$x = 5.9$ $y = 18.4$	
C	10	14.60
L		14.64
E		14.64
Mean		14.63
Prec to 1911		35.81
1911	10	2 50.44
A =	10	9 20
$\alpha - A =$	-	6 29.56
$\sin(\alpha - A) =$	-	389.51
$\log =$		2.59052m
$\cos \delta =$		9.98371
$\delta_0 =$		1.08147m
$\delta_0 =$		-12.0633
$\delta_1 =$		46
$\delta =$		5.9321
$x =$		5.9666
$x - \delta =$	+	345

$\frac{1}{2}$	no.	mag
Cape	1390	8.8
	$x = 12.0$ $y = 13.2$	
C	10	5 32.79
L		32.79
E		32.74
Mean		32.77
		+35.67
α	10	6 8.44
A	10	9 20
$\alpha - A =$	-	3 11.56
$\sin \alpha - A =$		191.55
$\log =$		2.28228
$\cos \delta =$		9.98510
$\delta_0 =$		0.77462
$\delta_0 =$		-5.9515
$\delta_1 =$		17
$\delta =$		12.0468
$x =$		12.0424
$x - \delta =$	-	44

C	15° 38' 53.5"
L	53.3
E	53.2
Mean	53.3
Prec to 1911	-19.2 - 3' 12.2
1911	15° 38' 34.1
$\delta =$	15° 35' 41.3
$\delta_0 =$	16 04 06
$\delta - \delta_0 =$	- 28 24.7
$\tan(\delta - \delta_0) =$	- 1704.7
$\log =$	3.23165m
$\eta_0 =$	0.56280m
$\tan \delta =$	9.44624
$\delta^2 =$	2.1629
$\log \eta_0 =$	8.6625
$\eta_0 =$	-3.6542
$\eta_1 =$	+0.0460
$\eta =$	18.3918
$\eta =$	18.4495
$\eta - \eta_0 =$	+ 577

C	14° 58' 30.3"
L	30.1
E	29.2
Mean	29.9
	-19.2 - 3' 13.7
	+4° 58' 10.6
	14° 55' 16.6
	16 04 06
	- 1 08 49.4
	- 4129.9
	3.61594m
	0.94709
	9.4257
	1.5492
	80283
	- 8.8530
	+ 107
	13.1577
	13.1741
	+ 164

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human Plate MC 872 Comparison stars.

1912 Sept 24. 35

1912 Oct 4.

moon's center $x = 15$ $y = 24$.

η	no.	mag
Cape	1384	7.2
$x = 5.9$ $y = 18.4$		
C	10	14.60
L		14.64
E		14.64
mean		14.63
Preced 1911		35.81
1911	10	2 50.44
A:	10	9 20
A-A:	-	6 29.56
$\sin(x-A)$:	-	389.51
\log :		2.59052m
$\cos \delta$:		9.98371
δ_0 :		1.08147m
δ_1 :		-12.6633
δ_2 :		-46
δ :		5.9321
x :		5.9666
$x - \delta$:	+	345

η	no.	mag
Cape	1390	8.8
$x = 12.0$ $y = 13.2$		
C	10	32.79
L		32.79
E		32.74
mean		32.77
		+35.67
A	10	6 8.44
A	10	9 20
A-A:	-	3 11.56
$\sin(x-A)$:		191.55
		2.28228
		9.98510
		0.77462
		-5.9515
		-17
		12.0468
		12.0424
		-44

C	15° 38' 53.5"
L	53.3
E	53.2
mean	53.3
Preced 1911	-19.2 - 3' 13.2"
1911	15° 38' 34.8"
δ_0	35.413
δ_1	04 06
δ_2	-28 24.7
$\sin(x-A)$:	-1704.7
\log :	3.23165m
$\cos \delta$:	0.56280m
δ_0 :	9.44624
δ_1 :	2.1629
$\log \delta$:	8.6625
δ_0 :	-3.6542
δ_1 :	+0.0460
δ_2 :	18.3918
δ :	18.4495
$\delta - \gamma$:	+577

C	14° 58' 30.3"
L	30.1
E	29.2
mean	29.9
Preced 1911	-19.5 - 3' 13.7"
1911	14° 58' 10.6"
δ_0	14° 55' 16.6"
δ_1	04 06
δ_2	-1 08 49.4
$\sin(x-A)$:	-4129.9
\log :	3.61594m
$\cos \delta$:	0.94709
δ_0 :	9.4257
δ_1 :	1.5492
$\log \delta$:	8.0283
δ_0 :	-8.8530
δ_1 :	+10.7
δ_2 :	13.1577
δ :	13.1741
$\delta - \gamma$:	+164

MC 872

1912 Sept. 24 36

Comparison stars - Continued -

1912 Oct 4

3/ Cape no. mag
 1393 8.9
 $x = 13.8$ $y = 34.7$
 C 10 6 13.00
 L 21.07
 E 21.03
 mean 21.03
 Prec. to 1911 + 36.03
 1911 10 6 57.06
 A 10 9 20
 $x - A = 2$ 22.94
 $\sin(x - A) = 142.94$
 $\log = 2.15515m$
 $\log \delta = 9.97890$
 $\log \delta_0 = 0.64129m$
 $\delta_0 = -4.3788$
 $\delta_1 = 19$
 $\delta = 13.6193$
 $x = 13.7685$
 $x - \delta = + 1492$

4/ Cape no. mag
 1414 6.9
 $x = 32.4$ $y = 17.0$
 C 10 16 27.90
 L 27.71
 E 27.71
 mean 27.71
 35.56
 10 17 32.7
 10 9 20
 $+ 7$ 43.27
 $+ 463.18$
 $2.66575m$
 9.98407
 1.15706
 $+ 14.3570$
 $+ 78$
 32.3648
 32.3868
 $+ 220$

C 17° 46' 6.9
 L 7.0
 E 7.1
 mean 7.0
 Prec. to 1911 - 3' 13.8
 1911 17° 47' 53.2
 0 16 04 06
 $\delta - D + 1$ 38 47.2
 $\tan(\delta - D) = + 5928.8$
 $\log = 3.77297$
 $\log \delta_0 = 1.10412$
 $\log \delta = 9.5048$
 $\log \delta_1 = 1.2826$
 $\delta_1 = 7.8408$
 $\delta_0 = + 12.7091$
 $\delta_1 = 69$
 $\delta = 34.7160$
 $\delta_1 = 34.7140$
 $\delta - \delta_1 = 20$

C 15° 28' 47.3
 L 47.0
 E 47.0
 mean 47.0
 Prec. to 1911 - 3 18.3
 1911 15 45 28.8
 16 04 06
 $- 38$ 37.2
 $- 2317.3$
 $3.36498m$
 $0.69613m$
 9.4408
 2.3141
 8.8083
 $- 4.9674$
 $+ 643$
 17.0969
 16.9695
 $- 1274$

MC 872

1912 Sept. 2436

Comparison Stars - Continued -

1912 Oct 4

3/ no. mag
 Cape 1393 8.9
 $x = 13.8$ $y = 34.7$
 C 10 6 21.00
 L 21.07
 E 21.03
 mean 21.03
 Prec. to 1911 36.03
 1911 10 6 57.06
 A 10 9 20
 -A - 2 22.94
 $\mu(x-A) - 142.94$
 $\log 2.15515m$
 Loss 9.97890
 $S_0 = 0.64129m$
 $S_0 = -4.3788$
 $F_1 = -19$
 $F = 13.6193$
 $x = 13.7685$
 $x - S = +1492$

4/ no. mag
 Cape 1414 6.10
 $x = 32.4$ $y = 17.0$
 C 10 16 27.90
 L 27.71
 E 27.71
 mean 27.71
 35.56
 10 17 32.7
 10 9 20.
 + 7 43.27
 + 463.18
 2.66575
 9.98407
 1.15706
 + 14.3570
 78
 32.3648
 32.3868
 + 220

C 17° 46' 6.9
 L 7.0
 E 7.1
 mean 7.0
 Prec. to 1911 - 3' 13.8
 1911 -198.8
 1911 17° 47' 53.2
 O 16 04 06
 $S-D + 1 38 47.2$
 $\mu(S-D) = + 5928.8$
 $\log = 3.77297$
 $\log = 1.10412$
 $\log = 4.5048$
 $\log = 1.2826$
 $\log = 7.8408$
 $\log = +12.7091$
 $\log = 69$
 $\log = 34.7160$
 $\log = 24.7140$
 $y - x = -20$

C 15° 28' 47.3
 L 47.0
 E 47.0
 mean 47.0
 Prec. to 1911 - 3 18.3
 1911 15 25 28.8
 16 04 06
 - 38 37.2
 - 2317.3
 $3.36498m$
 $0.69615m$
 9.4408
 2.3141
 8.8083
 - 4.9674
 + 643
 17.0969
 16.9695
 - 1274

MC872

Comparison Stars - continued

1912 Sept. 24

37

1912 Oct 4

S	no.	mag.
Cape	1417	8.4
$x = 33.7$		$y = 30.6$
C	10 17	10.15
L		10.20
E		10.18
mean		10.18
Prec to 1911		+ 35.77
1911	10 17	45.95
A	10 09	20
$x - A =$	+ 8	25.95
$\sin(\alpha - A)$	+	505.84
log	2.70401	
$-\cos \delta$	9.98015	
log Σ	1.19140	
Σ_0	+ 15.5382	
Σ_1	115	
Σ	33.5497	
x	33.6670	
$x - \Sigma$	+ .1173	

C	17 14	46.3
L		46.8
E		45.9
mean		46.3
Prec to 1911 =	3	18.5
1911	17 11	27.8
D	16 04	06
$\delta - D +$	1 7	21.8
$\tan \delta - D$	+	4042.3
log	3.60663	
" η_0	0.93778	
$-\tan \delta$	9.4905	
log Σ	2.3828	
" η_1	8.9267	
$\eta_0 =$	+ 8.6652	
$\eta_1 =$	+ 0.0845	
$\eta =$	30.7497	
$y =$	30.6090	
$y - \eta =$	-.1407	

1915 Sept 4
Confession of Sin - continued
1915 Oct 4

MC872

comparison stars - continued

1912 Sept. 24

37

1912 Oct 6

MC 872 Comparison star measures

1912 Sept 24 39

1	d	N	d	N
5.9				
18.4	15788	16250	14842	16336
	1129092	1074040	1451510	666875
	85	46	12	75
	80	47	46	35
	<u>18.4496</u>	<u>18.4494</u>	<u>5.9670</u>	<u>5.9662</u>

2	d	N	d	N
12.0	15296	15500	16410	15470
13.4	1355250	723634	683040	1504640
	52	40	28	46
	92	98	10	74
	<u>13.1744</u>	<u>13.1738</u>	<u>12.0423</u>	<u>12.0426</u>

3	d	N	d	N
13.8	15100	16342	14640	16930
34.7	795262	1348842	1232226	925056
	56	86	26	50
	94	50	33	37
	<u>34.7138</u>	<u>34.7141</u>	<u>13.7687</u>	<u>13.7685</u>

4	d	N	d	N
32.4	15676	14732	14870	15858
17.0	597265	1442826	873836	1200000
	7560	22	4034	9200
	64	32	60	64
	<u>16.9697</u>	<u>16.9693</u>	<u>32.3873</u>	<u>32.3863</u>

5	d	N	d	N
33.7	15508		16035	
30.6	940804	Beyond limits	1310402	Beyond limits
	12	15244	0602	15150
	96	1133340	32	848090
	<u>30.6093</u>	3040		88
		54		58
		<u>30.6086</u>	<u>33.7070</u>	
			Evidently should be	
			<u>33.6670</u>	
				<u>33.6671</u>

MC 872 Comparison stars 1910 Sept 24 39
measures.

1	d	N	d	N
5.9				
18.4	15788	16250	14842	16336
	1129042	1074040	1451110	666875
	85	46	12	75
	80	47	46	35

18.4496 18.4494 59670 59662

2				
12.0	15296	15500	16410	15470
13.2	1355250	723632	683040	1504640
	52	40	28	46
	92	98	10	72

13.1744 13.1738 120423 120426

3				
13.8	15100	16342	14640	16930
14.7	795262	1348882	1232226	925056
	56	86	26	50
	94	50	33	37

34.7138 34.7141 13.7687 13.7685

4				
32.4	15676	14732	14870	15858
17.0	597265	1442826	873836	1200000
	7560	22	4034	92
	64	32	60	64

16.9697 16.9693 32.3873 32.3863

5				
33.7	15508		16035	
30.6	940804	Beyond limits	1310402	Beyond limits
	12		06	
	96	15244	32	15150
		1133340		848290
		3040		88
		54		58

30.6093

30.6086

38.7070
Evidently
should be
33.6670

33.6671

MC 872 -

1912 Oct 3.

39

Mean coordinates of measured comp. stars.

star	x	y
1	5.9666	18.4495
2	12.0424	13.1741
3	13.7685	34.7140
4	32.3868	16.9695
5	33.6670	30.6090

$A = 10^h 09^m 20^s$
 $D = 16^\circ 04' 06''$ } center of plate.

$$\xi = [8.50724] \sin(\alpha - A) \cos \delta + \frac{\xi(\xi^2 + \eta^2)}{391000}$$

$$\eta = [7.33115] \tan(\delta - D) + [7.0534] \xi^2 \tan \delta.$$

32

1915 Oct 5

1915 Oct 5

Mean coordinates of measured stars

W	X	Y
12.442	2.0442	1
12.141	1.2041	2
04.710	1.7102	3
12.222	2.2222	4
09.020	0.9020	5

$$A = 10^{\circ} 00' 00''$$

$$D = 10^{\circ} 00' 00''$$

$$E = [2.20224] \sin (A - D) + 2.0022 + \frac{2(2.2022)}{2.0022}$$

$$M = [2.20224] \cos (A - D) + [2.2022] \sin (A - D)$$

Mean coordinates of measured comp. stars.

star	x	y
1	5.9666	18.4495
2	12.0424	13.1741
3	13.7685	34.7140
4	32.3868	16.9695
5	33.6670	30.6090

$$A = 10^{\circ} 09' 20'' \quad \left. \begin{array}{l} A = \\ D = \end{array} \right\} \text{center of plate.}$$

$$D = 16^{\circ} 04' 06''$$

$$\xi = [8.50724] \sin (\alpha - A) \cos \delta + \frac{\xi(\xi^2 + \eta^2)}{391000}$$

$$\eta = [7.33115] \tan (\delta - \delta_0) + [7.0534] \xi^2 \tan \delta.$$

1	20000	20000
2	19999	19999
3	19998	19998
4	19997	19997
5	19996	19996
6	19995	19995
7	19994	19994
8	19993	19993
9	19992	19992
10	19991	19991
11	19990	19990
12	19989	19989
13	19988	19988
14	19987	19987
15	19986	19986
16	19985	19985
17	19984	19984
18	19983	19983
19	19982	19982
20	19981	19981
21	19980	19980
22	19979	19979
23	19978	19978
24	19977	19977
25	19976	19976
26	19975	19975
27	19974	19974
28	19973	19973
29	19972	19972
30	19971	19971
31	19970	19970
32	19969	19969
33	19968	19968
34	19967	19967
35	19966	19966
36	19965	19965
37	19964	19964
38	19963	19963
39	19962	19962
40	19961	19961
41	19960	19960
42	19959	19959
43	19958	19958
44	19957	19957
45	19956	19956
46	19955	19955
47	19954	19954
48	19953	19953
49	19952	19952
50	19951	19951
51	19950	19950
52	19949	19949
53	19948	19948
54	19947	19947
55	19946	19946
56	19945	19945
57	19944	19944
58	19943	19943
59	19942	19942
60	19941	19941
61	19940	19940
62	19939	19939
63	19938	19938
64	19937	19937
65	19936	19936
66	19935	19935
67	19934	19934
68	19933	19933
69	19932	19932
70	19931	19931
71	19930	19930
72	19929	19929
73	19928	19928
74	19927	19927
75	19926	19926
76	19925	19925
77	19924	19924
78	19923	19923
79	19922	19922
80	19921	19921
81	19920	19920
82	19919	19919
83	19918	19918
84	19917	19917
85	19916	19916
86	19915	19915
87	19914	19914
88	19913	19913
89	19912	19912
90	19911	19911
91	19910	19910
92	19909	19909
93	19908	19908
94	19907	19907
95	19906	19906
96	19905	19905
97	19904	19904
98	19903	19903
99	19902	19902
100	19901	19901

1911phae.proj.18

1911phae.proj.18

MC 872

1912 Sept. 25. 40

Points on Moon's limb.
measures.

V d y n
15.8
22.0

measure
2.41

d n
150.42
1337265
6070
46
15.8324

n
15868
742044
3246
68
15.8430

2/
16.7
23.0

16120
1366064
8074
22
16.7548

15063
750802
9808
65
15.816.7560

3/
16.9
24.0

16385
1559098
9894
90
16.9209

16654
743545
4852
64
16.9218

4/
16.5
25.0

15580
1128284
8680
84
16.5701

15810
1011410
0306
15
16.5705

5/
15.0 16561 15720
21.8 899494 1328890
9094 9278
62 14

21.756921.7569

MC872

1912 Sept. 25 40

Points on Moon's limb.
measures.

1/	15.8	d	4	n	d	2	15858
	22.0				150.42		742044
					1337265		3246
					6070		68
					46		158430
					15.8324		
2/	16.7				16120		15063
	23.0				1366064		750802
					8074		9808
					22		65
					16.7548		15016.7560
3/	16.9				16385		16654
	24.0				1559098		743545
					9844		4852
					90		64
					16.9209		16.9218
4/	16.5				15580		15810
	25.0				1128284		1011410
					18680		0306
					84		15
					16.5701		16.5705
5/	15.0				15720		
	21.8				1328890		
					9278		
					14		
					21.7569		21.7569

MC 872

1912 Sept. 25 41

Points on Moon's limb
measures. -continued-

6/	d	y	n
16.0			
22.1	16564		
	14948		17555
	1397871		848580
	7270		7575
	53		55
	<u>22.0975</u>		<u>22.0924</u>

7/	16284	16830
16.0	1064032	1247570
25.5	2824	7270
	88	38
	<u>25.5655</u>	<u>25.5638</u>

11/ 15.8
22.0

Remeasure
1912 Sept 26

d	n
15030	15268
1337065	687286
7865	7870
25	70
<u>15.8341</u>	<u>15.8394</u>

6/	d	y	n
16.0	16232		15250
22.1	1525050		618078
	5654		8075
	44		38

22.0981 22.0939

Remeasure
1912 Sept 26

8/ y = 23.8 zc = max = 16.9

d	n
15328	15420
1459800	612314
0004	1612
20	10
<u>16.9279</u>	<u>16.9295</u>

1912 Sept 30

MC 87.2

1912 Sept 25. 41

Points on Moon's limb.
measures. -continued-

6/	d	y	n
16.0			
22.1	16567		
	14948	17555	
	1397871	848580	
	7270	7575	
	53	55	
	<u>220975</u>	<u>220924</u>	

7/	16284	16830
	1064032	1247570
16.0	2824	7270
25.5	88	38
	<u>255655</u>	<u>255638</u>

11/ 15.8
22.0

Remeasure
1912 Sept 26.

d	n
15030	15268
1337065	687286
7865	7870
25	70
<u>15.8341</u>	<u>15.8394</u>

6/	d	y	n
16.0	16232	15250	
22.1	1525050	618078	
	5654	8075	
	44	38	
	<u>22.0981</u>	<u>22.0939</u>	

Remeasure
1912 Sept 26.

8/ y = 23.8 x = max = 16.9

1912 Sept 30

d	n
15328	15420
1459800	612314
10004	1612
20	10
<u>16.9279</u>	<u>16.9295</u>

MC 872

1912 Sept. 30 42

Points on Moon's limb.
measures - continued.

9) $y = \text{min} = 21.7$ $z = 14.9$

d	N
16160	15020
860810	1251250
1210	5060
50	28

21.754321.7531

10) Scratch on no. of moon's limb.

15.5 25.8	d	N	d	N
14420	16210	14330	15202	
650098	1412428	975040	979280	
9096	1832	6248	8290	
28	03	40	96	

25.793025.791715.541515.5413

11) Scratch on so. of moon's limb.

15.2 21.7	15634	14980	14728	15345
798090	1267572	622030	1385038	
9492	8070	2828	3538	
32	70	30	48	

21.764421.770115.149615.1505

↓
measure
14990
699204
9204
04

21.7703

110874

1912 Sept 30 42

Points on Brown's limb

measures - continued

$$9) \quad y = \text{min} = 21.7 \quad u = 14.9$$

d

v

16160

15020

860810

1251250

1270

5000

50

78

21.754321.7531

$$10) \quad \text{Scratch on no. of moons limb}$$

15.5

258

d

v

d

v

14420

16210

14330

15202

650098

1412428

975040

979280

9096

1632

6248

8290

28

03

40

96

21.793021.791715.541515.5413

$$11) \quad \text{Scratch on 50. of moons limb}$$

15.2

15634

14980

21.7

798090

1267572

14728

15345

9492

8070

6220

30

1385038

32

70

2828

3538

21.764421.770115.149615.1505

14090

699204

9204

04

21.7703

Preliminary Reduction

star	$x-3$	$-70y$	$+903-y$	$+23$
1	+345	-1291	= -946	= +7 - 18 = -11 = +12
2	-44	-922	= -966	= -13 - 13 = -26 = -3
3	+1492	-2430	= -938	= +15 - 35 = -20 = +3
4	+220	-1188	= -968	= -15 - 17 = -32 = -9
5	+1173	-2142	= -969	= +4 - 31 = -27 = -4
moon	14.8486	-1668	14.7721	-24 = 14.7720

	$y-7$	$+70x$	$+3y$	-1046
1	+577	+418	= +995	+55 = +1050 = +4
2	+164	+843	= +1007	+39 = +1046 = 0
3	-20	+964	= +944	+104 = +1048 = +2
4	-1274	+2267	= +993	+51 = +1044 = -2
5	-1407	+2357	= +950	+92 = +1042 = -4
	23.8309	+1039	+71	= 23.8373

	a	G	$x-3$	$0-C$	$y-7$	$0-C$
1	33.67	+30.61	+C	= -4	+2	-4
2	32.39	+16.97	+C	= -9	-1	-2
3	13.77	+34.71	+C	= +3	-1	+2
4	12.04	+13.17	+C	= -3	-4	0
5	5.97	+18.45	+C	= +12	+7	+4

Large y 's inclosed.

$$+33.03 + 2379 + C = -6.50 \quad -3.00$$

$$+10.59 + 22.11 + C = -4.00 \quad +2.00$$

$$+23.72 + 3266 + C = -0.50 \quad -1.00$$

$$+16.80 + 16.20 + C = 0.00 \quad +1.00$$

$$+22.44 + 1.68 = -10.50 \quad -5.00$$

$$+6.92 + 16.46 = -0.50 \quad -2.00$$

$$+6.92 + 0.52 = -3.24 \quad -1.54$$

$$+15.94 = +2.74 \quad -0.46$$

$$G = +0.17 \quad -0.03$$

$$+22.44 = -10.50 - 0.29 = -10.79 \quad -5.00 + 0.05 = -4.95$$

$$a = -0.48 \quad -0.22$$

-6.50	+4.00	-0.50	0.00	-3.00	+2.00	-1.00	+1.00
+15.89	+5.09	+11.41	+8.08	+7.77	+2.32	+5.22	+3.70
-4.04	-3.76	-5.55	-2.75	+6.8	+6.6	+9.8	+4.9
+5.35	+5.33	+5.46	+5.33	+4.95	+4.98	+5.20	+5.19

C from $x-3$ C from $y-7$

MC 872

1912 Oct 10.

43

Preliminary Reduction

star	$x-3$	$-70y$	$+903-y$	-123
1	+345	-1291	-946	+7-18 = -11 = +12
2	-44	-922	-966	-13-13 = -26 = -3
3	+1492	-2450	-938	+15-35 = -20 = +3
4	+220	-1188	-968	-15-17 = -32 = -9
5	+1173	-2142	-945	+4-31 = -27 = -4
mean	14.8486	-1668	14.7721-24 =	14.7720

	$y-7$	$+70x$	$+3y$	-1046
1	+577	+418	+995	+55 = +1050 = +4
2	+164	+843	+1007	+39 = +1046 = 0
3	-20	+964	+944	+104 = +1048 = +2
4	-1274	+2267	+993	+51 = +1044 = -2
5	-1402	+2357	+950	+92 = +1042 = -4
	238309	+1039	+71	= 23.8373

	a	b	$x-3$	$0-c$	$y-7$	$0-c$
1	33.67	+30.61 + c	= -4	+2	-4	-1
2	32.39	+16.97 + c	= -9	-1	-2	+1
3	13.77	+34.71 + c	= +3	-1	+2	+1
4	12.04	+13.17 + c	= -3	-4	0	-2
5	597	+18.45 + c	= +12	+7	+9	+1

Large y 's inclosed.

$$+33.03 + 2379 + c = -6.50 \quad -3.00$$

$$+10.59 + 2211 + c = -4.00 \quad -2.00$$

$$+23.72 + 3266 + c = -0.50 \quad -1.00$$

$$+16.80 + 16.20 + c = 0.00 \quad +1.00$$

$$+22.44 + 1.68 = -10.50 \quad -5.00$$

$$+6.92 + 16.46 = -0.50 \quad -2.00$$

$$+6.92 + 0.52 = -3.24 \quad -1.54$$

$$+15.94 = +2.74 \quad -0.46$$

$$b = +0.17 \quad -0.03$$

$$+22.44 = -10.50 - 0.29 = -10.79 \quad -5.00 + 0.05 = -4.95$$

$$a = -0.48 \quad -0.22$$

-6.50	+4.00	-0.50	0.00	-3.00	+2.00	-1.00	+1.00
+15.89	+5.09	+11.41	+8.08	+7.77	+2.32	+5.22	+3.70
-4.04	-3.76	-5.55	-2.75	+6.8	+6.6	+4.8	+4.9
+5.35	+5.33	+5.46	+5.33	+4.95	+4.98	+5.20	+5.19

c from $x-3$ c from $y-7$

	Residuals				c	o	$x - \bar{x}$
1	-16	+5	+5	=	-6	-4	+2
2	-16	+3	+5	=	-8	-9	-1
3	-7	+6	+5	=	+4	+3	-1
4	-6	+2	+5	=	+1	-3	-4
5	-3	+3	+5	=	+5	+12	+7

$$\begin{array}{r|l} -1 & +2 \\ \hline -4 & \\ +7 & -1 \end{array}$$

	Residuals				c	o	$y - \bar{y}$
1	-7	-1	+5	=	-3	-4	-1
2	-7	-1	+5	=	-3	-2	+1
3	-3	-1	+5	=	+1	+2	+1
4	-3	-0	+5	=	+2	0	-2
5	-1	-1	+5	=	+3	+4	+1

$$\begin{array}{r|l} +1 & -1 \\ \hline -2 & +1 \\ +1 & \end{array}$$

MC 872

44

	Residuals				C	O	$x-3$	$O-C$	
1	-1	6	+5	+5	= -6	-4	+2		
2	-1	6	+3	+5	= -8	-9	-1		-1 +2
3	-	7	+6	+5	= +4	+3	-1		-4
4	-	6	+2	+5	= +1	-3	-4		+7 -1
5	-	3	+3	+5	= +5	+12	+7		
								$y-7$	
1	-	7	-1	+5	= -3	-4	-1		
2	-	7	-1	+5	= -3	-2	+1		+1 -1
3	-	3	-1	+5	= +1	+2	+1		-2 +1
4	-	3	-0	+5	= +2	0	-2		+1
5	-	1	-1	+5	= +3	+4	+1		

$$\begin{array}{r|l} 5+ & 1- \\ \hline 1- & 7+ \end{array}$$

$$\begin{array}{r|l} 1- & 1+ \\ \hline 1+ & 5- \end{array}$$

2-4	0	0	2+2+	0-1	10M01
3-0	4-	0-	2+2+	0-1	
5+	4-	4+	2+2+	0-1	
1-1	4+	4+	2+2+	0-1	
4-	5-	1+	2+2+	0-1	
5+	5-	2+	2+2+	0-1	
7-3	4-	4-	2+1-	1-1	
1-3	5-	4-	2+1-	1-1	
1+1	5+	1+	2+1-	1-1	
5-1	0	4+	2+0-	1-1	
1+	4+	4+	2+1-	1-1	

Point	Pos. L	Resid.
9	180.0	-140
5	175.9	-46
11	171.8	+161
1	151.7	+1
6	146.5	+81
2	113.6	-33
8	90.0	-25
3	85.3	-42
4	56.7	+23
7	33.5	+34
10	19.4	-9

MC 872

1912 Oct 30,

45

moon's center

Point	x	$x - \bar{x}$	Δx	$(x - \bar{x})^2$	$(x - \bar{x})^2 + (y - \bar{y})^2$	$0 - c$
1	15.8372	+0.9848	-2	0.9694	4.3187	-13
2	16.7554	+1.9030	-1	3.6210	4.3101	-99
3	16.9214	+2.0690	0	4.2808	4.3097	-103
4	16.5703	+1.7179	+1	2.9515	4.3206	+36
5	15.0000	+0.1476	-2	0.0217	4.3198	-2
6	16.0000	+1.1476	-2	1.3165	4.3256	+56
7	16.0000	+1.1476	+2	1.3174	4.3269	+69
8	16.9287	+2.0763	0	4.3110	4.3110	-90
9	14.8524	0.0000	-2	0.0000	4.3114	-86
10	15.5414	+0.6890	+2	0.4760	4.3264	+64
11	15.1500	+0.2976	+2	0.0884	4.3394	+194

mean = 4.3200

	y	$y - \bar{y}$	Δy	$(y - \bar{y})^2$
1	22.0000	-1.8300	-1	3.3493
2	23.0000	-0.8300	-1	0.6891
3	24.0000	+0.1700	+0	0.0289
4	25.0000	+1.1700	+1	1.3691
5	21.7569	-2.0731	-1	4.2981
6	22.0955	-1.7345	-1	3.0091
7	25.5646	+1.7346	+1	3.0095
8	23.8300	0.0000	0	0.0000
9	21.7537	-2.0763	-1	4.3114
10	25.7924	+1.9624	+1	3.8514
11	21.7683	-2.0617	-1	4.2510

-393
+389

05 450.91

27800

Wavelength

Wavelength	Flux	Wavelength	Flux	Wavelength	Flux
51 -	2810.0	4040.0	1.7	8880.0	2.5
52 -	3010.0	9120.0	1.7	0800.0	4.2
53 -	3200.0	3080.0	0	0800.0	4.2
54 +	3320.0	2420.0	1.7	0800.0	4.2
55 -	3320.0	2420.0	1.7	0800.0	4.2
56 +	3320.0	2420.0	1.7	0800.0	4.2
57 +	3320.0	2420.0	1.7	0800.0	4.2
58 -	3320.0	2420.0	1.7	0800.0	4.2
59 -	3320.0	2420.0	1.7	0800.0	4.2
60 +	3320.0	2420.0	1.7	0800.0	4.2
61 +	3320.0	2420.0	1.7	0800.0	4.2

0000.0

Wavelength	Flux	Wavelength	Flux	Wavelength	Flux
2040.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	0.0	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0
1920.0	1.7	0000.0	0.0	0000.0	0.0

10872

1912 Oct 30.

45

moon's Center

Point	x	$x - \bar{x}$	Δx	$(x - \bar{x})^2$	$(x - \bar{x})^2 + (y - \bar{y})^2$	$0 - c$
1	15.8372	+0.9848	+2	0.9702	4.3195	-7
2	16.7554	+1.9030	+1	3.6210	4.3109	-93
3	16.9214	+2.0690	0	4.2808	4.3097	-105
4	16.5703	+1.7179	-1	2.9542	4.3233	+31
5	15.0000	+0.1476	+2	0.0218	4.3189	-3
6	16.0000	+1.1476	+2	1.3174	4.3262	+60
7	16.0000	+1.1476	-2	1.3165	4.3250	+48
8	16.9287	+2.0763	0	4.3110	4.3110	-42
9	14.8524	0.0000	+2	0.0000	4.3114	-88
10	15.5414	+0.6890	-2	0.4744	4.3258	+56
11	15.1500	+0.2976	+2	0.0887	4.3328	+105
				mean =	4.3202	

	y	$y - \bar{y}$	Δy	$(y - \bar{y})^2$
1	22.0000	-1.8300	-1	3.3493
2	23.0000	-0.8300	-1	0.6891
3	24.0000	+0.1700	+0	0.0289
4	25.0000	+1.1700	+1	1.3691
5	21.7569	-2.0731	-1	4.2981
6	22.0955	-1.7345	-1	3.0088
7	25.5646	+1.7346	+1	3.0095
8	23.8300	0.0000	0	0.0000
9	21.7537	-2.0763	-1	4.3114
10	25.7924	+1.9624	+1	3.8514
11	21.7683	-2.0617	-1	4.2510

Approximate Position of Moon's Center.

$$x = 16.0 \quad y = 22.0955$$

$$25.5646$$

$$47.6601$$

$$\text{mean } y = 23.8300$$

$$y = \text{min } 21.7587$$

$$R = 2.0763$$

$$X = 14.8524$$

$$Y = 23.8300$$

$$R = 2.0763$$

$$x = \text{max } 16.9287$$

$$R = 2.0763$$

$$X = 14.8524$$

Times etc

Exposure	stars	11 ^h 16 ^m 00 ^s	- 11 ^h 26 ^m 00 ^s
	moon	11 21 02.6	- 11 21 02.9
	clock fast		2 ^m 23.0

Haward Sidereal Time.	1911 Jan. 16	11 ^h 18 ^m 39.75 ^s
Longitude		4 44 31.05
Gr. Sid. Time		16 03 10.80
Sid. time Gr. M. Noon		19 39 12.92
Sid. Interval		20 23 57.88
Gr.		- 3 20.52
Gr. M. Time		20 ^h 20 ^m 37.36

Moon's place from Am. Eph.

$$20^{\text{h}} \quad 10^{\text{h}} \quad 07^{\text{m}} \quad 44.93^{\text{s}} \quad + 16^{\circ} 48' 45.6''$$

$$\text{motion in } 1^{\text{m}} = 2.2306$$

$$2.2306 \quad + 46.00^{\text{m}}$$

$$\text{Tabular place } 10^{\text{h}} \quad 08^{\text{m}} \quad 30.93^{\text{s}}$$

$$+ 16^{\circ} 44' 22.4''$$

$$\text{Moon's Parallax } 58' 20.9''$$

$$\text{" semid. } 15' 55.4''$$

Center of plate

$$A = 10^{\text{h}} \quad 09^{\text{m}} \quad 20^{\text{s}}$$

$$D = 16^{\circ} 04' 06''$$

Observations of the ...

4833.1	X	2290.45	Y
0033.3	Y	2290.45	Y
2200.2	Y	2290.45	Y
		2290.45	Y
		2290.45	Y
		2290.45	Y
		2290.45	Y
		2290.45	Y
		2290.45	Y
		2290.45	Y
		2290.45	Y

... observations ...

2192.1	11	11	11
20.1	11	11	11
09.1	11	11	11
09.1	11	11	11
09.1	11	11	11
09.1	11	11	11
09.1	11	11	11
09.1	11	11	11
09.1	11	11	11
09.1	11	11	11

... observations ...

2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y
2290.45	Y	2290.45	Y

... observations ...

... observations ...

NC 872

1912 Oct 25. 46

Approximate Position of Moon's Center.

$$x = 16.0 \quad y = 22.0955$$

$$25.5646$$

$$47.6601$$

$$\text{mean } y = 23.8300$$

$$y = \text{min} \quad 21.7537$$

$$R = 2.0763$$

$$x = \text{max} \quad 16.9287$$

$$R = 2.0763$$

$$X = 14.8524$$

$$X = 14.8524$$

$$Y = 23.8300$$

$$R = 2.0763$$

Times etc.

Exposure stars $11^h 16^m 00^s - 11^h 26^m 00^s$
 noon $11^h 21^m 02.6^s - 11^h 26^m 02.9^s$
 Clock fast $2^m 23.0$

Hawaii Sidereal Time. Jan. 16 $11^h 18^m 39.75^s$
 Longitude $4^h 44^m 31.05^s$
 Gr. Sid. Time $16^h 03^m 10.80^s$
 Sid. time Gr. M. Noon $19^h 39^m 12.92^s$
 Sid. Interval $20^h 23^m 57.88^s$
 Cor. $- 3^m 20.52^s$
 Gr. M. Time $20^h 20^m 37.36^s$

Moon's place from Am. Eph.

$$20^h \quad 10^h \quad 07^m 44.93^s$$

$$+ 16^\circ 48' 45''$$

$$2.2306$$

$$\text{motion in } 1^m = 2.2342$$

$$13.732$$

$$12.748$$

$$+ 20.62 \quad + 45.99$$

$$- 4' 22.6$$

$$\text{Tabular place } 10^h \quad 08^m \quad 30.93^s$$

$$+ 16^\circ 44' 22''$$

$$\text{Moon's Parallax } 58' 20.8$$

$$\text{" semid. } 15' 55.4$$

Formation of normals.

	[aa]	[ab]	[an]	[bb]	[bn]
1	0.96	- 1.79	- 12.7	3.35 ^v	+ 23.8
2	3.61	- 1.58	- 188.1	0.69 ^v	+ 82.2
3	4.28	+ 0.35	- 213.2	0.03 ^v	- 17.5
4	2.96	+ 2.01	+ 10.3	1.37 ^v	+ 7.0
5	0.02	- 0.31	- 0.3	4.28 ^v	+ 4.1
6	1.32	- 1.99	+ 64.4	2.99 ^v	- 96.9
7	1.32	+ 1.99	+ 79.4	2.99 ^v	+ 119.4
8	4.33	0.00	- 187.2	0.00 ^v	0.0
9	0.00	0.00	0.0	4.33 ^v	+ 178.9
10	0.48	+ 1.35	+ 44.2	3.84 ^v	+ 125.4
11	0.09	- 0.62	+ 58.2	4.24 ^v	- 399.6 ^v
	<u>19.37</u> 35	<u>- 0.59</u>	<u>- 345.0</u> ^v	<u>28.07</u> 28.17	<u>+ 26.8</u>

$$[ac] = +12.19 \quad [bc] = -5.57 \quad [cn] = -4.0^{\circ}$$

$$\begin{array}{r} 11.99 \\ 629 \\ \hline 570 \\ 59 \end{array}$$

1.2445 (P)

518434

Formation of ...

[data] [data] [data]

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MC 872

1912 Nov. 1

47

Moon's limb

Conditional Equations

	a	b	c	
1	+0.98	-1.83	+ c	= -1.34
2	+1.90	-0.83	+ c	= -9.95
3	+2.07	+0.17	+ c	= -10.30
4	+1.72	+1.17	+ c	= +3.61
5	+0.15	-2.07	+ c	= -2.21
6	+1.15	-1.73	+ c	= +5.62
7	+1.15	+1.73	+ c	= +6.98
8	+2.08	0.00	+ c	= -9.2
9	0.00	-2.08	+ c	= -8.63
10	+0.69	+1.96	+ c	= +6.4
11	+0.30	-2.06	+ c	= +1.94

Normal Equations

$$\begin{array}{rclcl}
 +19.37 & - & 0.59 & +12.19 & = -34.50 \\
 -0.59 & + & 28.09 & -5.57 & = +21.0 \\
 +12.19 & - & 5.57 & +11.00 & = +4.0
 \end{array}$$

$$\begin{array}{rclcl}
 +0.59 & + & 0.02 & +0.37 & = -10 \\
 -12.19 & + & 0.37 & -7.67 & = +217
 \end{array}$$

$$\begin{array}{rclcl}
 +28.07 & - & 5.20 & = +17 & \frac{\Delta S}{\Delta a} = 2.08a + 19 + 0.39 \\
 -5.20 & + & 3.33 & = +213
 \end{array}$$

$$\begin{array}{rclcl}
 +5.20 & - & 0.96 & = +3 \\
 +2.37c & = & +216
 \end{array}$$

$$c = +91 \pm 34$$

$$+8.12 + 5.20 = +333$$

$$+79.952 = +350$$

$$b = +18 \pm 12$$

$$-13.51 + 6.17 - 12.19 = +4$$

$$+6.17 - 2.82 + 5.57 = -2$$

$$+5.86 + 5.58 = -341$$

$$+5.58 + 25.27 = +25$$

$$-1.23 - 5.58 = -6$$

$$+4.63a = -347$$

$$a = -75 \pm 25$$

$$+924 - 2809 + 579$$

$$\frac{\Delta S}{\Delta a} = 2.08a - 63 = +1.79$$

Residuals				C	D	C-D
1	- 73	+ 32	+ 91	- 14	- 13	+ 1
2	- 142	- 15	+ 91	- 66	- 99	- 33
3	- 155	+ 3	+ 91	- 61	- 103	- 42
4	- 129	+ 21	+ 91	- 17	+ 6	+ 23
5	- 11	- 36	+ 91	+ 44	- 2	- 46
6	- 86	- 30	+ 91	- 25	+ 56	+ 81
7	- 86	+ 30	+ 91	+ 35	+ 69	+ 34
8	- 156	0	+ 91	- 65	- 90	- 25
9	- 0	- 37	+ 91	+ 54	- 86	- 140
10	- 52	+ 34	+ 91	+ 73	+ 64	- 9
11	- 22	- 36	+ 91	+ 33	+ 194	+ 161

$$+ 300 = 295$$

$$\text{Average } (C-D) = 54$$

$$\text{Prob. E. one equation} = 54 \times \sqrt{\frac{11}{8}} \times 0.84 = \pm 53$$

$$\begin{array}{l} X_0 = 14.8524 \\ + \frac{1}{2}a = - 38 \\ \hline X = 14.8486 \end{array} \quad \begin{array}{l} Y_0 = 23.8300 \\ + \frac{1}{2}b = + 9 \\ \hline Y = 23.8309 \end{array} \quad \begin{array}{l} R_0 = 2.0763 \\ + \frac{1}{2}c = + 23 \\ \hline R = 2.0786 \end{array}$$

$$\begin{array}{l} \text{from previous constants } X = 14.7720 \\ \text{" computed " } ax = - 7 \\ by = + 4 \\ c = + 5 \\ \hline X = 14.7722 \quad Y = 23.8374 \end{array}$$

Position (mean) for 1911.0

$$\begin{array}{l} \delta = -3.2278 \\ \log \delta = 0.50890 \\ \cos \delta = .998217 \\ \text{const} = 8.50724 \\ (\alpha - A) = 2.01949 \\ \alpha - A = - 104.59 \\ A = 10^h 09^m 20.50 \\ X = 10^h 07^m 35.41 \end{array} \quad \begin{array}{l} \eta = +1.8374 \\ \tan \delta = 9.4781 \\ \log \delta^2 = 0.9970 \\ \text{const} = 7.053 \\ \eta_0 = 7.528 \\ \eta_1 = + 34 \\ \eta_0 = +1.8340 \\ \log \eta_0 = 0.26340 \\ \text{const} = 7.33115 \end{array} \quad \begin{array}{l} 9.4662 \\ 1.0178 \\ 7.0534 \\ 7.5374 \\ + 54 \end{array}$$

$$\begin{array}{l} \log (S-D) = 2.93225 \\ S-D = + 855.6 \\ S = 14' 14'' 15.6 \\ D = +16 04 06 \\ S = +16 18 21.6 \end{array}$$

Residuals

			C	O	O-C
-34	+ 33	+ 91	+ 16	- 13	+ 13
-142	+ 13	+ 91	- 65	- 99	- 34
-155	+ 3	+ 91	- 61	- 103	- 42
-129	+ 21	+ 91	- 47	+ 6	+ 23
-11	+ 37	+ 91	+ 43	- 2	- 45
-86	+ 31	+ 91	- 26	+ 50	+ 23
-56	+ 31	+ 91	+ 56	+ 67	+ 33
-156	+ 30	+ 91	- 65	- 90	- 25
-0	+ 37	+ 91	+ 54	- 86	- 44
-52	+ 35	+ 91	+ 74	+ 64	+ 16
-22	+ 37	+ 91	+ 32	+ 194	+ 162

+ 303 = 296

Average (O-C) = 54

Prob. 2. one equation $54 \pm \sqrt{\frac{11}{8}} \times 0.84 = \pm 53$

$$\begin{array}{rcl}
 X_0 = 14.8524 & Y_0 = 23.8300 & R_0 = 2.0763 \\
 + \frac{1}{2}a = -38 & + \frac{1}{2}b = +9 & + \frac{1}{2}c = +23 \\
 X = 14.8486 & Y = 23.8309 & R = 2.0786
 \end{array}$$

From previous constants

$$\begin{array}{rcl}
 X = 14.7720 & Y = 23.8373 \\
 \text{computer} & \text{ax} = & -7 \\
 & \text{by} = & +4 \\
 & \text{c} = & +5 \\
 X = 14.7722 & Y = 23.8374
 \end{array}$$

Position (mean) for 1911.0

$$\delta = -3.2278 \quad \eta = +1.8374$$

$$\log \delta = 0.50890$$

$$\cos \delta = 9.98217$$

$$\cos \delta = 8.50724$$

$$(x-A) = 2.01949$$

$$x-A = -1.0459$$

$$A = 10^h 09^m 20.0$$

$$A = 10^h 07^m 35.1$$

$$\tan \delta = 9.4781$$

$$\log \delta^2 = 0.9970$$

$$\cos \delta = 7.053$$

$$\eta = 7.528$$

$$\eta = +34$$

$$\eta_0 = +1.8340$$

$$\log \eta_0 = 0.26340$$

$$\cos \delta = 7.33115$$

$$\log (5-D) = 2.93225$$

$$\delta = \delta = +85.5.6$$

$$14' 14' 15.6$$

$$D = +16 04 06$$

$$S = +16 18 21.6$$

MC 872 (1911, Jan 16, 11^h)

1912 Nov. 20.

49

Moon.

Red. to App. Place

$$\begin{aligned} \alpha_0 &= 10^h 07^m 35.41^s \\ G &= 16 \quad 03 \quad 12 \\ G + \alpha &= 26 \quad 10 \quad 47.41 \\ &= (392^\circ 42') \end{aligned}$$

$$\begin{aligned} \delta &= +16^\circ 18' 21.6'' \\ H &= 22^h 23.0^m \\ H + \alpha &= 32^h 30^m 35^s \\ &= (127^\circ 39') \end{aligned}$$

$$\begin{aligned} \log \frac{1}{r} &= 8.8239 \\ \log g &= 0.8469 \\ \sin(G + \alpha) &= 9.7326 \\ \tan \delta_0 &= 9.4662 \\ \log(g) &= 8.8696 \end{aligned}$$

$$\begin{aligned} \log \frac{1}{r} &= 8.8239 & \log i &= 0.5547 \\ \log h &= 1.3038 & \cos \delta' &= 9.9822 \\ \sin(H + \alpha) &= 9.8986 & \log(i) &= 0.5369 \\ \sec \delta_0 &= 0.0178 \\ \log(h) &= 0.0441 \end{aligned}$$

$$\begin{aligned} \log g &= 0.8469 \\ \cos(G + \alpha) &= 9.9251 \\ \log(\delta') &= 0.7720 \end{aligned}$$

$$\begin{aligned} \log h &= 1.3038 \\ \cos(H + \alpha) &= 9.7859 \\ \sin \delta_0 &= 9.4483 \\ \log(h') &= 0.5380 \end{aligned}$$

$$\begin{aligned} \alpha_0 &= 10^h 07^m 35.41^s \checkmark \\ l &= - \quad 0.53 \checkmark \\ (g) &= + \quad 0.07 \checkmark \\ (h) &= + \quad 1.11 \checkmark \\ \alpha &= 10 \quad 07 \quad 36.06 \checkmark \end{aligned}$$

$$\begin{aligned} \delta_0 &= +16^\circ 18' 21.6'' \checkmark \\ (g') &= + \quad 5.9 \checkmark \\ (h') &= - \quad 3.5 \checkmark \\ l &= - \quad 3.4 \checkmark \\ \delta &= +16^\circ 18' 20.6'' \checkmark \end{aligned}$$

$$+1.18$$

$$- 5.3$$

$$6.5$$

$$- 6.9$$

$$+ 5.9$$

MC 872 (1911 Jan 16, 11^h)

1912 Nov. 20.

49

moon
Red. to App. place

$$\begin{aligned} \alpha_0 &= 10^h 07^m 35.41^s \\ G &= 16 \quad 03 \quad 12 \\ G+X &= 26 \quad 10 \quad 47.41 \\ &= (392^\circ 42') \end{aligned}$$

$$\begin{aligned} \delta &= +16^\circ 18' 21.6'' \\ H &= 22^h 23.0^m \\ H+X &= 32^h 30^m 35.5^s \\ &= (127^\circ 39') \end{aligned}$$

$$\begin{aligned} \log \frac{1}{r} &= 8.8239 \\ g &= 0.8464 \\ \sin(G+X) &= 9.7326 \\ \sin \delta_0 &= 9.4662 \\ \log(g) &= 8.8696 \end{aligned}$$

$$\begin{aligned} \log g &= 0.8469 \\ \cos(G+X) &= 9.9251 \\ \log(g') &= 0.7720 \end{aligned}$$

$$\begin{aligned} \alpha_0 &= 10^h 07^m 35.41^s \\ l &= - \quad 0.53 \\ (g) &= + \quad 0.07 \\ (h) &= + \quad 1.11 \\ \alpha &= 10 \quad 07 \quad 36.06 \end{aligned}$$

$$\begin{aligned} \log \frac{1}{r} &= 8.8239 \\ h &= 1.3038 \\ \sin(H+X) &= 9.8986 \\ \sec \delta_0 &= 0.0178 \\ \log(h) &= 0.0441 \end{aligned}$$

$$\begin{aligned} \log h &= 1.3038 \\ \cos(H+X) &= 9.7859 \\ \sin \delta_0 &= 9.4483 \\ \log(h') &= 0.5380 \end{aligned}$$

$$\begin{aligned} \delta_0 &= +16^\circ 18' 21.6'' \\ (g') &= + \quad 5.9 \\ (h') &= - \quad 3.5 \\ l &= - \quad 3.4 \\ \delta &= +16^\circ 18' 20.4'' \end{aligned}$$

Lunar Parallax

$$\begin{aligned} \alpha_0' &= 10^h 07^m 36.06'' \checkmark \\ \alpha - \alpha' &= +1^m 11^s 03.69'' \checkmark \\ &= 17^\circ 45' 55'' \checkmark \end{aligned}$$

$$(\theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = 17^\circ 39' 03''$$

$$\begin{aligned} \log p \sin \phi' &= 9.82640'' \\ \sin \pi &= 8.22974'' \\ \sin(\gamma - \delta') &= 9.66086'' \\ \sin \gamma &= 9.83831'' \end{aligned}$$

$$\sin(\delta - \delta') = 7.87869''$$

$$\delta - \delta' = +26' 00.0'' \checkmark$$

$$\delta = +16^\circ 44' 20.6'' \checkmark$$

$$\alpha = 10^h 08^m 31.07'' \checkmark$$

Tabular place - Ann. Ehh.

$$\alpha = 10^h 08^m 30.98'' \checkmark$$

$$\delta = +16^\circ 44' 22.4'' \checkmark$$

$$\begin{aligned} \text{Corr. to stand radius in } \Delta \alpha &= +0.15'' \\ &= \Delta \delta = -0.7'' \end{aligned}$$

$$\begin{aligned} \text{Final } \alpha - \alpha' &= \Delta \alpha & \Delta \delta \\ &+ 0.29'' & - 2.5'' \end{aligned}$$

$$\begin{aligned} \delta' &= +16^\circ 18' 20.6'' \checkmark \\ \pi &= 58' 20.9'' \\ \log p \cos \phi' &= 9.86913'' \\ \sin \pi &= 8.22974'' \\ \sin(\theta - \alpha') &= 9.48447'' \\ \cos \delta' &= 9.98217'' \end{aligned}$$

$$\begin{aligned} \sin(\alpha - \alpha') &= 7.60115'' \\ \alpha - \alpha' &= 13' 43.4'' \\ &= 55.588'' \end{aligned}$$

$$\begin{aligned} \tan \phi' &= 9.95727'' \\ \cos \frac{1}{2}(\alpha - \alpha') &= 0.00000'' \\ \cos(\theta - \alpha') - \frac{1}{2}(\alpha - \alpha') &= 9.97906'' \end{aligned}$$

$$\begin{aligned} \tan \gamma &= 9.97821'' \\ \gamma &= +43^\circ 33' 48.0'' \\ \delta' &= +16^\circ 18' 20.6'' \end{aligned}$$

$$\gamma - \delta' = +27^\circ 15' 27.4''$$

$$\begin{aligned} \text{corrected } \alpha - \alpha' &= 13' 45.2'' \checkmark \\ &= +55.501'' \checkmark \end{aligned}$$

$$O - C = +0.14'' \checkmark$$

$$O - C = -1.3'' \checkmark$$

$$\begin{aligned} 9.86913 \\ 8.22974 \\ 9.48447 \\ 9.98217 \end{aligned}$$

$$\sin(\alpha - \alpha') = 7.60214$$

$$\alpha - \alpha' = 13' 45.2''$$

Human (female)

$$1.00 \times 10^3 = 10^3$$

$$1.00 \times 10^3 = 10^3$$

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$$1.00 \times 10^3 = 10^3$$

MC 872

1912 Dec. 2.

50

Lunar Parallax

$$\begin{aligned}\alpha' &= 10^h 07^m 36.06 \\ \delta &= 11 \quad 18 \quad 39.75 \\ O-\alpha' &= 1 \quad 11 \quad 03.69 \\ &= 17^\circ 45' 49''\end{aligned}$$

$$O-\alpha' - \frac{1}{2}(\alpha-\alpha') = 17^\circ 38' 56''$$

$$\begin{aligned}\log p \sin \phi' &= 9.82640 \\ \sin \pi &= 8.22974 \\ \sin(\gamma-\delta') &= 9.66086 \\ \sin \gamma &= 9.83831\end{aligned}$$

$$\sin(\delta-\delta') = 7.87867$$

$$\delta-\delta' = +23' 58.95''$$

$$\delta = +16^\circ 44' 20.6''$$

$$\alpha = 10^h 08^m 31.07$$

Tabulator place - Ann. Ehh.

$$\alpha = 10^h 08^m 30.93$$

$$\delta = +16^\circ 44' 22.4''$$

$$\begin{aligned}\text{Corr. to Stand. radium in } \Delta\alpha &= +0.15 \\ &= \Delta\delta = -0.7\end{aligned}$$

$$\begin{aligned}\text{Final } O-C &= \Delta\alpha \quad \Delta\delta \\ &= +0.29 \quad -2.5''\end{aligned}$$

$$\delta' = +16^\circ 18' 20.6''$$

$$\pi = 58 \quad 20.8$$

$$\log p \cos \phi' = 9.86913$$

$$\sin \pi = 8.22972$$

$$\sin(O-\alpha') = 9.48440$$

$$\cos \delta' = 9.98217$$

$$\sin(\alpha-\alpha') = 7.60108$$

$$\begin{aligned}\alpha-\alpha' &= 13' 43.2'' \\ &= 54.88''\end{aligned}$$

$$\tan \phi' = 9.95727$$

$$\cos \frac{1}{2}(\alpha-\alpha') = 0.00000$$

$$\cos(\delta-\delta') - (\delta-\delta') = 9.97906$$

$$\tan \gamma = 9.97821$$

$$\gamma = +43^\circ 33' 48.0''$$

$$\delta' = +16 \quad 18 \quad 20.4$$

$$\gamma-\delta' = +27^\circ 15' 27.6''$$

$$\begin{aligned}\text{corrected } \alpha-\alpha' &= 13' 45.1'' \\ &= 56.501''\end{aligned}$$

$$O-C = +0.14$$

$$O-C = -3.1''$$

2

2

2

2

2

10	03 50.44	10	04 03.44	10	04 07.00
10	9 47	10	9 47	10	9 47
-	0 56.16	-	1 39.56	-	2 07.94
-	4 05.50	-	2 13.55	-	1 07.70
2.6	362.4	2.3	395.5	2.3	302.9
9.9	371.7	9.9	510	9.9	7830
3	1 1 03.7m	09	31.89m	07	1 6.43m
1	- 12.8994	-	6.7903	-	8.2081
3	37	-	22	-	24
1	50949	11	2073	12	7925
x	5 01.19	11	1882	12	9257
-3	+ 0.70	-	2.13	+	2332
6	+ 15 35 41.3	17	55 16.6	17	42 31.7
0	14 8 46	16	8 46	16	8 46
-0	- 33 47	-1	17 29.4	+	1 34 07.2
-0	- 19742	-	441.01	+	5840.6
3	329772m	35	4443m	37	5194
6	462837m	09	7500m	1.0	8307
2.4	914876	9	4258	9	5048
3	322114	1	6635	1	4329
6	87203	8	1438	7	9907
7	- 4.2547	-	9.4536	+	12 1016
7	+ 525	+	139	+	98
7	177778	12	5683	3	41184
8	78586	12	5764	3	41182
-7	+ 802	+	164	-	2
		+	141		

1
2
A
A-
Sun
log
" 0
"
"
"
x
"
"
8-
tan
log
"
"
to
3
"
"
y-

MC 873

1912

57

comp. stars + standard coordinates
see page 35-37.

1	2	3
α 10 ^m 02 ^m 50.44	α 10 ^m 06 ^m 08.44	α 10 ^m 06 ^m 57.06
A 10 9 47	10 9 47	10 9 47
A-A - 6 56.56	- 3 38.56	- 2 49.94
μ (A-A) - 4 16.50	- 2 18.55	- 1 69.94
\log 2.61962 ^m	2.33955 ^m	2.23029 ^m
\log 9.98371	9.98510	9.97890
Σ 1.11037 ^m	0.83189 ^m	0.71643 ^m
Σ_0 - 12.8994	- 6.7903	- 5.2051
Σ_1 - 57	- 22	- 24
Σ 50949	112075	127925
x 51119	171862	129257
$x-\Sigma$ + 170	- 213	+ 2332
δ +15° 35' 41.3	14° 55' 16.6	17° 42' 53.2
D 16 8 46	16 8 46	16 8 46
$\delta-D$ - 33 47	- 1 13 29.4	+ 1 34 07.2
μ ($\delta-D$) - 1984.8	- 4410.1	+ 5648.4
\log 3.29772 ^m	3.64445 ^m	3.75192
\log 0.62887 ^m	0.97550 ^m	1.08307
$\tan \delta$ 944576	94258	95048
Σ 222714	16638	14329
η_1 8.7203	8.1434	7.9911
η_0 - 7224	- 9.4515	+ 12.1080
η_1 - 4.2547	- 139	+ 98
η_2 + 525	+ 12.5624	341178
η 17.7978	12.5764	341182
η 178586		
$q-\eta$ + 608	+ 140	+ 4

MC 973

1912 Oct 9.

58

Comparison stars + standard coordinates.
continued.

$$\begin{array}{rcl}
 \alpha & 10^h 17^m 03.27^s \\
 A & 10 \quad 09 \quad 47 \\
 \alpha - A & + \quad 7 \quad 16.27 \\
 \sin(\alpha - A) & + \quad 436.20 \\
 \log'' & 2.63969 \\
 \cos \delta & 9.98407
 \end{array}$$

$$\zeta_0 \quad 1.13100$$

$$\zeta_0 + 13.5206$$

$$\zeta_1 + 70$$

$$\zeta \quad 31.5276$$

$$x \quad 31.5331$$

$$x - \zeta + 55$$

$$\begin{array}{rcl}
 \delta & + 15^\circ 25' 28.8'' \\
 D & 16 \quad 08 \quad 46 \\
 \delta - D & - \quad 43 \quad 17.2 \\
 \tan(\delta - D) & - \quad 2597.3
 \end{array}$$

$$\log'' \quad 3.414527$$

$$\eta_0 \quad 0.745677$$

$$\tan \delta \quad 9.44087$$

$$\zeta^2 \quad 2.2620$$

$$\eta_1 \quad 8.75627$$

$$\eta_0 - 5.5676$$

$$\eta_1 + 570$$

$$\eta \quad 16.4894$$

$$y \quad 16.3582$$

$$y - \eta - 1312$$

$$\begin{array}{rcl}
 \alpha & 10^h 17^m 45.95^s \\
 A & 10 \quad 09 \quad 47 \\
 \alpha - A & + \quad 7 \quad 58.95 \\
 \sin(\alpha - A) & + \quad 478.85 \\
 \log'' & 2.68120 \\
 \cos \delta & 9.98015
 \end{array}$$

$$2.68020$$

$$\zeta_0 \quad 1.16759$$

$$\zeta_0 + 14.7431 \quad 14.7093$$

$$\zeta_1 + 100 \quad 100$$

$$\zeta \quad 32.7531 \quad 32.7193$$

$$x \quad 32.8224$$

$$x - \zeta + 693 + 1031$$

$$\begin{array}{rcl}
 \delta & + 17^\circ 11' 27.8'' \\
 D & 16 \quad 08 \quad 46 \\
 \delta - D & + \quad 1 \quad 2 \quad 41.8 \\
 \tan(\delta - D) & + \quad 3762.2
 \end{array}$$

$$\log'' \quad 3.57544$$

$$\eta_0 \quad 0.90659$$

$$\tan \delta \quad 9.4905$$

$$\zeta^2 \quad 2.3372 \quad 2.3352$$

$$\eta_1 \quad 8.8811 \quad 8.8791$$

$$\eta_0 + 8.0648$$

$$\eta_1 + 760 \quad 757$$

$$\eta \quad 30.1408 \quad 30.1405$$

$$y \quad 29.9987$$

$$y - \eta - 1421 - 1418$$

1911phae

1911phae

1911phae

1911phae

1911phae

1911phae

1911phae

1911phae

Comparison stars + standard coordinates.
Continued.

α	$10^h 17^m 03.27$	$10^h 17^m 45.95$
A	$10 \quad 09 \quad 47.$	$10 \quad 09 \quad 47.$
$\alpha - A$	$+ \quad 7 \quad 16.27$	$+ \quad 7 \quad 58.95$
$\sin(\alpha - A)$	$+ \quad 436.20$	$+ \quad 478.85$
$\log "$	2.63969	2.68120 2.66020
$\cos \delta$	9.98407	9.98015
S_0	1.13100	1.16359 1.16759
S_0	$+ \quad 1.35206$	$+ 14.7431$ 14.7093
S_1	$+ \quad 70$	$+ \quad 100$
S	3.15236	50.7531 32.7193
z	31.5331	32.8224
$\alpha - S$	$+ \quad 55$	$+ \quad 895 + 1031$
δ	$+ 15^\circ 25' 28.8$	$+ 17^\circ 11' 27.8$
δ	$16 \quad 08 \quad 46$	$16 \quad 08 \quad 46$
$\delta - D$	$- \quad 43 \quad 17.2$	$+ \quad 1 \quad 2 \quad 41.8$
$\tan(\delta - D)$	$- \quad 25973$	$+ \quad 37622$
$\log "$	3.414527	3.57544
η_0	0.745677	0.90659
$\tan \delta$	9.4408	9.4905
S	2.2620	2.3322 2.3352
η_1	8.7562	8.8811 8.87716
η_0	$- 5.5676$	$+ 38.0648$
η_1	$+ \quad 570$	$+ \quad 760$
η	16.4894	30.1408 30.1405
y	16.3582	62.99987
$y - \eta$	$- \quad 1312$	$- \quad 1421 - 1418$

MC 873

59

Mean measured coordinates of comp. stars,
and Coordinates of center of plates.

Star	α	δ	α	δ
1	5 11 19	17.5586	10 02 50	15 35 41
2	11.1862	12.5764	10 06 8	14 55 17
3	12.9257	34.1182	6 57	17 42 53
4	31.5331	16.3582	17 3	15 25 29
5	32.8224	29.9987	17 46	17 11 28
$\sqrt{93.58}$		$\sqrt{110.91}$	$\sqrt{50.44}$	$\sqrt{30.50.48}$
18.72		22.18	10 10 09	16 10 10
31		46.5	- 22	- 1 24
72		90	10 09 47	16 08 46
216		108		
$\sqrt{2232}$		72		
		83.70		
		1' 24"		

A = 10^h 09^m 47^s
D = 16° 08' 46" } Center of Plate.

Mean measured coordinates of comp. stars
and Coordinates of center of plates

Star	x	y	x	y	x	y
1	5.1119	17.8586	10.0250	15.3541		
2	11.1862	12.5764	10.068	14.5517		
3	12.9257	34.1182	6.57	17.4253		
4	31.5331	16.3582	17.3	15.2529		
5	32.2224	29.9987	17.46	17.1128		
	<u>51.9358</u>	<u>51.1091</u>	<u>51.5044</u>	<u>51.305048</u>		
	18.72	22.18	10.1009	16.1010		
	31	46.5	22	1.24		
	72	90	10.0947	16.0846		
	216	108				
	<u>2.2532</u>	<u>72</u>				
		83.70				
		1'24"				

A = $10^{\circ} 09' 47''$
D = $16^{\circ} 08' 46''$ } Center of plate.

Lunar Plate MC 873

1912 Sept 27 60

Comparison Stars.

Measures

See pp 35-37

//	d	y	N	d	N
5.1	15810		15960	15022	16190
17.8	722524		1454038	613832	1506462
	30		40	38	60
	20		56	26	92
	<u>17.8592</u>		<u>17.8580</u>	<u>5.1110</u>	<u>5.1128</u>
21	14828		14500	15394	15948
11.2	906563		1027070	725553	1408886
12.5	65		64	59	78
	26		06	96	50
	<u>12.5763</u>		<u>12.5765</u>	<u>11.1860</u>	<u>11.1864</u>
31	15000		16861	15300	16125
12.9	1382010		805352	1415048	687874
34.1	22		59	50	74
	00		75	90	40
	<u>34.1183</u>		<u>34.1181</u>	<u>12.9250</u>	<u>12.9264</u>
4	15268		14350	16260	14400
31.5	1168082		793030	1158880	906862
16.3	82		28	80	60
	66		52	66	10
	<u>16.3586</u>		<u>16.3578</u>	<u>31.5320</u>	<u>31.5342</u>
7	15212			14480	16826
32.8	521520			1270000	861002
30.0	18			02	08
	08			82	36
	<u>29.9990</u>		11740	<u>32.8221</u>	<u>32.8227</u>
			1172028		
			25		
			<u>29.9984</u>		

Beyond
limit

Lunar Plate MC 873

1912 Sept 27 60

Measures Comparison Stars.

See pp 35-37

11	y		x	z	
	d	v		d	v
1	15810	15960	15022	16190	
7.8	722524	1454038	613832	1506462	
	30	40	38	60	
	20	56	26	92	
	<u>17.8592</u>	<u>17.8580</u>	<u>5.1110</u>	<u>5.1178</u>	
2	14828	14500	15394	15948	
11.2	906563	1027070	725553	1408886	
12.5	65	64	59	78	
	26	06	96	50	
	<u>12.5763</u>	<u>12.5765</u>	<u>11.1860</u>	<u>11.1864</u>	
3	15000	16861	15300	16125	
14.9	1382010	805352	1415048	687874	
14.1	22	59	50	74	
	00	75	90	40	
	<u>341183</u>	<u>341181</u>	<u>12.9250</u>	<u>12.9264</u>	
4	15268	14350	16260	14400	
15.5	1168082	793030	1158880	906862	
16.3	82	78	80	60	
	66	52	66	10	
	<u>16.3586</u>	<u>16.3578</u>	<u>31.5320</u>	<u>31.5342</u>	
5	15212		14480	16826	
17.8	521520		1270000	861002	
18.0	18		02	08	
	08		82	36	
	<u>29.9990</u>	<u>11740</u>	<u>32.8221</u>	<u>32.8227</u>	
		<u>1172028</u>			
		25			
		<u>29.9984</u>			

Beyond limit

MC 873 Points on Moon's limb 1912 Sept. 27 61
 Measured. Sept. 28

1	d	y	N	d	x	N
15.0	16080		15978			
20.8	766665		1438272			
	7265		7470			
	90		70			

20.8421 20.8398

2	15514			remeasure
	70			
16.0	15450	14808		15820
21.4	1169504	852620		957665
	9090	0002		5258
	60	00		30

21.3758 21.3709 21.3737

3	14876	15458	15860
16.0	1124240	905255	948276
24.4	4040	6860	7274
	86	58	64

24.3640 24.3601 24.3614

4	Remeasure			
15.4	d	x	N	
21.0	15898		16555	15368
	1057060		1185065	1002098
	5260		5875	2230
	06		63	76

15.4658 15.4697 15.4646 15.4744

5	15652	15652	15510
16.4	1008896	1008896	1106260
22.0	9096	9096	5550
	52	52	08

measured Nov. 1.

11	15480	17338
14.6	755750	1522020
20.8	5460	2020
	70	22

y-min

20.7917 20.885

16.4440 16.4452

ML 873 Points on the *noctuid* limb. 1912 Sept 27 61
 Measured. continued
 Sept 28 1912

1	d	y	N	d	x	N
15.0	16080		15978			
20.8	7666 65		14382 72			
	72 65		74 70			
	90		70			

20.8421 20.8398 16.6230

2	15514					
	70					
16.0	15450		14808		15820	
21.4	11695 04		8526 20		79576 65	
	90 90		00 02 08		52 580	
	60		00		30	

21.3758 21.3709 21.3737

3	14876		15458		15860	
16.0	11242 40		905255		948276	
24.4	40 40		68 60 78		72 74 05	
	86		58		64	

24.3640 24.3601 24.3614

4	15898		16555		15368	
15.4	10570 60		11850 65		10020 98	
21.0	5260		5875		22300 4	
	06		63		76	

15.4658 15.4697 15.4646 15.4744

5	15652		15652		15652	
16.4	10088 96		10088 96		10088 96	
22.0	90 06		90 96		90 96	
	52		52		52	

measured nov. 1.

16.4440 16.4452

11	15480		17338	
14.6	7557 50		15220 20	
20.8	5460		2020	
y-min	70		22	

227917 22885

MC 873 Points on moon's limb
measures - continued

1912 Sept 28. 67

b	y	d	N
16.6		14960	16136
23.0		11234 44	9858 52
		40 30	5850
		60	32

16.6276 16.6280

7		15900	15218
16.3		888077	12230 15
24.0		7088	2220
		08	20

16.2972 16.2996

8		15955	15700
x max		1228692	9350 44
y 22.8		9298	50 52
		65	05

16.6342 16.6355

9	Scratch on south limb		
15.3	15470	16784	14470
20.9	632030	1591010	692830
	2225	1004	3230
	50	68	50

20.9128 20.9126 15.2476

15.2463

10	Scratch on no. limb	15280	
15.6	15044	14950	11202 10
24.6	835035	1163020	0000
	4837	2025	70
	44	36	

24.6702 24.6678 15.5927

15.5918

Point 11 on page 61.

1912 Oct. 3

17304
1483232
40 40
88

Remeasures
gives practi-
cally same
results.

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1911phae.proj.18

1911phae.proj.18

1911phae.proj.18

MC873 Points on moon's limb
measures - continued

1912 Sept 28. 67

6 2-9 y-72 2-2 x
166 177 188 199 210 221 232 243 254 265 276 287 298 309 320 331 342 353 364 375 386 397 408 419 430 441 452 463 474 485 496 507 518 529 540 551 562 573 584 595 606 617 628 639 650 661 672 683 694 705 716 727 738 749 760 771 782 793 804 815 826 837 848 859 870 881 892 903 914 925 936 947 958 969 980 991 1002 1013 1024 1035 1046 1057 1068 1079 1090 1101 1112 1123 1134 1145 1156 1167 1178 1189 1200 1211 1222 1233 1244 1255 1266 1277 1288 1299 1310 1321 1332 1343 1354 1365 1376 1387 1398 1409 1420 1431 1442 1453 1464 1475 1486 1497 1508 1519 1530 1541 1552 1563 1574 1585 1596 1607 1618 1629 1640 1651 1662 1673 1684 1695 1706 1717 1728 1739 1750 1761 1772 1783 1794 1805 1816 1827 1838 1849 1860 1871 1882 1893 1904 1915 1926 1937 1948 1959 1970 1981 1992 2003 2014 2025 2036 2047 2058 2069 2080 2091 2102 2113 2124 2135 2146 2157 2168 2179 2190 2201 2212 2223 2234 2245 2256 2267 2278 2289 2300 2311 2322 2333 2344 2355 2366 2377 2388 2399 2410 2421 2432 2443 2454 2465 2476 2487 2498 2509 2520 2531 2542 2553 2564 2575 2586 2597 2608 2619 2630 2641 2652 2663 2674 2685 2696 2707 2718 2729 2740 2751 2762 2773 2784 2795 2806 2817 2828 2839 2850 2861 2872 2883 2894 2905 2916 2927 2938 2949 2960 2971 2982 2993 3004 3015 3026 3037 3048 3059 3070 3081 3092 3103 3114 3125 3136 3147 3158 3169 3180 3191 3202 3213 3224 3235 3246 3257 3268 3279 3290 3301 3312 3323 3334 3345 3356 3367 3378 3389 3400 3411 3422 3433 3444 3455 3466 3477 3488 3499 3510 3521 3532 3543 3554 3565 3576 3587 3598 3609 3620 3631 3642 3653 3664 3675 3686 3697 3708 3719 3730 3741 3752 3763 3774 3785 3796 3807 3818 3829 3840 3851 3862 3873 3884 3895 3906 3917 3928 3939 3950 3961 3972 3983 3994 4005 4016 4027 4038 4049 4060 4071 4082 4093 4104 4115 4126 4137 4148 4159 4170 4181 4192 4203 4214 4225 4236 4247 4258 4269 4280 4291 4302 4313 4324 4335 4346 4357 4368 4379 4390 4401 4412 4423 4434 4445 4456 4467 4478 4489 4500 4511 4522 4533 4544 4555 4566 4577 4588 4599 4610 4621 4632 4643 4654 4665 4676 4687 4698 4709 4720 4731 4742 4753 4764 4775 4786 4797 4808 4819 4830 4841 4852 4863 4874 4885 4896 4907 4918 4929 4940 4951 4962 4973 4984 4995 5006 5017 5028 5039 5050 5061 5072 5083 5094 5105 5116 5127 5138 5149 5160 5171 5182 5193 5204 5215 5226 5237 5248 5259 5270 5281 5292 5303 5314 5325 5336 5347 5358 5369 5380 5391 5402 5413 5424 5435 5446 5457 5468 5479 5490 5501 5512 5523 5534 5545 5556 5567 5578 5589 5600 5611 5622 5633 5644 5655 5666 5677 5688 5699 5710 5721 5732 5743 5754 5765 5776 5787 5798 5809 5820 5831 5842 5853 5864 5875 5886 5897 5908 5919 5930 5941 5952 5963 5974 5985 5996 6007 6018 6029 6040 6051 6062 6073 6084 6095 6106 6117 6128 6139 6150 6161 6172 6183 6194 6205 6216 6227 6238 6249 6260 6271 6282 6293 6304 6315 6326 6337 6348 6359 6370 6381 6392 6403 6414 6425 6436 6447 6458 6469 6480 6491 6502 6513 6524 6535 6546 6557 6568 6579 6590 6601 6612 6623 6634 6645 6656 6667 6678 6689 6700 6711 6722 6733 6744 6755 6766 6777 6788 6799 6810 6821 6832 6843 6854 6865 6876 6887 6898 6909 6920 6931 6942 6953 6964 6975 6986 6997 7008 7019 7030 7041 7052 7063 7074 7085 7096 7107 7118 7129 7140 7151 7162 7173 7184 7195 7206 7217 7228 7239 7250 7261 7272 7283 7294 7305 7316 7327 7338 7349 7360 7371 7382 7393 7404 7415 7426 7437 7448 7459 7470 7481 7492 7503 7514 7525 7536 7547 7558 7569 7580 7591 7602 7613 7624 7635 7646 7657 7668 7679 7690 7701 7712 7723 7734 7745 7756 7767 7778 7789 7800 7811 7822 7833 7844 7855 7866 7877 7888 7899 7910 7921 7932 7943 7954 7965 7976 7987 7998 8009 8020 8031 8042 8053 8064 8075 8086 8097 8108 8119 8130 8141 8152 8163 8174 8185 8196 8207 8218 8229 8240 8251 8262 8273 8284 8295 8306 8317 8328 8339 8350 8361 8372 8383 8394 8405 8416 8427 8438 8449 8460 8471 8482 8493 8504 8515 8526 8537 8548 8559 8570 8581 8592 8603 8614 8625 8636 8647 8658 8669 8680 8691 8702 8713 8724 8735 8746 8757 8768 8779 8790 8801 8812 8823 8834 8845 8856 8867 8878 8889 8900 8911 8922 8933 8944 8955 8966 8977 8988 8999 9010 9021 9032 9043 9054 9065 9076 9087 9098 9109 9120 9131 9142 9153 9164 9175 9186 9197 9208 9219 9230 9241 9252 9263 9274 9285 9296 9307 9318 9329 9340 9351 9362 9373 9384 9395 9406 9417 9428 9439 9450 9461 9472 9483 9494 9505 9516 9527 9538 9549 9560 9571 9582 9593 9604 9615 9626 9637 9648 9659 9670 9681 9692 9703 9714 9725 9736 9747 9758 9769 9780 9791 9802 9813 9824 9835 9846 9857 9868 9879 9890 9901 9912 9923 9934 9945 9956 9967 9978 9989 10000

16.6276

16.6280

7 163 240 16.6276 16.6280

16.2972

16.2996

8 163 240 16.2972 16.2996

16.6342

16.6355

9 Scratch on south limb. 1912 Oct 3

10 Scratch on no. limb. 15.2476 15.2463

16.5927

16.5918

Point 11 on page 61.

Preliminary Reduction

Star	$x-z$	-724	$+1122$
1	$+170 - 1286 = -1116$	$= +6$	
2	$-213 - 906 = -1119$	$= +3$	
3	$+1332 - 2456 = -1124$	$= -2$	
4	$+55 - 1177 = -1122$	$= 0$	
5	$+1031 - 2160 = -1129$	$= -7$	
moon	$14.5565 - 1647$	$= 14.5040^{\checkmark}$	

	$y-\eta$	$+70x$	$+3x$	-973
1	$+608 + 358 = +966$	$+15 = +981$	$= +8$	
2	$+161 + 783 = +944$	$+33 = +977$	$= +4$	
3	$-2 + 904 = +902$	$+39 = +941$	$= -32$	
4	$-1312 + 2207 = +895$	$+95 = +990$	$= +17$	
5	$-1418 + 2298 = +880$	$+98 = +978$	$= +5$	
moon	$22.8682 + 1019^{\checkmark}$	$+44^{\checkmark}$	$= 22.8772^{\checkmark}$	

Equations of Condition

Star	a	b	c	
5	32.82	$+30.00$	$+c = -7$	$+5$
4	31.53	$+16.36$	$+c = 0$	$+17$
3	12.93	$+34.12$	$+c = -2$	-32
2	11.19	$+12.58$	$+c = +3$	$+4$
1	5.11	$+17.86$	$+c = +6$	$+8$

Mean Equations.

X	32.18	$+23.18$	$+c = -3.50$	$+11.00$
x	9.74	$+21.52$	$+c = +2.33$	-6.67
Y	22.88	$+32.06$	$+c = -4.50$	-13.50
y	15.94	$+15.60$	$+c = +3.00$	$+9.67$
<hr/>				
	22.44	$+1.66$	$= -5.83$	$+17.67$
(.309)	6.94	$+16.46$	$= -7.50$	-23.17
	6.94	$+0.51$	$= -1.80$	$+5.46$
		$+15.95$	$= -5.70$	-28.63
		b	$= -0.36$	-1.79
	22.44	$a = -5.83 + 0.60 = -5.23$		$+17.67 + 2.97 = +20.64$
		a	$= -0.23$	$+0.92$

-3.5	+2.3	-4.5	+3.0	+11.0	-6.7	-13.5	+9.7
+7.4	+22	+5.3	+3.7	-29.6	-9.0	-21.1	-14.6
+8.4	+7.7	+11.6	+5.6	+41.5	+38.5	+57.5	+27.9
<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
+12.3	+12.2	+12.4	+12.3	+22.9	22.8	+22.9	+23.0

C from $x-z$ C from $y-\eta$.

1912 Oct 11

Post-Combustion

1912 Oct 11

Thermodynamic Properties

Station	1	2	3	4	5
Pressure	10.0	10.0	10.0	10.0	10.0
Temperature	1000	1000	1000	1000	1000
Enthalpy	1000	1000	1000	1000	1000
Entropy	1000	1000	1000	1000	1000
Internal Energy	1000	1000	1000	1000	1000

Station	1	2	3	4	5
Pressure	10.0	10.0	10.0	10.0	10.0
Temperature	1000	1000	1000	1000	1000
Enthalpy	1000	1000	1000	1000	1000
Entropy	1000	1000	1000	1000	1000
Internal Energy	1000	1000	1000	1000	1000

Equation of State

Station	1	2	3	4	5
Pressure	10.0	10.0	10.0	10.0	10.0
Temperature	1000	1000	1000	1000	1000
Enthalpy	1000	1000	1000	1000	1000
Entropy	1000	1000	1000	1000	1000
Internal Energy	1000	1000	1000	1000	1000

Mass Flow

Station	1	2	3	4	5
Pressure	10.0	10.0	10.0	10.0	10.0
Temperature	1000	1000	1000	1000	1000
Enthalpy	1000	1000	1000	1000	1000
Entropy	1000	1000	1000	1000	1000
Internal Energy	1000	1000	1000	1000	1000

Station	1	2	3	4	5
Pressure	10.0	10.0	10.0	10.0	10.0
Temperature	1000	1000	1000	1000	1000
Enthalpy	1000	1000	1000	1000	1000
Entropy	1000	1000	1000	1000	1000
Internal Energy	1000	1000	1000	1000	1000

Continuity equation: $\dot{m}_1 = \dot{m}_2 = \dot{m}_3 = \dot{m}_4 = \dot{m}_5$

MC 873

Plate Constants.

1912 Oct 11. 63

Preliminary Reduction.

Star $x-z$ -724 $+1122$

1	$+170 - 1286 = -1116$	$= +6$
2	$-213 - 906 = -1119$	$= +3$
3	$+1332 - 2456 = -1124$	$= -2$
4	$+55 - 1177 = -1122$	$= 0$
5	$+1031 - 2160 = -1129$	$= -7$
mean	$14.5565 - 1647$	$= 14.5040$

$y-\eta$ $+70x$ $+3x$ -973

1	$+008 + 358 = +966$	$+15 = +981$	$= +8$
2	$+161 + 783 = +944$	$+33 = +977$	$= +4$
3	$-2 + 904 = +902$	$+39 = +941$	$= -32$
4	$-1312 + 2207 = +895$	$+95 = +990$	$= +17$
5	$-1418 + 2298 = +880$	$+98 = +978$	$= +5$
mean	$22.8682 + 1019$	$+44$	$= 22.8772$

Equations of Condition

Star	a	b	c	
5	32.82	+30.00	$+c = -7$	+5
4	31.53	+16.36	$+c = 0$	+17
3	12.93	+34.12	$+c = -2$	-32
2	11.19	+12.58	$+c = +3$	+4
1	5.11	+17.86	$+c = +6$	+8

Mean Equations.

X	32.18	+23.18	$+c = -3.50$	+11.00
x	9.74	+21.52	$+c = +2.33$	-6.67
Y	22.88	+32.06	$+c = -4.50$	-13.50
y	15.94	+15.60	$+c = +3.00$	+9.67
	22.44	+1.66	$= -5.83$	+17.67
(309)	6.94	+16.46	$= -7.50$	-23.17
	6.94	+0.51	$= -1.80$	+5.46
		+15.95 b	$= -5.70$	-28.63
		b	$= -0.36$	-1.79
	22.44 $a = -5.83 + 0.60 = -5.23$			+17.67 + 2.97 = +20.64
	$a = -0.23$			+0.92

-3.5	+2.3	-4.5	+3.0	+11.0	-6.7	-13.5	+9.7
+7.4	+2.2	+5.3	+3.7	-29.6	-9.0	-21.1	-14.6
+8.4	+7.7	+11.6	+5.6	+41.5	+38.5	+57.5	+27.9
+12.3	+12.2	+12.4	+12.3	+22.9	22.8	+22.9	+23.0

C from $x-z$ C from $y-\eta$.

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ML 873

1912. Oct 11 64

Residuals.
(x - \bar{x})

star

5	-8	-11	+12	=	-7	-7	0
4	-7	-6	+12	=	-1	0	
3	-3	-12	+12	=	-3	-2	
2	-3	-5	+12	=	+4	+3	
1	-1	-6	+12	=	+5	+6	

873

0 - 6

872

0 - 6

873 - 872

0	+7	-7
+1	-4	+5
+1	-1	+2
-1	-1	0
+1	+2	-1

(y - \bar{y})

5	+30	-54	+23	=	-1	+5	+6
4	+29	-29	+23	=	+23	+17	-6
3	+12	-61	+23	=	-26	-32	-6
2	+10	-23	+23	=	+10	+4	-6
1	+5	-32	+23	=	-4	+8	+12

(y - \bar{y})

+1	+5
-2	-4
+1	-7
+1	-7
-1	+13

578-579 (578-579)									
5-	5+	0	1-	2-	1+	1+	1-	1-	1-
2+	1-	1+	0	1-	1+	1+	1-	1-	1-
2+	1-	1+	2-	2-	2+	2+	2-	2-	2-
0	1-	1-	2+	2+	2+	2+	2-	2-	2-
1+	2+	1+	2+	2+	2+	2+	2-	2-	2-
578-579 (578-579)									
2+	2-	2+	2+	1-	2+	2+	2-	2+	2-
2-	2-	2-	2+	2+	2+	2+	2-	2+	2-
2-	2-	2-	2-	2-	2-	2-	2-	2-	2-
2+	2+	2+	2+	2+	2+	2+	2-	2+	2-
2+	2-	2+	2+	2-	2+	2+	2-	2+	2-

ML 873

64

Residuals.

Star						873	872	873-872
						0-6	(0-6)	
5	-8	-11	+12	= -7	-7	0	+7	-7
4	-7	-6	+12	= -1	0	+1	-4	+5
3	-3	-12	+12	= -3	-2	+1	-1	+2
2	-3	-5	+12	= +4	+3	-1	-1	0
1	-1	-6	+12	= +5	+6	+1	+2	-1
5	+30	-54	+23	= -1	+5	+6	+1	+5
4	+29	-29	+23	= +23	+17	-6	-2	-4
3	+12	-61	+23	= -26	-32	-6	+1	-7
2	+10	-23	+23	= +10	+4	-6	+1	-7
1	+5	-32	+23	= -4	+8	+12	-1	+13

MC 873

1912 Oct 25. 65

Times etc.

Exp to stars	1911 Jan 16	11 ^h 28 ^m 30 ^s	38 ^m 30 ^s
moon		11 33 06.4	33 06.6
Clock fast			2 23.0
Havard Sid. Time		11 30 43.5 ^v	
Long.		4 44 31.05 ^v	
Greenw. Sid. time		16 15 14.55 ^v	
Sid. T. mean noon		19 39 12.92 ^v	
Sid. Interval		20 36 1.63 ^v	
Reduction		3 22.49 ^v	
Gr. M. T.		20 32 39.14 ^v	
From Am. Eph.	R.A	Dec.	
moon 20 ^h	10 ^h 07 ^m 44.93 ^v	+16° 48' 45.0 ^v	
Motion in 1 ^m = 2.2295 ^v		-12.59 ^v	
" " 32.852 ^v	+ 1 12.80 ^v	- 6 56.0 ^v	
Tabular place	10 08 57.73 ^v	+16 41 49.0 ^v	
moons Parallax.	58' 20.5 ^v		
" Semid.	15 55.3 ^v		

Center of Plate A = 10^h 09^m 47^s D = 16° 08' 46"

Approximate center of Moon.

x = 16.0	y = 21.3740	max X = 16.6348
" "	y = 24.3624	R = 2.0781
	45.7364	X = 14.5567
mean Y =	22.8682	
min Y =	20.7901	
R =	2.0781	

Times etc.

Exp to stars	1911 Jan 16	11	28	30.5	38	30
moon		11	33	06.4	33	06.6
clock fast					2	23.0
Harvard Sid. Time		11	30	43.5		
Long.		4	44	31.05		
Greenw. Sid. time		16	15	14.55		
Sid. T. mean noon.		19	39	12.92		
Sid. Interval		20	36	1.63		
Reduction			3	22.49		
Gr. W. T.		20	32	39.14		
From Am. Eph.	R.A					
moon 20	10h 07m 44.93					
motion in 1m: 2.2276						
" " 32.65	+ 1 12.97					
Tabular place	10 08 57.67					
moon's Parallax.	58' 20.4					
" " Sun's.	1.5 55.3					

Approximate center of moon.

x = 16.0	y = 21.3740	max X = 16.6348
" "	y = 24.3624	R = 2.0781
	45.7364	X = 14.5567
mean Y = 22.8682		
min Y = 20.7901		
R = 2.0781		

MC873

1912 Nov. 1.

66

Woon's Limit.

Point	x	$x - \bar{x}$	Δx	$(x - \bar{x})^2$	$(x - \bar{x})^2 + (y - \bar{y})^2$	$0 - c$
1	15.0000	+0.4433	-2	0.1963	4.3062	-91
2	16.0000	+1.4433	-1	2.0828	4.3157	+4
3	16.0000	+1.4433	+1	2.0834	4.3163	+10
4	15.4686	+0.9119	-2	0.8312	4.3217	+64
5	16.4446	+1.8879	-1	3.5638	4.3177	+24
6	16.6278	+2.0711	0	4.2894	4.3068	-85
7	16.2984	+1.7417	+1	3.0339	4.3149	-4
8	16.6348	+2.0781	0	4.3185	4.3185	+32
9	15.2470	+0.6903	-2	0.4762	4.3005	bad point reject
10	15.5922	+1.0355	+2	1.0727	4.3159	+6
11	14.5567	0.0000	-2	0.0000	4.3189	+36
				mean:	4.3153	(except 9)

	y	$y - \bar{y}$	Δy	$(y - \bar{y})^2$
1	20.8410	-2.0272	-1	4.1099
2	21.3740	-1.4942	-1	2.2329
3	24.3624	+1.4942	+1	2.2329
4	21.0000	-1.8682	-1	3.4905
5	22.0000	-0.8682	-1	0.7539
6	23.0000	+0.1318	0	0.0174
7	24.0000	+1.1318	+1	1.2810
8	22.8682	0.0000	0	0.0000
9	20.9127	-1.9555	-1	3.8243
10	24.6690	+1.8008	+1	3.2432
11	20.7901	-2.0781	-1	4.3189

Point	Res. c	Res.
11	180.0	+31
1	167.6	-94
9	160.6	-150
4	154.0	+64
2	136.0	+6
5	119.7	+28
8	90.0	+37
6	86.4	-80
7	57.0	0
3	44.0	+12
10	29.9	+6

not used in solution

1.0000000000

278000

Final Results

$\alpha - \delta$	$\gamma - \delta$	$\alpha - \delta$	$\gamma - \delta$	$\alpha - \delta$	$\gamma - \delta$	$\alpha - \delta$	$\gamma - \delta$
10 -	2210.84	5481.0	2 -	2344.0 -	0000.21	1	
4 +	2212.8	5580.2	1 -	2344.1 +	0000.01	2	
01 +	2212.8	4280.3	1 +	2344.1 +	0000.01	3	
2 +	2212.8	3122.0	2 -	2344.0 -	0000.43	4	
4 +	2212.8	3222.0	1 -	2344.1 +	0000.01	5	
7 -	2212.8	4280.3	0	1120.2 +	8120.21	6	
8 -	2212.8	3222.0	1 +	2344.1 +	0000.01	7	
2 -	2212.8	3222.0	0	1120.2 +	8120.21	8	
7 -	2212.8	4280.3	2 -	2344.0 -	0000.21	9	
4 +	2212.8	3222.0	2 +	2344.1 +	0000.21	10	
2 +	2212.8	3222.0	2 -	2344.0 -	0000.00	11	

$\alpha - \delta$	$\gamma - \delta$	$\alpha - \delta$	$\gamma - \delta$	$\alpha - \delta$	$\gamma - \delta$	$\alpha - \delta$	$\gamma - \delta$
10 -	2210.84	5481.0	2 -	2344.0 -	0000.21	1	
4 +	2212.8	5580.2	1 -	2344.1 +	0000.01	2	
01 +	2212.8	4280.3	1 +	2344.1 +	0000.01	3	
2 +	2212.8	3122.0	2 -	2344.0 -	0000.43	4	
4 +	2212.8	3222.0	1 -	2344.1 +	0000.01	5	
7 -	2212.8	4280.3	0	1120.2 +	8120.21	6	
8 -	2212.8	3222.0	1 +	2344.1 +	0000.01	7	
2 -	2212.8	3222.0	0	1120.2 +	8120.21	8	
7 -	2212.8	4280.3	2 -	2344.0 -	0000.21	9	
4 +	2212.8	3222.0	2 +	2344.1 +	0000.21	10	
2 +	2212.8	3222.0	2 -	2344.0 -	0000.00	11	

MCB73

1912 Nov. 1.

66

Moon's Limit.

Point	x	$x - \bar{x}$	Δx	$(x - \bar{x})^2$	$(x - \bar{x})^2 + (y - \bar{y})^2$	$O - C$
1	15.0000	+0.4433	-2	0.1963	4.3062	-91
2	16.0000	+1.4433	-1	2.0828	4.3157	+4
3	16.0000	+1.4433	+1	2.0834	4.3163	+10
4	15.4686	+0.9119	-2	0.8312	4.3217	+64
5	16.4446	+1.8879	-1	3.5638	4.3177	+24
6	16.6278	+2.0711	0	4.2894	4.3068	-85
7	16.2984	+1.7417	+1	3.0339	4.3149	-4
8	16.6348	+2.0781	0	4.3185	4.3185	+32
9	15.2470	+0.6903	-2	0.4762	4.3005	
10	15.5922	+1.0355	+2	1.0727	4.3159	+6
11	14.5567	0.0000	-2	0.0000	4.3189	+36
				mean =	4.3155	

	y	$y - \bar{y}$	Δy	$(y - \bar{y})^2$
1	20.8410	-2.0272	-1	4.1099
2	21.3740	-1.4942	-1	2.2329
3	24.3624	+1.4942	+1	2.2329
4	21.0000	-1.8682	-1	3.4905
5	22.0000	-0.8682	-1	0.7539
6	23.0000	+0.1318	0	0.0174
7	24.0000	+1.1318	+1	1.2810
8	22.8682	0.0000	0	0.0000
9	20.9127	-1.9555	-1	3.8243
10	24.6690	+1.8008	+1	3.2432
11	20.7901	-2.0781	-1	4.3189

Formation of normal equations.

no.	[aa]	[ab]	[an]	[bb]	[bn]
1	0 19 -	0 89 -	40 0	4 12 +	184 7
2	2 07 -	2 15 +	5 8	2 22 -	6 0
3	2 07 +	2 15 +	14 4	2 22 +	14 9
4	0 83 -	1 70 +	58 2	3 50 -	119 7
5	3 55 -	1 64 +	45 1	0 76 -	20 9
6	4 28 +	0 27 -	176 0	0 02 -	11 0
7	3 03 +	1 97 -	7 0	1 28 -	4 5
8	4 33	0 00 +	66 6	0 00	0 0
9					
10	1 08 +	1 87 +	6 2	3 24 +	10 8
11	0 00 -	0 00 +	0 0	4 33 -	74 9
	+21 43 -	0 12 -	-26 7	+21 69 -	-26 6

$$[ac] = +13.05$$

$$[bc] = -3.79$$

$$[cn] = -4.0$$

MC 873

Moon's Cimb

1912 Nov. 1.

1912 Nov. 18.

67

Conditional Equations

				0	c	0-c
1	+ 0.44	a - 2.03	b + c =	- 91	+ 3	- 94
2	+ 1.44	- 1.49	+ c =	+ 4	- 2	+ 6
3	+ 1.44	+ 1.49	+ c =	+ 10	- 2	+ 12
4	+ 0.91	- 1.87	+ c =	+ 64	0	+ 64
5	+ 1.89	- 0.87	+ c =	+ 24	- 4	+ 28
6	+ 2.07	+ 0.13	+ c =	- 85	- 5	- 80
7	+ 1.74	+ 1.13	+ c =	- 4	- 4	0
8	+ 2.08	0.00	+ c =	+ 32	- 5	+ 37
[9]	+ 0.69	- 1.96	+ c =	- 148	+ 2	[- 150]
10	+ 1.04	+ 1.80	+ c =	+ 6	0	+ 6
11	+ 0.00	- 2.08	+ c =	+ 36	+ 5	+ 31

Normal Equations

a	b	c	
+ 21.43	- 0.12	+ 13.05	= - 27.0
- 0.12	+ 21.69	- 3.79	= - 27
+ 13.05	- 3.79	+ 10.00	= - 4.0
+ 0.12	- 0.00	+ 0.07	= 0
- 13.05	+ 0.07	- 7.95	= + 16

-174 + 184 Average = 36

P.E. of one equation = ± 36

$$\frac{\Delta a}{\Delta n} = 2.08 \times - .61 = - 1.27$$

$$\frac{\Delta b}{\Delta n} = 2.08 \times + .17 = + 0.36$$

$$+ 3.72 - 0.64 = - 5$$

$$+ 1.41 c = + 7$$

$$c = + 5 \pm 30$$

$$- 6.75 + 3.72 = + 22$$

$$+ 14.94 b = - 5$$

$$b = 0 \pm 9$$

$$\begin{array}{rcl} - 17.03 & + & 4.95 \\ + 4.95 & - & 1.44 \\ + 4.40 & + & 4.83 \\ + 4.83 & + & 20.25 \\ - 1.15 & - & 4.83 \\ + 3.25 a & = & - 15 \end{array}$$

$$+ 4.95 - 1.44 + 3.79 = - 1$$

$$+ 4.40 + 4.83 = - 22$$

$$+ 4.83 + 20.25 = - 28$$

$$- 1.15 - 4.83 = + 7$$

$$+ 3.25 a = - 15$$

$$a = - 5 \pm 20$$

MC 873

Uroon's Cimb

1912 Nov. 1.

67

1912 Nov. 12.

Conditional Equations

	a	b	c	0	c	0-c
1	+0.44	-2.03	+c	=	-91	+3
2	+1.44	-1.49	+c	=	+4	-2
3	+1.44	+1.49	+c	=	+10	-2
4	+0.91	-1.87	+c	=	+64	0
5	+1.89	-0.87	+c	=	+24	-4
6	+2.07	+0.13	+c	=	-85	-5
7	+1.74	+1.13	+c	=	-4	-4
8	+2.08	0.00	+c	=	+22	-5
9	+0.69	-1.96	+c	=	-150	+37
10	+1.04	+1.80	+c	=	+6	0
11	+0.00	-2.08	+c	=	+36	+5

Normal Equations

a	b	c	
+21.43	-0.12	+13.05	= -27.0
-0.12	+21.69	-3.79	= -27
+13.05	-3.79	+10.00	= -24.0

+0.12	-0.00	+0.07	= 0
-13.05	+0.07	-7.95	= 16

+21.69	-3.72	= -27
-3.72	+2.05	= +12

+3.72	-0.64	= -5
-------	-------	------

+14.1c	= +7
--------	------

-6.75	+3.72	= +22
-------	-------	-------

+14.74b	= -5
---------	------

-17.03	+4.95	-13.05	= +5
+4.95	-1.44	+3.79	= -1

+4.40	+4.83	= -22
-------	-------	-------

+4.83	+20.25	= -28
-------	--------	-------

-1.15	-4.83	= +7
-------	-------	------

+3.25a	= -15
--------	-------

$$a = -5 \pm 20$$

MC673

1912 Nov. 19.

68

$$\begin{array}{rcl}
 X_0 = 14.5567 & Y_0 = 22.8682 & R_0 = 2.0781 \\
 \frac{1}{2}a = -2 & \frac{1}{2}b = 0 & \frac{1}{2}c = +1 \\
 X = 14.5565 \pm 10 & Y = 22.8682 \pm 4 & R = 2.0782 \pm 8 \\
 \text{Applying prelim. const.} & X = 14.5040 & Y = 22.8772 \\
 \text{" computed " } & ax = -3 & +13 \\
 & by = -8 & -41 \\
 & c = +12 & +23 \\
 \hline
 X = 14.5041 & Y = 22.8767
 \end{array}$$

Means position for 1911.0.

$$\begin{array}{rcl}
 \bar{\delta} = -3.4959 & \eta = +0.8767 \\
 \log \bar{\delta} = 0.54356 & \tan \delta = 9.477 \\
 \cos \delta = 9.98227 & \log \delta^2 = 1.087 \\
 \text{const} = 8.50724 & \text{const} = 7.053 \\
 & \log \eta = 7.617 \\
 \log (h-A) = 2.05405 & \eta_1 = 41 \\
 \alpha-A = -11^h 53.25^m & \eta_0 = 0.8726 \\
 \alpha-A = -01^m 53.25^s & \log \eta_0 = 9.94082 \\
 A = 10^h 09 47' & \text{const} = 7.33115 \\
 \lambda = 10^h 07^m 53.75^s
 \end{array}$$

$$\begin{array}{rcl}
 (S-D) = 2.60967 & \\
 S-D = +407.1 = +6' 47.1 & \\
 D = +16^{\circ} 08' 46 & \\
 S = +16^{\circ} 15' 33.1 &
 \end{array}$$

Jerome & 49 Red. to app. place in $\alpha = +0.65$
 $\mu \delta = -1.2$

$$\begin{array}{rcl}
 \alpha_0 = 10^h 07^m 53.75^s & \delta_0 = +16^{\circ} 15' 33.1 \\
 \text{Red} = +0.65 & \text{Red} = 1.0 \\
 \alpha = 10 07 54.40 & \delta = +16 15 32.1
 \end{array}$$

$$\begin{array}{rcl}
 \delta_0 = +16^{\circ} 15' 33.1 & \\
 \text{Red} = 1.0 & \\
 \delta = +16 15 32.1 &
 \end{array}$$

$$\begin{array}{rcl}
 X_0 = 14.5567 & Y_0 = 22.8682 & R_0 = 2.0781 \\
 \frac{1}{2}a = -2 & \frac{1}{2}b = 0 & \frac{1}{2}c = +1 \\
 X = 14.5565 \pm 10 & Y = 22.8682 \pm 4 & R = 2.0782 \pm 8 \\
 \text{Applying prelim. constants. } X = 14.5040 & Y = 22.8772 & \\
 \text{" computed " } ax = -3 & +13 & \\
 by = -8 & -41 & \\
 c = +12 & +23 & \\
 \hline
 X = 14.5041 & Y = 22.8767 &
 \end{array}$$

Mean position for 1911.0

$$\begin{array}{rcl}
 \delta = -3.4959 & \eta = +0.8767 & \\
 \log \delta = 0.54356m & \tan \delta = 9.477 & \\
 \cos \delta = 9.98227 & \log \delta = 10.87 & \\
 \cos \delta = 8.50724 & \cos \delta = 7.053 & \\
 \log (d-A) = 2.05405m & \log \eta = 7.617 & \\
 d-A = -11.3.25 & \eta_1 = 41 & \\
 d-A = -01.53.25 & \eta_0 = 0.8726 & \\
 A = 10^h 09 47 & \log \eta_0 = 9.94082 & \\
 A = 10^h 07^m 53.75 & \text{const } 7.33115 &
 \end{array}$$

$$\begin{array}{rcl}
 (s-D) = 2.60967 & & \\
 s-D = +4.07.1 = +6' 47.1 & & \\
 D = +16^{\circ} 08' 46 & & \\
 s = +16^{\circ} 15' 33.1 & &
 \end{array}$$

From 49 Red. to App. place in δ : +0.65
 $\delta = -1.2$

$$\begin{array}{rcl}
 d_0 = 10^h 07^m 53.75 & s_0 = +16^{\circ} 15' 33.1 & \\
 \text{Red } + 0.65 & \text{Red } - 1.2 & \\
 a = 10 07 54.40 & s = +16 15 32.9 &
 \end{array}$$

Lunar Parallax.

$$\alpha' = 10^h 07^m 54.40''$$

$$\theta = 11 30 43.5''$$

$$\delta = +16^\circ 15' 32.1''$$

$$\pi = 58' 20.4''$$

$$\theta - \alpha' = 1^h 22^m 49.10''$$

$$= +20^\circ 42' 16.5''$$

$$\log p \cos \phi' = 9.86913''$$

$$\log \sin \pi = 8.22967''$$

$$\log \sin(\theta - \alpha') = 9.54845''$$

$$\log \cos \delta' = 9.98227''$$

$$\frac{1}{2}(\alpha - \alpha') = 7' 7' 56.8''$$

$$\theta - \alpha' - \frac{1}{2}(\alpha - \alpha') = 20^\circ 34' 19.7''$$

$$\log \sin(\alpha - \alpha') = 7.66498''$$

$$\text{Approx. } \alpha - \alpha' = 15' 53.7''$$

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

$$\log \cos(\frac{1}{2}(\alpha - \alpha')) = 0.00000''$$

$$\log \cos(\theta - \alpha' - \frac{1}{2}(\alpha - \alpha')) = 9.97138''$$

$$\tan \phi' = 9.98589''$$

$$\gamma = +44^\circ 04' 09.5''$$

$$\delta' = +16^\circ 15' 32.1''$$

$$\log \cos \delta = 9.98130''$$

$$\sin(\alpha - \alpha') = 7.66595''$$

$$\gamma - \delta' = +27^\circ 48' 37.4''$$

$$\alpha - \alpha' = 15' 55.8''$$

$$= +1^m 03.72''$$

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

$$\log \sin \pi = 8.22967''$$

$$\log \sin(\gamma - \delta') = 9.66890''$$

$$\log \sin \gamma = 9.84231''$$

$$\log \sin(\delta - \delta') = 7.88266''$$

$$\delta - \delta' = +26' 14.3''$$

$$\delta = +16^\circ 41' 46.4''$$

$$\alpha = 10^h 08^m 58.12''$$

$$\text{Ann. Eph. } \delta = 16 41 49.0''$$

$$\alpha = 10 08 57.73''$$

$$O - C = -2.6''$$

$$+0.39''$$

$$\text{Corr. to land radius} = -0.1''$$

$$+0.02''$$

$$\text{Final } O - C = -1.7''$$

$$+0.41''$$

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Lunar Parallax.

$$\alpha' = 10^h 07^m 54.40''$$

$$\delta = 11^\circ 30' 43.5''$$

$$\delta = +16^\circ 15' 32.1''$$

$$\pi = 58' 20.4''$$

$$\theta - \alpha' = 1^h 22^m 49.10''$$

$$= +20^\circ 42' 16.5''$$

$$\log p \cos \phi' = 9.86913''$$

$$\sin \pi = 8.22967''$$

$$\sin(\theta - \alpha') = 9.54845''$$

$$\cos \delta' = 9.98227''$$

$$\frac{1}{2}(\alpha - \alpha') = 7' 7'' 56.8''$$

$$\theta - \alpha' - \frac{1}{2}(\alpha - \alpha') = 20^\circ 34' 19.7''$$

$$\sin(\alpha - \alpha') = 7.66498''$$

$$\log \alpha - \alpha' = 15' 53.7''$$

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

$$\cos \frac{1}{2}(\alpha - \alpha') = 0.00000''$$

$$\cos(\theta - \alpha' - \frac{1}{2}(\alpha - \alpha')) = 9.97138''$$

$$\tan \phi = 9.98589''$$

$$\gamma = 44^\circ 04' 09.6''$$

$$\delta' = 16^\circ 15' 32.1''$$

$$\log \cos \delta = 9.98150''$$

$$\sin(\alpha - \alpha') = 7.66595''$$

$$\gamma - \delta' = 27^\circ 48' 37.4''$$

$$\alpha - \alpha' = 15' 55.8''$$

$$= 1'' 03.72''$$

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

$$\sin \pi = 8.22967''$$

$$\sin(\gamma - \delta') = 9.66890''$$

$$\sin \gamma = 9.84231''$$

$$\sin(\delta - \delta') = 7.88266''$$

$$\delta - \delta' = +26' 14.3''$$

$$\delta = +16^\circ 41' 46.4''$$

$$\sin \phi \delta = 16^\circ 41' 48.4''$$

$$O - C = +2.6$$

$$\text{Corr. to stand. radius} = 0.1$$

$$\text{Final } O - C = -2.7$$

$$\alpha = 10^h 08^m 58.12''$$

$$\alpha = 10^\circ 08' 57.67''$$

$$+ 0.45''$$

$$+ 0.02''$$

$$+ 0.41''$$

