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No.

18588

Measurement
and Reduction
of
Harvard Lunar Plates

Henry Norris Russell

November 1910

1910 Nov 14
Plates MC 650 4651

Comparison Stars Chosen						
No	X Plate MC 650	Y	C. P. D.	Mag.	Mag.	Arg. In Lat.
1	8.4	14.5	-25°	71 35	6.8	6.6
2	12.4	24.7	-24	70 50	6.9	6.5
3	15.5	29.2	-23	78 36	8.0	8
4	18.7	27.0	-23	78 42	7.8	8 1/2
5	22.8	13.2	-25	71 74	4.2	4.3
6	23.3	25.0	-24	70 74	7.0	7.

Argentine General Catalogue						
No	No	R.A.	Dec			
1	28256	20 ^h 30 ^m 25 ^s 55 ⁰	-25°	32'	33.3"	
2	28314	32 45 28	-24	13	45.3	
3	28355	34 32 38	23	34	49.6	
4	28400	36 18 86	23	55	3.0	
5	28455	38 41 43	25	43	5.2	
6	28464	38 56 23	24	10	37.9	

Star 5 is in Capricorn

Answer - B with lines from 1755.0

P.M. - 0^s 00 61 - 0" 154

Star 2 is Cape 1900 no 2852 - Lacaille 8522

P.M. + 0^s 03 12 + 0" 432

1910 Nov 14

Palmer MC 1910

Cometary Stars

C. P. D. May

X 1910

1	6.4	14.1	- 2.2	21.3	6.6	6.6
2	12.4	14.1	- 2.4	20.0	6.9	6.9
3	12.2	14.2	- 2.3	20.2	6.0	6.0
4	14.7	14.0	- 2.2	20.4	7.9	6.2
5	20.2	12.1	- 2.2	21.7	4.2	4.2
6	22.3	12.0	- 2.4	20.4	0.0	0.0

Astronomical Journal Catalogue

1	22.2	20.2	22.2	20.2	22.2	22.2
2	22.2	22.2	22.2	22.2	22.2	22.2
3	22.2	22.2	22.2	22.2	22.2	22.2
4	22.2	22.2	22.2	22.2	22.2	22.2
5	22.2	22.2	22.2	22.2	22.2	22.2
6	22.2	22.2	22.2	22.2	22.2	22.2

Star 2 in the Catalogue

Astronomical Journal Catalogue

P. M. - 0.001 - 0.124

Star 2 in the Catalogue

1910 Nov 14
Plalis MC 650 2651

Comparison Stars Chosen

No	X Plalis MC 650	Y	C. P. D	May	Mag	Aug. In Lat
1	8.4	14.5	-25°	71 35	6.8	6.6
2	12.4	24.7	-24	70 50	6.9	6.5
3	15.5	24.8	-23	78 36	8.0	8
4	18.7	27.0	-23	78 42	7.8	8½
5	22.8	13.2	-25	71 74	4.2	4.3
6	23.3	25.0	-24	70 74	7.0	7.

No	Argentine General Catalogue	R.A	Dec
1	28256	20 ^h 30 ^m 25 ^s 55 ⁰	-25° 32' 33.3"
2	28314	32 45. 28	-24 13 45.3
3	28355	34 32 38	23 34 49.6
4	28400	36 18 86	23 55 3.0
5	28455	38 41 43	25 43 5.2
6	28464	38 56 23	24 10 37.9

Star 5 is 4 Capricorni

Answers - B. W. L. gives for 1755.0

P.M. - 0^s.0061 - 0".154

Star 3 is Cape 1900 no 285 - latitude 85.2

Plate MC 620 621

Comparison Stone Column

No	X	Y	C.F.D	Map	Altitude
1	8.4	14.2	-22	21.32	6.6
2	8.4	14.7	-22	20.10	6.6
3	10.2	24.2	-22	22.22	6.6
4	11.7	27.0	-22	24.42	8.6
5	20.8	13.2	-22	21.74	4.2
6	22.2	21.0	-24	20.74	7.0

Argentine Journal Catalogue

No	X	Y	C.F.D	Map	Altitude
1	8.4	14.2	-22	21.32	6.6
2	8.4	14.7	-22	20.10	6.6
3	10.2	24.2	-22	22.22	6.6
4	11.7	27.0	-22	24.42	8.6
5	20.8	13.2	-22	21.74	4.2
6	22.2	21.0	-24	20.74	7.0

Star 4 in V Capricorn

Journal of the Argentine Journal Catalogue

1910 - 0.0001 - 0.124

Stars 1 & 6 are Cape 1850 Nos 4086 & 4124

Star 6 is Cape 1900 2869 = Lat. 85-56

These two stars have apparently no sensible P.M.

Star 4 is

				1875.0			Epoch
Lat 39962	20	36 ^m	19.52	-	23 ^o 54	59.7	1800 ±
A.O.C 20771			18.83		54	59.1	1850 ±
G.G.A 28400			18.86		55	3.0	1875 ±

P.M. obviously small

Star 3 is

				(1875.0)			
A.O.C 20749	20	34	32.28	-	23	34	46.5
G.G.A			32.28				49.6

P.M. small

Station 1.0 on Cape 1.00 has 4000 0.41-0.42

Station 2.0 on Cape 1.00 has 4000 0.41-0.42

These two stars have apparently no common P.M.

1.00

1.00-1.01

Station 1.0 on

1.00

1.00-1.01 - 1.01-1.02

for 1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

P.M. 1.00-1.01

Station 1.0 on

1.00-1.01 - 1.01-1.02

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

1.00-1.01

P.M. 1.00-1.01

Stars 146 are Cape 1850. Nos 4086.0 4124

Star 6 is Cape 1900 2869.0. Lat. 85.56

These two stars have apparently no sensible P.M.

Star 4 is

			1875.0			Epoch
Lat	39962	20 36	19.52	- 23	54	59.7 1800 ±
A.O.C	20771		18.83		54	59.1 1850 ±
C.G.A	21400		18.86		55	3.0 1875 ±

P.M. obviously small

Star 3 is

			1870.0			Epoch
A.O.C	20749	20 34	32.24	- 23	34	46.5
C.G.A	31523		32.15		34	49.6

P.M. small

Poschons for 1900.0
from Hedrick's 20 diurnal Catalogue

no	α		P.M.		δ	P.M.	
1	20	31 55 ^s 104	+0.0063	- 25 27	25.78 +0.007		
2	20	34 14 796	+ 0.376	- 24 8	21.72 +0.461		
5	20	40 10 570	- 0.041	- 25 37	48.50 -0.148		
6	20	40 24 504	- 0.023	- 24 5	16.88 -0.029		

Use these, ^{with p.m. to 1910} and the plans of nos
3 & 4 brought up to 1900 from the B.G.A. without P.M.
Corrections are as follows

	Pre.	Sec. var	Pre.	Sec. var
3	+ 3.539	- 0.015	+ 12.521	+ 0.395
4	+ 3.533	- 0.015	+ 12.642	+ 0.395

giving for 1900.0

3	20 ^h	36 ^m	0 ^s 55-	- 23	29	35.3
4	20	37	47.13	- 23	49	45.7

Both need correction by
+1".2

3

Poolman for 1900

Heilich 2 to 2000

10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100
10	20	30	40	50	60	70	80	90	100

Class these and the balance of the

2000 up to 1900 from the U.S.A. and from P.H.

Results are as follows

3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12

Results for 1900

3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12

Both and compare

4100

Positions for 1900.0
from Hedrick's 20 draco Catalogue

3

no	α				P.M.	δ	P.M.
1	20	31	55 ^s	104	+0.0063	-25 27	25.78 +0.007
2	20	34	14	796	+0.0376	-24 8	21.72 +0.461
5	20	40	10	570	-0.0041	-25 37	45.50 -0.145
6	20	40	24	504	-0.0023	-24 5	16.88 -0.029

Use these ^{with p.m. to 1910} and the places of nos

3 & 4. brought up to 1900 from the C.G.A. without P.M.

Corrections are as follows

	Prec.	Sec. var.	Prec.	Sec. var.
3	+ 3.539	- 0.015	+ 12.521	+ 0.395
4	+ 3.533	- 0.015	+ 12.642	+ 0.395

giving for 1900.0

3	20 ^h	36 ^m	0 ^s .55-	- 23	29	35.3
4	20	37	47.13	- 23	49	45.7

Both need correction

by +1"2

MC 651 to p Plate MC 654

4

Measures 1910 Nov 15

Star	d	μ	d	μ
1	15825	4821	13205	2211
8.14	10816	9849	9253.66	6132
	1409	4244	5070	3529
	45	38	196	188
14.	<u>5022</u>	<u>5015</u>	8. <u>3941</u>	<u>3931</u>
2	13076	3971	12099	2471
12.24	6221	10835	7827.42	6724
	19	32	5835	21
	84	71	96	59
24	<u>6861</u>	<u>6863</u>	12 <u>4265</u>	<u>4257</u>
3	12157	4437	13552	2840
10.59	5318	11060	8368	8022
	20	61	7870	2818
	62	19	71	26
29.	<u>6639</u>	<u>6636</u>	15 <u>5199</u>	<u>5193</u>
4	12935	4233	13702	2702
18.27	12298	4872.70	7168.60	9227
	300	64	8072	27
	43	19	21	697
27.	<u>0636</u>	<u>0635</u>	18 <u>6544</u>	<u>6528</u>

Plate MC 650

4

Measures. 1910 Nov 15.

Star	d	n	d	n
1	15825	4821	13205	2211
8.14	10816	9849	925366	6132
	1409	4244	5070	3529
	45	38	196	188
14.	<u>5022</u>	<u>5015</u>	<u>3941</u>	<u>3931</u>
2	13076	3971	12099	2471
12.24	6221	10835	752742	6724
	19	32	5835	21
	84	71	96	59
24	<u>6861</u>	<u>6862</u>	<u>4265</u>	<u>4257</u>
3	12157	4437	13052	2840
10.59	5518	11060	6366	5022
	20	61	7870	2818
	62	19	13971	26
29.	<u>6639</u>	<u>6636</u>	<u>5199</u>	<u>5193</u>
4	12935	4233	13702	2702
18.27	12298	487270	716860	9227
	300	54	5072	27
	43	19	21	697
27.	<u>0636</u>	<u>0635</u>	<u>6544</u>	<u>6528</u>

MC 650 Meas. 1910 Nov 15.

Star	y		x	
5-	d	n	d	n
22. 13	13939	3546	11910	1782
large	12298	5769	421212	9510
not	9892	6459	3018	12
quite	42	32	12	90
round				
6	<u>13, 16 43</u>	<u>16 23</u>	<u>222. 7694</u>	<u>77 23</u>
23 20	13344	1836	12078	2667
	12998	228976	9414	5315-30
	98	51 82	2019	27 2512
	61	11	106	58
	<u>25. 0447</u>	<u>0446</u>	<u>23. 2670</u>	<u>26 59</u>

5-. remeasured

11928	2343	13951	2294
10285	3979	6249	10002 12
83 88	7579	3946	02 10
24	43	60	90
<u>16 42</u>	<u>16 35</u>	<u>7713</u>	<u>7716</u>
Mean for 5-			
<u>16 42</u>	<u>16 29</u>	<u>7704</u>	<u>7720</u>

MC 100 - 1000 - 1000

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MC 650 Meas. 1910 Nov 15

5-

Star	y	x
5-	d	n
22. 13	13939	3546
large	12298	3769
not	98 92	64 59
quite	42	32 71
some		
6	<u>13. 16 45</u>	<u>16 23</u>
	13344	1826
3 20-	12998	2289 76
	98	81 82
	61	11
25. 0447	<u>0446</u>	23. 2670
		<u>2659</u>

5- remeasured

11928	2343	13951	2294
10285	3979	6249	10002 12
83 88	75 79	3946	02 10
24	43	60	90
<u>16 42</u>	<u>16 35</u>	<u>7713</u>	<u>7716</u>
Mean for 5-			
<u>16 42</u>	<u>16 29</u>	<u>7704</u>	<u>7720</u>

MC 650

6

Mean Measured Coordinates

Star	x	y	Differences $d-x$ y	
1	8 3936	14.6018	+ 10	+ 7
2	12.4261	24.6862	+ 8	- 2
3	15.5796	29.6638	+ 6	+ 3
4	18.6536	27.0636	+ 16	+ 1
5	22.7712	13.1636	- 16	+ 13
6	23.2660	25.0446	+ 11	+ 1
			Mean	+ 5 - + 4
			Average deviation	8 4
			Excluding star 5	2.6 2.4

From comparison with the meridian
planes we find for the centre of the plate
 $x = 18$, $y = 22$

$$A = 20^h 37^m 25^s$$

$$D = -24^\circ 29' 15''$$

Reseau interval is approximately $465''$

The large and unsymmetrical image of
Star 5 is evidently less accurately measurable
than the others for which the ^{average} error of measurement
is $0.00025 \times \sqrt{5} \times 465'' = 0''.09$

MC 620

Jensen, J. (1905)

Star	X	Y	Difference
1	23.32	14.2018	+ 10
2	12.4261	24.6265	+ 2
3	12.2192	29.6638	+ 8
4	12.6236	27.0236	+ 12
5	22.7712	13.1636	- 16
6	23.2660	20.0446	+ 11

These are four for the stars of the plate
 compared with the position
 of the stars in the
 original plate.

The large and small numbers in the
 table are the positions of the stars in the
 original plate.

The positions of the stars in the
 original plate are approximately 10".

MC 650

6

Mean measured Coordinates

Star	x	y	Difference x	Difference y
1	8 3936	14.5018	+ 10	+ 7
2	12.4261	24.6862	+ 8	- 2
3	15.5796	29.6638	+ 6	+ 3
4	18.6536	27.0636	+ 16	+ 1
5	22.7712	13.1636	- 16	+ 13
6	23.2660	25.0446	+ 11	+ 1

Mean + 5 - + 4

Average deviation 8 4

Excluding star 5 2.6 2.4

From comparison with the meridian
planes we find for the center of the plate

$$X = 18 \quad Y = 22$$

$$A = 20^{\circ} 37' 25''$$

$$D = -24^{\circ} 29' 15''$$

Reseau interval is approximately $465''$

The large and unsymmetrical image of
Star 5 is evidently less accurately measurable
than the others for which the ^{average} error of measurement
is $0.00025 \times \sqrt{5} \times 465'' = 0''.09$

Star	X	Y	Difference
1	8.3436	14.6015	+ 10
2	12.4264	24.6624	- 2
3	17.6742	29.6637	+ 3
4	18.6234	27.0636	+ 1
5	22.7712	12.1636	+ 12
6	23.2660	28.0446	+ 11

From comparison with the position
 plates we find for the center of the plate
 $X = 14.4$, $Y = 24.4$
 $H = 20^{\circ} 27' 22''$
 $D = 24^{\circ} 24' 12''$
 Position relative to approximately 1400.

The large and irregular shape of
 the star is certainly the result of
 the position for which the star is
 observed.

Computation of Standard Co-Ordinates 7

$$\xi = \sin(\alpha - A) \cos \delta + \frac{1}{2} \xi (\xi^2 + 4)$$

$$\eta = \tan(\delta - D) + \frac{1}{2} \xi^2 \tan \delta$$

Let $\alpha - A$ be expressed in seconds of time

" $\delta - D$ " " " " " " are

" Reason value be assumed $465''.00 = .$

$= \frac{1}{442.18}$ in circular measure

Let $\sin(\alpha - A) = \alpha - A + \Delta\alpha$

$\tan(\delta - D) = \delta - D + \Delta\delta$

(See p. 13)

These quantities may be taken from the following tables

$\alpha - A$	$\Delta\alpha$	$\delta - D$	δD	$\delta - D$	$\Delta\delta$
100 ^s	-0.001	8080''	+0.05	1830''	+0.05
130 ^s	-0.002	1240''	+0.15	2680''	+0.15
179 ^s	-0.005	1470''	+0.25	3170''	+0.25
257 ^s	-0.015	1650''	+0.35	3550''	+0.35
306 ^s	-0.025	1790''	+0.45	3860''	+0.45
341 ^s	-0.035	1915''	+0.55	4130''	+0.55
371 ^s	-0.045			4360''	+0.65
397 ^s	-0.055	5340	1.35	4570''	+0.75
420 ^s	-0.065	5670	1.45	4860''	+0.85
441 ^s	-0.075	5800	1.55	4950''	+0.95
459 ^s	-0.085	5930	1.65	5100''	+1.05
476 ^s	-0.095	6050	1.75	5250	1.15
492 ^s	-0.105	6150	1.85	5400	1.25
		6280	1.95		
		6350	2.05		

Computation of Standard Deviation

$$E = \frac{1}{n} \sum (x - \bar{x})^2 = \frac{1}{n} \sum x^2 - \bar{x}^2$$

$$s^2 = \frac{1}{n} \sum (x - \bar{x})^2 = \frac{1}{n} \sum x^2 - \bar{x}^2$$

Let $\bar{x} = 100$ and $\sum x^2 = 10000$

Then $s^2 = \frac{1}{n} \sum x^2 - \bar{x}^2 = \frac{10000}{n} - 100^2$

For $n = 10$, $s^2 = \frac{10000}{10} - 100^2 = 1000 - 10000 = -9000$

For $n = 20$, $s^2 = \frac{10000}{20} - 100^2 = 500 - 10000 = -9500$

For $n = 30$, $s^2 = \frac{10000}{30} - 100^2 = 333.33 - 10000 = -9666.67$

For $n = 40$, $s^2 = \frac{10000}{40} - 100^2 = 250 - 10000 = -9750$

For $n = 50$, $s^2 = \frac{10000}{50} - 100^2 = 200 - 10000 = -9800$

For $n = 60$, $s^2 = \frac{10000}{60} - 100^2 = 166.67 - 10000 = -9833.33$

For $n = 70$, $s^2 = \frac{10000}{70} - 100^2 = 142.86 - 10000 = -9857.14$

For $n = 80$, $s^2 = \frac{10000}{80} - 100^2 = 125 - 10000 = -9875$

For $n = 90$, $s^2 = \frac{10000}{90} - 100^2 = 111.11 - 10000 = -9888.89$

For $n = 100$, $s^2 = \frac{10000}{100} - 100^2 = 100 - 10000 = -9900$

Computation of Standard Coordinates

8

We then have in mean intervals

$$\xi = [8.50864] \sin(\alpha - A) \cos \delta + \frac{\xi(\xi^2 + \eta^2)}{393600}$$

$$\eta = [7.33255] \tan(\delta - D) + \frac{\xi^2 \tan \delta}{[2.94800]}$$

Equinox 1900 Star 1 (including P. 141)

α	$20^h 31^m 53^s.17$	δ	$- 25^\circ 27' 25''.1$
$\alpha - A$	$- 5 29 83$	$\delta - D$	$- 58 10.1$
$\sin(\alpha - A)$	$- 329.80$	$\tan(\delta - D)$	$- 3490''.4$
\log	2.51825^u	\log	3.54288^u
$\log \cos \delta$	9.95564	\log	7.33255
$\log \sin \delta$	8.50864	$\log \eta_0$	0.87543^u
$\log \xi_0$	0.98253^u	$\log \xi^2$	1.9650
ξ_0	$- 9.6058$	$\tan \delta$	9.6777^u
ξ_2	$- 27$	\log	7.0520
ξ	8.3915	$\log \eta_1$	8.6947^u
χ	8.3936	η_0	$- 7.5065$
$\chi - \xi$	$+ 26$	η_1	$- 0.0495$
		η	14.4440
		y	14.5018
		$y - \eta$	$+ 578$

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Computation of Standard Coordinates

8

We then have in mean intervals

$$\xi = [8.50864] \sin(\alpha - A) \cos \delta + \frac{\xi(\xi^2 + \eta^2)}{393600}$$

$$\eta = [7.33255] \tan(\delta - D) + \frac{\xi^2 \tan \delta}{[2.94800]}$$

Equinox 1900 Star 1 (including P. 141)

$$\alpha \quad 20^{\text{h}} \quad 31^{\text{m}} \quad 53^{\text{s}}.17 \quad \delta \quad - \quad 25^{\circ} \quad 27' \quad 25''.1$$

$$\alpha - A \quad - \quad 5 \quad 29 \quad 83 \quad \delta - D \quad - \quad 5^{\circ} \quad 8' \quad 10.1$$

$$\sin(\alpha - A) \quad - \quad 329.80 \quad \tan(\delta - D) \quad - \quad 3490''.4$$

$$\log \quad 2.51825^{\text{m}}$$

$$\log \quad 3.54288^{\text{m}}$$

$$\log \cos \delta \quad 7.95564$$

$$\log \cos \delta \quad 7.33255^{\text{m}}$$

$$\text{const} \quad 5.50864$$

$$\log \eta_0 \quad 0.87643^{\text{m}}$$

$$\log \xi_0 \quad 0.98253^{\text{m}}$$

$$\log \xi^2 \quad 1.9650$$

$$\xi_0 \quad - \quad 9.6058$$

$$\tan \delta \quad 9.6777^{\text{m}}$$

$$\text{const} \quad 7.0520$$

$$\xi_2 \quad - \quad 27$$

$$\log \eta_1 \quad 8.6947^{\text{m}}$$

$$\xi \quad 8.3900^{\text{m}}$$

$$\eta_0 \quad - \quad 7.5065^{\text{m}}$$

$$\chi \quad 8.3936$$

$$\eta_1 \quad - \quad 0.0495^{\text{m}}$$

$$\eta \quad 14.4440$$

$$\chi - \xi \quad + \quad 26$$

$$\chi \quad 14.5018$$

$$\chi - \eta \quad + \quad 578$$

Epoch 1910.75

Star 2

Star 2

Star 3

9

α $34^h 15^m 20^s$
 $\alpha - A$ $- 3 \quad 9 \quad 80$
 $\sin \alpha - A$ $- 189.79$

$36^h 0^m 55^s$
 $- 1 \quad 24.45$
 $- 84.45$

\log 2.27828^m
 $\cos \delta$ $9 \quad 96026$
 $\cos t$ $8 \quad 50864$

$1 \quad 92660^m$
 $9 \quad 96242$
 8.50864

$\log \epsilon_0$ 0.74718^m

0.39746^m

ϵ_0 $- 5.5870$

$- 2.4972$

ϵ_1 $- 5$

$- 4$

ϵ $12 \quad 4125$

15.5024

X $12 \quad 4261$

15.5196

$X - \epsilon$ $+ 136$

$+ 172$

δ $- 24^h 8^m 16^s 8$

$- 23 \quad 29 \quad 35.3$

$\delta - D$ $+ 20 \quad 58.2$

$+ 59 \quad 39.7$

$\tan \delta - D$ $+ 12 \quad 58.2$

$+ 35 \quad 80.1$

\log 3.09975
 $\cos t$ $7 \quad 33255$

3.55389
 7.33255

$\log \eta_0$ $0 \quad 43230$

0.88644

$\log \epsilon^2$ $1 \quad 4943$

$0 \quad 795$

$\tan \delta$ $9 \quad 6514^m$

9.6380^m

$\cos t$ $7 \quad 0520$

$7 \quad 0520$

$\log \eta_1$ 8.1977

7.485^m

η_0 $+ 2 \quad 7058$
 η_1 $- 15-8$

$+ 7.6992$
 $- 30$

η 24.6900

$29 \quad 6962$

η $24 \quad 6862$

$29 \quad 6638$

$\eta - \eta$ $- 38$

$- 324$

Epoch 1910.75

Star 2

Star 2

Star 3

α $34^{\circ} 10' 20''$
 $\alpha - A$ $- 3 \quad 9 \quad 80$
 $\alpha - A$ $- 189.79$

$36^{\circ} 0' 55''$
 $- 1 \quad 24.45$
 $- 84.45$

\log 2.27828
 $\cos \delta$ $9 \quad 96026$
 $\cos t$ $8 \quad 50864$

$1 \quad 92660$
 $9 \quad 96242$
 $8 \quad 50864$

\log 0.74718

0.39746

Σ $- 5.5870$

$- 2.4972$

Σ $- 5$

$- 4$

Σ $12 \quad 4125$

$15 \quad 5024$

X $12 \quad 4261$

$75 \quad 5196$

$X - \Sigma$ $+ 136$

$+ 172$

δ $- 24^{\circ} 8' 16'' 8$

$- 23 \quad 29 \quad 35.2$

$\delta - D$ $+ \quad 20 \quad 58.2$

$+ \quad 59 \quad 39.7$

$\tan \delta - D$ $+ \quad 12 \quad 58.2$

$+ \quad 35 \quad 80.1$

\log 3.09975
 $\cos t$ $7 \quad 33255$

$3 \quad 55389$
 $7 \quad 33255$

\log 0.43230

0.88644

\log $1 \quad 4943$

$0 \quad 795$

$\tan \delta$ $9 \quad 6514$

$9 \quad 6380$

$\cos t$ $7 \quad 0520$

$7 \quad 0520$

\log 8.1977

7.485

η_0 $+ 2 \quad 7058$
 η_1 $- \quad 158$

$+ 7.6992$
 $- \quad 30$

η $24 \quad 6900$

$29 \quad 6962$

η $24 \quad 6862$

$29 \quad 6638$

$\eta - \eta$ $- \quad 38$

$- \quad 324$

Star 4

Star 5

Star 6 10

$$\alpha \quad 37 \quad 47.13$$

$$A-\alpha \quad + \quad 22.13$$

$$S(A-\alpha)$$

$$40 \quad 10.53$$

$$+ \quad 2 \quad 53.53$$

$$+ \quad 165.53$$

$$40 \quad 24.48$$

$$+ \quad 2 \quad 59.48$$

$$+ \quad 179.48$$

$$\log \quad 1 \quad 34498$$

$$\cos \delta \quad 9. \quad 96131$$

$$\sin \delta \quad 8. \quad 50864$$

$$2 \quad 21858$$

$$9. \quad 95501$$

$$8. \quad 50864$$

$$2 \quad 25407$$

$$9 \quad 96043$$

$$8. \quad 50864$$

$$\log S_0 \quad 9. \quad 81493$$

$$0. \quad 68253$$

$$0. \quad 72308$$

$$S_0 \quad + \quad 0. \quad 6530$$

$$S_1 \quad 0$$

$$+ \quad 4. \quad 8142$$

$$+ \quad 15$$

$$+ \quad 5. \quad 2855$$

$$+ \quad 8$$

$$S \quad 18 \quad 6530$$

$$22 \quad 8157$$

$$23 \quad 2863$$

$$X \quad 18 \quad 6536$$

$$22 \quad 7712$$

$$23 \quad 2660$$

$$X-S \quad + \quad 6$$

$$- \quad 445$$

$$- \quad 203$$

$$\delta \quad - \quad 23 \quad 49 \quad 45.7$$

$$- \quad 20 \quad 29 \quad 50.0$$

$$- \quad 24. \quad 5 \quad 17.1$$

$$\sin \delta \quad + \quad 39 \quad 29.3$$

$$- \quad 1 \quad 8 \quad 35.0$$

$$+ \quad 23 \quad 57.9$$

$$\tan(\delta-D) \quad + \quad 2369.4$$

$$- \quad 4075.5$$

$$+ \quad 1437.9$$

$$\log \quad 3. \quad 37464$$

$$\cos \delta \quad 7 \quad 33255$$

$$3. \quad 61443$$

$$7 \quad 33255$$

$$3 \quad 15773$$

$$7 \quad 33255$$

$$\log \eta_1 \quad 0. \quad 70729$$

$$0. \quad 94698$$

$$0 \quad 49028$$

$$\log S \quad 9. \quad 630$$

$$1. \quad 3650$$

$$1. \quad 4462$$

$$\tan \delta \quad 9. \quad 6450$$

$$9 \quad 6810$$

$$9 \quad 6504$$

$$\cos \delta \quad 7. \quad 0520$$

$$7 \quad 0520$$

$$7 \quad 0520$$

$$\log \eta_2 \quad 6. \quad 327$$

$$8. \quad 0980$$

$$8. \quad 1486$$

$$\eta_1 \quad + \quad 5 \quad 0956$$

$$- \quad 8. \quad 8508$$

$$+ \quad 3 \quad 0923$$

$$\eta_2 \quad + \quad 2$$

$$- \quad 125$$

$$- \quad 141$$

$$\eta \quad 27. \quad 0954$$

$$13 \quad 2367$$

$$25 \quad 0782$$

$$\eta \quad 27. \quad 0636$$

$$13 \quad 1636$$

$$25 \quad 0446$$

$$\eta - \eta \quad - \quad 318$$

$$+ \quad 269$$

$$- \quad 336$$

	Star 4	Star 5	Star 6 10
α	37 47.13	40 10.53	40 24.48
$\Delta\alpha$	+ 22.13	+ 2 53.53	+ 2 59.48
$\Delta\alpha\cos\delta$		+ 165.53	+ 179.48
\log	1 34498	2 21888	2 25407
$\cos\delta$	9.96131	9.95501	9.96043
$\cos\epsilon$	8.50864	8.50864	8.50864
$\log\epsilon$	9.81493	0.68253	0.72308
S_0	+ 0.6530	+ 4.8142	+ 5.2855
S_1	0	+ 15	+ 8
S	18 6530	22 8157	23 2863
X	18 6536	22 7712	23 2660
$X-S$	+ 6	- 445	- 203
δ	- 23 49 45.7	- 25 37 50.0	- 24.5 17.1
$\Delta\delta$	+ 39 29.3	- 1 8 35.0	+ 23 57.9
$\tan\delta - \Delta\delta$	+ 2369.4	- 4115.5	+ 1437.9
\log	3.37464	3.61443	3 15773
$\cos\epsilon$	7 33255	7 33255	7 33255
$\log\epsilon$	0.70729	0.94698	0 49028
$\log\epsilon$	9.630	1.3650	1.4462
$\tan\delta$	9.6450 ~	9 6810 ~	9 6504 ~
$\cos\epsilon$	7.0520	7 0520	7 0520
$\log\epsilon$	6.327 ~	8.0980 ~	8.1486 ~
η_1	+ 5 0956	- 8.8508	+ 3 0923
η_2	+ 2	- 125	- 141
η	27.0954	13 7357	25 0782
η	27.0636	13 1636	25 0446
$\eta - \eta$	- 318	+ 269	- 336

x
1
2
3
4
6
6
Sun
4x
Sun
1-4
RA
-0
1-6
C
-0
-0

MC 650 Plate Constants

11

x	Equations of Condition				X-ΔS	y-η
1	8.39 a	+ 14.50 b	+ c	=	+ 21	+ 578
2	12.43 a	+ 24.69 b	+ c	=	+ 136	- 38
3	15.52 a	+ 29.66 b	+ c	=	+ 172	- 324
4	18.63 a	+ 27.06 b	+ c	=	+ 6	- 318
6	23.27 a	+ 25.04 b	+ c	=	- 203	- 336
5	22.77 a	+ 13.16 b	+ c	=	- 445	+ 269

Mean Equations

Sum x	12.11 a	+ 22.95 b	+ c	=	+ 110	+ 272
4x	21.56 a	+ 21.75 b	+ c	=	- 214	- 128
Sum y	15.58 a	+ 13.83 b	+ c	=	- 212	+ 424
4y	17.47 a	+ 26.61 b	+ c	=	+ 28	- 254

9.45 a	- 1.20 b	=	- 324	- 200
2.89 a	+ 12.78 b	=	+ 240	- 678
-1.89 a	+ 0.24 b	=	+ 65	+ 40
	13.02 b	=	+ 305	- 638
9.45 a		=	- 296	- 254

$$a = -31.4, -27.5 \quad b = +23.4, -49.0$$

Sum	+110	-214	-212	+28
-ΔS	+380	+677	+488	+549
-b _y	-537	-510	-324	-623
c	-47	-44	-48	-46
u'	+72	-128	+424	-254
-ΔS	+335	+598	+426	+479
-e _y	+1124	+1067	+678	+1306
f	+1537	+1530	+1538	+1531

MC 650 Plate Constants

11

	Equations of Correction				X-δ	Y-η
1	8.39	a	+ 14.50	b + c =	+ 21	+ 578
2	12.43	a	+ 24.69	b + c =	+ 136	- 38
3	15.52	a	+ 29.66	b + c =	+ 172	- 324
4	18.65	a	+ 27.06	b + c =	+ 6	- 318
6	23.27	a	+ 25.04	b + c =	- 203	- 336
5	22.77	a	+ 13.16	b + c =	- 445	+ 269

Mean Equations

Sum	12.11	a	+ 22.95	b + c =	+ 110	+ 72
Lx	21.56	a	+ 21.75	b + c =	- 214	- 128
Sum y	15.58	a	+ 13.83	b + c =	- 212	+ 424
L y	17.47	a	+ 26.61	b + c =	+ 28	- 254
	9.45	a	- 1.20	b	= - 324	- 200
	2.89	a	+ 12.78	b	= + 240	- 678
	-1.89	a	+ 0.24	b	= + 65	+ 40
			13.02	b	= + 305	- 638
	9.45	a			= - 296	- 259
	a = - 31.4, - 27.5				b = + 23.4, - 49.9	

R41	110	+ 110	- 214	+ 212	+ 28
505	+ 380	+ 677	+ 488	+ 549	
214	- 537	- 510	- 324	- 623	
e	- 47	- 44	- 48	- 46	
c	+ 72	- 128	+ 424	- 254	
- d5	+ 335	+ 598	+ 432	+ 485	
- e y	+ 1124	+ 1067	+ 678	+ 1306	
f	+ 1527	+ 1530	+ 1530	+ 1530	

MC 657

Reduction

12

Star	1	2	3	4	6	5
α X	- 264	- 391	- 486	- 587	- 720	- 715
β G	+ 46	- 46	- 46	- 46	- 46	- 46
α Q	+ 340	+ 578	+ 695	+ 634	+ 687	+ 808
Comp	+ 30	+ 141	+ 163	+ 27	- 189	- 453
V-S	+ 21	+ 136	+ 172	+ 6	- 203	- 445
0-0	+ 9	- 5	+ 9	+ 5	- 14	+ 8

α X	- 230	- 342	- 425	- 518	- 638	- 628
β Y	- 710	- 1210	- 1453	- 1327	- 1228	- 645
C	+ 1534	+ 1534	+ 1534	+ 1534	+ 1534	+ 1534
Comp	+ 587	- 23	- 349	- 310	- 337	+ 269
4-4	+ 578	- 38	- 324	- 318	- 326	+ 269
0-0	- 19	- 15	+ 26	- 7	+ 1	+ 19

Average residual in x, 8, in y, 14

Corresponding probable error (combined merid. places & plate)

$$= \text{average residual} \times \sqrt{\frac{2}{3}} \times 0.854 =$$

$$\text{in } x \pm 0^R 0010 = \pm 0''47$$

$$\text{in } y \pm 0^R 0017 = \pm 0''78$$

$$\text{mean} \pm 0^R 0014 = \pm 0''64$$

Satisfactory

Worst residual out of 12 1''.2

Probable error of reduction of measured coordinate to $\alpha \sqrt{15}$, near middle of plate (norm) is $\frac{1}{\sqrt{15}}$ of above
 $\approx \pm 0''19 = \pm 0^S 014$ in R.A. and $\pm 0''32$ in Dec.

MC 650		Reduction						12
Star	1	2	3	4	6	5		
α X	- 264	- 391	- 486	- 587	- 720	- 715		
β G	+ 46	- 46	- 46	- 46	- 46	- 46		
ρ Q	+ 340	+ 570	+ 695	+ 634	+ 687	+ 308		
Comp	+ 30	+ 145	+ 163	+ 22	- 189	- 452		
γ S	+ 21	+ 136	+ 172	+ 6	- 203	- 445		
0-C	+ 9	- 5	+ 9	+ 25	- 145	+ 8		
α X	- 232	- 342	432	519	638	624		
β Y	710	1210	1453	1327	1228	645		
C	+ 1535	+ 1535	+ 1535	+ 1535	+ 1535	+ 1535		
Comp	+ 587	- 28	- 349	- 314	- 327	+ 267		
γ Y	+ 578	- 38	- 324	- 318	- 326	+ 269		
0-C	- 9	- 15	+ 25	- 7	+ 4	+ 19		

Average residual in x , 8, in y , 14

Corresponding probable error (combined merid. places & plate

$$= \text{average residual} \times \sqrt{\frac{6}{3}} \times 0.854$$

$$\text{in } x \pm 0^R 0010 = \pm 0''47$$

$$\text{in } y \pm 0^R 0017 = \pm 0''78$$

$$\text{mean} \pm 0^R 0014 = \pm 0''64$$

Worst residual out of 12 $1''2$

Probable error of reduction of measured coordinate to α, δ , near middle of plate $\approx \frac{1}{16}$ of above

$$\approx \pm 0''19 = \pm 0^S 014 \text{ in RA} \quad \pm 0''32 \text{ in Dec}$$

Improved Constants for Compuhaz Standard Coordinates

13

From the above values of the plate-constants
 $a = -0.00314$, $B = -0.00490$, it appears that the
 assumed value of the mean interval is too small.
 Theoretically, a & c should differ by the ungonimetical
 refraction, which amount is $a - c = +0.00028 \tan^2 z$
 for plates taken on the meridian.
 The present plate is in declination $= 24.29'$, the latitude
 of Harvard is $+42'$. Hence z is approximately 67° ,
 which should make $a - c = +0.0014$, agreeing
 very well with $+0.0016$ observed.

The actual scale value is therefore about $\frac{1}{200}$ part
 smaller. The mean interval $\frac{1}{200}$ greater than assumed.
 Hereafter we will assume $R = 466''.50$
 Our formulas then become

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

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

which will be used till further notice

Japanese Institute for Geophysics
 Standards: 2 series

From the above values of the plate constants
 $a = -0.00314$, $b = -0.00040$, it appears that the
 constant value of the series referred to two series
 theoretical, as a series referred to the wavelength
 refraction, which amount is $a = -0.00314$ and $b =$
 for plates taken at the wavelength
 The present plate is an observation of a star, the value
 of θ is 4.2 . Hence θ is approximately 4.2
 when θ is 4.2 , $a = -0.00314$, $b =$
 and θ is 4.2 , $a = -0.00314$, $b =$
 The actual value is 4.2 and θ is 4.2
 constant value is 4.2 and θ is 4.2
 Hereafter we will assume $R = 4.2$
 On the other hand, the value

$$E = [2.20124] \sin(\theta - A) \cos \theta + \frac{2.1111}{0.00000}$$

$$H = [2.21112] \sin(\theta - D) + [2.0214] \sin \theta + 2$$

where θ is the angle of the plate

MC 650

Moon's Lane

Mass 1910 Nov 47¹⁴

$X = 18.00$ $y = 19.00$ close to limb, too near
for measurement

Scratch near S. cusp

 $X = 17.5$

X

y

 $y = 18.9$

12458

8425-

17983

2658

4488

16388.00

8450

12171

90

95.59

88.86

20

66

14

90

50

17. 79 75

79 77

18. 95 05

9520

 $X = 17.4$

17977

2659

 $y = \underline{mm}$

8845

11809

50 48

05 00

82

54

18. 91 34

9150

 $X = 17.0$

17983

1662

 $y = 18$

7890

11237

90.89

44 48

88

60

 $y = 19.0$

10721

4815-

18. 95 97

9583

2290 92

13254

54

 $X = K4$

72 68

68

28

05-

16. 8443

8452

MC 650

Moon's limb

Mean 1910 Nov 17¹⁴

$X = 18.00$ $y = 19.00$ close to limb, too near
for measurement

Scaldis near S. cusp

 $X = 17.5$

*

42

 $y = 18.9$

12458

8420

17983

2658

4488

16388.00

8450

12171

90

95 89

84 86

70

66

14

90

50

17. 79 75

79 77

18. 95 05

9520

 $X = 17.4$

17977

2659

 $y = \text{mm}$

8842

11809

50 48

05 00

82

54

 $X = 17.0$

17983

1662

 $y = 18$

7390

11237

90 89

44 48

88

64

 $y = 19.0$

10721

4813

18. 95 97

9583

2290 92

13254

54

 $X = 18.4$

72 68

68

23

05

16. 8443

8452

MC650

Moon's Lamb

Meas 1910 Nov 17

~~y = 16.0~~~~X = 14.4~~

x = 16

y = 19+

d

n

d

n

14610

2325

9605-82

7339

525-90

38²⁹

22

22

19.5026

5012

y = 20

~~12890~~

3998

12883

x = 15+

~~75-20 40~~ 10340

6570

~~20 20~~

37

99⁰⁶~~900~~

83

29

15-

6357

6870-

y = 20.8

13881

3960

x = mean

9708

8139

15.4

10

38

88

48

15-

4172

4183

y = 21.0

13885

3962

x = 15+

9699

8161

87

70

92

63

5-5-

15-

4196

4206

y = 22.0

14890

2952

x = 15+

75-20

40 10320

30 20

30

900

39

15-

7370

7387

MC650

Moon's Lane

Meas 1910 Nov 17

~~14 = 16~~

d

n

~~X = 14~~

X = 16

y = 19 +

y = 20

X = 15 +

12 90

3998

12 883

~~75 20~~

10340

6370

~~82 20~~

37

99 06

~~900~~

83

19

15.

6351

6375

y = 20.8

13881

3960

X = min

9708

8139

15 +

10

38

80

48

15.

4172

4183

y = 21.0

13885

3902

X = 15 +

9699

8161

87

70

92

63

53

15.

4196

4206

y = 22.0

14890

2952

X = 15 +

7520

4010330

3020

30

900

39

15.

7370

7387

14610

2325

960582

7339

38090

3829

22

22

19.5026

5012

Mc 650 Moon's Limb Meas 1910 Nov 17¹⁶

X		Y	
a	n	a	n
X = 16.0			
Y = 22.4			
Re-measured 1910 Nov 25			
11620	1961	11730	1211
8431	5776 78	8625	4418 10
25-31	68 78	42	25 18
26	61 74	30	12
3192	3214	22. 3099	3207
mean	3202		

Scratch near N. pole

X = 16.4	12084	4863	11532	1224
Y = 22.4	4947	11978	3789	8968 62
	48	78 70	90	55 67
	55	90	67	20
	89	45		

16	7138	7126	22. 7746	7744
----	------	------	----------	------

Same re-meas 1910 Nov 23

a	n	a	n
12286	1872	11875	3974
9410	4737	9626 10	6217
30 12	41	20 21	17
310	64	89	60
16. 7123	7128	22. 7741	7764

means for this point

16. 7129	22. 7746
----------	----------

Changes negligible

MC 650 Moon's Limb. Mean 1910 Nov 17 ¹⁶

X = 16.0

y = 22.4

Re-measured 1910 Nov 20

11620 1961
8431 57 76 76
25-31 11 76
26 61 74
3192 32 14

11730

1211

8635-32

4418 10

42

25-18

30

12

22. 3099

3207

Scratch near N. pole

X = 16.4

y = 20.8

12084 4661
4947 11978
48 70 70
58 40
89 45

11532

1221

2759

8908 62

40

58 67

27

20

16 7138 7126

22. 7746

7744

Same means

1910 Nov 23

12286 1672
4410 4737
30 12 41
310 64

11875

3974

9626 10

6217

20 21

17

89

60

16 7123 7128

22. 7741

7754

means for this point

16. 7129

22. 7746

Changes negligible

MC 650

Mean Coordinates of Points on Moon's Limb

Point	X	$x - x_0$	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	Diff
0	18.0000	+0.585	0.3422	(3.9942) (+101)	
1	17.7976	+0.3826	0.1471	3.9879	+38
2	17.4	0.0000	0.0000	3.9872	+31
3	17.0000	-0.4150	0.1722	3.9825	-16
4	16.8448	-0.5702	0.3250	3.9770	-71
5	16.0000	-1.4150	2.0022	3.9877	+36
6	15.6363	-1.7787	3.1638	3.9937	-4
7	15.4178	-1.9972	3.9888	3.9888	+47
8	15.4201	-1.9949	3.9796	3.9875	+36
9	15.7378	-1.6772	2.8130	3.9789	-52
10	16.0000	-1.4150	2.0022	3.9883	+42
11	16.7132	-0.7018	0.4925	3.9652	-129
Mean				3.9841	Sub 26

	y	$y - y_0$	$(y - y_0)^2$	Correction for Refraction
0	19.0000	-1.911	3.6520	(+ 110)
1	18.9572	-1.9598	3.8408	+ 110
2	18.9142	-1.9968	3.9872	+ 120
3	18.9590	-1.9520	3.8103	+ 114
4	19.0000	-1.9110	3.6520	+ 110
5	19.5019	-1.4091	1.9855	+ 60
6	20.0000	-0.9110	0.8299	+ 25
7	20.8	0.0000	0.0000	0
8	21.0000	+0.0890	0.0079	0
9	22.0000	+1.0890	1.1859	+ 35
10	22.3203	+1.4093	1.9861	+ 60
11	22.7745	+1.8635	3.4727	+ 104

Approximate Center $x_0 = 17.415$ $y_0 = 20.711$ Radius $r_0 = 1.9960$

(Added later)

The above values of $y - y_0$ are too small by 0.0015 of their amount, owing to refractive distortion see p 13. Those of $(y - y_0)^2$ must be increased by 0.0030 of their amount as shown in column following

Mean Components of Points on Meridian

Point	X	X - X ₀	(X - X ₀) ²	(X - X ₀) ³	(X - X ₀) ⁴
1	10.000	0.000	0.000	0.000	0.000
2	10.000	0.000	0.000	0.000	0.000
3	10.000	0.000	0.000	0.000	0.000
4	10.000	0.000	0.000	0.000	0.000
5	10.000	0.000	0.000	0.000	0.000
6	10.000	0.000	0.000	0.000	0.000
7	10.000	0.000	0.000	0.000	0.000
8	10.000	0.000	0.000	0.000	0.000
9	10.000	0.000	0.000	0.000	0.000
10	10.000	0.000	0.000	0.000	0.000
11	10.000	0.000	0.000	0.000	0.000
12	10.000	0.000	0.000	0.000	0.000
13	10.000	0.000	0.000	0.000	0.000
14	10.000	0.000	0.000	0.000	0.000
15	10.000	0.000	0.000	0.000	0.000
16	10.000	0.000	0.000	0.000	0.000
17	10.000	0.000	0.000	0.000	0.000
18	10.000	0.000	0.000	0.000	0.000
19	10.000	0.000	0.000	0.000	0.000
20	10.000	0.000	0.000	0.000	0.000
21	10.000	0.000	0.000	0.000	0.000
22	10.000	0.000	0.000	0.000	0.000
23	10.000	0.000	0.000	0.000	0.000
24	10.000	0.000	0.000	0.000	0.000
25	10.000	0.000	0.000	0.000	0.000
26	10.000	0.000	0.000	0.000	0.000
27	10.000	0.000	0.000	0.000	0.000
28	10.000	0.000	0.000	0.000	0.000
29	10.000	0.000	0.000	0.000	0.000
30	10.000	0.000	0.000	0.000	0.000
31	10.000	0.000	0.000	0.000	0.000
32	10.000	0.000	0.000	0.000	0.000
33	10.000	0.000	0.000	0.000	0.000
34	10.000	0.000	0.000	0.000	0.000
35	10.000	0.000	0.000	0.000	0.000
36	10.000	0.000	0.000	0.000	0.000
37	10.000	0.000	0.000	0.000	0.000
38	10.000	0.000	0.000	0.000	0.000
39	10.000	0.000	0.000	0.000	0.000
40	10.000	0.000	0.000	0.000	0.000
41	10.000	0.000	0.000	0.000	0.000
42	10.000	0.000	0.000	0.000	0.000
43	10.000	0.000	0.000	0.000	0.000
44	10.000	0.000	0.000	0.000	0.000
45	10.000	0.000	0.000	0.000	0.000
46	10.000	0.000	0.000	0.000	0.000
47	10.000	0.000	0.000	0.000	0.000
48	10.000	0.000	0.000	0.000	0.000
49	10.000	0.000	0.000	0.000	0.000
50	10.000	0.000	0.000	0.000	0.000

Mean = 10.000

Point	X	X - X ₀	(X - X ₀) ²	(X - X ₀) ³	(X - X ₀) ⁴
1	10.000	0.000	0.000	0.000	0.000
2	10.000	0.000	0.000	0.000	0.000
3	10.000	0.000	0.000	0.000	0.000
4	10.000	0.000	0.000	0.000	0.000
5	10.000	0.000	0.000	0.000	0.000
6	10.000	0.000	0.000	0.000	0.000
7	10.000	0.000	0.000	0.000	0.000
8	10.000	0.000	0.000	0.000	0.000
9	10.000	0.000	0.000	0.000	0.000
10	10.000	0.000	0.000	0.000	0.000
11	10.000	0.000	0.000	0.000	0.000
12	10.000	0.000	0.000	0.000	0.000
13	10.000	0.000	0.000	0.000	0.000
14	10.000	0.000	0.000	0.000	0.000
15	10.000	0.000	0.000	0.000	0.000
16	10.000	0.000	0.000	0.000	0.000
17	10.000	0.000	0.000	0.000	0.000
18	10.000	0.000	0.000	0.000	0.000
19	10.000	0.000	0.000	0.000	0.000
20	10.000	0.000	0.000	0.000	0.000
21	10.000	0.000	0.000	0.000	0.000
22	10.000	0.000	0.000	0.000	0.000
23	10.000	0.000	0.000	0.000	0.000
24	10.000	0.000	0.000	0.000	0.000
25	10.000	0.000	0.000	0.000	0.000
26	10.000	0.000	0.000	0.000	0.000
27	10.000	0.000	0.000	0.000	0.000
28	10.000	0.000	0.000	0.000	0.000
29	10.000	0.000	0.000	0.000	0.000
30	10.000	0.000	0.000	0.000	0.000
31	10.000	0.000	0.000	0.000	0.000
32	10.000	0.000	0.000	0.000	0.000
33	10.000	0.000	0.000	0.000	0.000
34	10.000	0.000	0.000	0.000	0.000
35	10.000	0.000	0.000	0.000	0.000
36	10.000	0.000	0.000	0.000	0.000
37	10.000	0.000	0.000	0.000	0.000
38	10.000	0.000	0.000	0.000	0.000
39	10.000	0.000	0.000	0.000	0.000
40	10.000	0.000	0.000	0.000	0.000
41	10.000	0.000	0.000	0.000	0.000
42	10.000	0.000	0.000	0.000	0.000
43	10.000	0.000	0.000	0.000	0.000
44	10.000	0.000	0.000	0.000	0.000
45	10.000	0.000	0.000	0.000	0.000
46	10.000	0.000	0.000	0.000	0.000
47	10.000	0.000	0.000	0.000	0.000
48	10.000	0.000	0.000	0.000	0.000
49	10.000	0.000	0.000	0.000	0.000
50	10.000	0.000	0.000	0.000	0.000

Approximate Center = 10.000

Radius = 1.9920

The above values of μ are for the whole day

0.0010 of the amount of the variation of the position

and 0.10 of the amount of the variation of the position

0.0020 of the amount of the variation of the position

MC 650

Mean Coordinates of Points on Moon's Limb

Point	X	$x - x_0$	$(x - x_0)^2$	$(x - x_0) + (y - y_0)^2$	Diff
0	18.0000	+ 0.585	0.3422	(3.9942) (+101)	
1	17.7976	+ 0.3826	0.1471	3.9879	+ 38
2	17.4	0.0000	0.0000	3.9872	+ 31
3	17.0000	- 0.4150	0.1722	3.9825	- 16
4	16.8448	- 0.5702	0.3250	3.9770	- 71
5	16.0000	- 1.4150	2.0027	3.9877	+ 36
6	15.6363	- 1.7787	3.1638	3.9937	- 4
7	15.4178	- 1.9972	3.9888	3.9888	+ 47
8	15.4201	- 1.9949	3.9796	3.9875	+ 36
9	15.7378	- 1.6772	2.8130	3.9789	- 52
10	16.0000	- 1.4150	2.0022	3.9883	+ 42
11	16.7132	- 0.7018	0.4925	3.9652	- 88

Mean 3.9841

	y	$y - y_0$	$(y - y_0)^2$	Correction for Refraction
0	19.0000	- 1.911	3.6520	(+ 110)
1	18.9572	- 1.9598	3.8408	+ 115
2	18.9142	- 1.9968	3.9872	+ 120
3	18.9590	- 1.9520	3.8103	+ 114
4	19.0000	- 1.9110	3.6520	+ 110
5	19.5019	- 1.4091	1.9855	+ 60
6	20.0000	- 0.9110	0.8299	+ 25
7	20.8	0.0000	0.0000	0
8	21.0000	+ 0.9890	0.0079	0
9	22.0000	+ 1.0890	1.1859	+ 35
10	22.3203	+ 1.4093	1.9861	+ 60
11	22.7745	+ 1.8635	3.4727	+ 104

Approximate Center $x_0 = 17.415$ $y_0 = 20.911$ Radius $R_0 = 1.9960$

(Added later)

The above values of $y - y_0$ are too small by 0.0015 of their amount, owing to refractive distortion, see p 13. Those of $(y - y_0)^2$ must be increased by 0.0030 of their amount, as shown in following column.

MC 650

Solution for Moon's Center.

$$x = 17.415 + \frac{1}{2}a \quad y = 20.911 + \frac{1}{2}b \quad \lambda^2 = 3.9841 + c$$

$$r^2 = 1.9960 + \frac{1}{2}c$$

Point Equations of Condition

c 0-c

1	+ 0.38 a	- 1.96 b	+ c	=	+ 38
2	0.00	- 2.00	+ c	=	+ 31
3	- 0.41	- 1.95	+ c	=	- 16
4	- 0.57	- 1.91	+ c	=	- 71
5	- 1.42	- 1.41	+ c	=	+ 36
6	- 1.78	- 0.91	+ c	=	- 4
7	- 2.00	0.00	+ c	=	+ 47
8	- 1.99	+ 0.09	+ c	=	+ 36
9	- 1.68	+ 0.09	+ c	=	- 52
10	- 1.42	+ 1.41	+ c	=	+ 42
11	- 0.70	+ 1.86	+ c	=	- 89

Normal Equations

$$\begin{cases} -11.59a - 5.70b + 11.00c = -2 & \text{Comp} \\ -0.55 + 24.76 - 5.70 = -176 & -177 \\ +19.09 - 0.55 - 11.59 = +60 & -61 \end{cases}$$

Solution

$$-6.00a - 2.96b + 5.70c = -1$$

$$-12.19 - 6.00 + 11.59 = -2$$

$$\begin{cases} -6.55a + 23.80b = -177 \\ +6.90a - 6.55b = -62 \end{cases}$$

Weight of c
= 2.51

$$+6.55a - 6.21b = -59$$

$$-1.96a + 6.55b = -58$$

$$+15.59b = -236$$

$$+4.94a = -115$$

$$a = -23.3 \quad b = -15.2 \quad c = -32.5$$

MC 650

18

Solution for Moon's Center

$$X = 17.415 + \frac{1}{2}a \quad Y = 20.911 + \frac{1}{2}b \quad A^2 = 3.9841 \mp C$$

$$n = 1.9960 \mp \frac{1}{2}C$$

Point

Equations of Condition

C 0-C

1	+0.38 a	-1.96 b	+ C	=	+ 38
2	0.00	-2.00	+ C	=	+ 31
3	-0.41	-1.95	+ C	=	- 16
4	-0.57	-1.91	+ C	=	- 71
5	-1.42	-1.41	+ C	=	+ 36
6	-1.78	-0.91	+ C	=	- 4
7	-2.00	0.00	+ C	=	+ 47
8	-1.99	+0.09	+ C	=	+ 36
9	-1.68	+0.09	+ C	=	- 52
10	-1.42	+1.41	+ C	=	+ 42
11	-0.70	+1.86	+ C	=	- 89

Normal Equations

$$\begin{cases} -11.59a - 5.70b + 11.00c = -2 & \text{comp} \\ -0.55 & +24.76 - 5.70 = -176 \\ +19.07 & -0.55 - 11.59 = -169 \end{cases} \quad \begin{matrix} -2 \\ -177 \\ -61 \end{matrix}$$

Solution

$$\begin{cases} -6.00a - 2.96b + 5.70c = -1 \\ -12.19 & -6.00 + 11.59 = -2 \end{cases}$$

$$\begin{cases} -6.55a + 27.80b & = -177 \end{cases} \quad \text{Weight of } b$$

$$\begin{cases} +6.90a - 6.55b & = -62 \end{cases} \quad = 2.51$$

$$\begin{cases} +6.55a - 6.21b & = -59 \end{cases}$$

$$\begin{cases} -1.96a + 6.55b & = -58 \end{cases}$$

$$+15.59b = -236$$

$$+4.94a$$

$$= -115$$

$$a = -23.3 \quad b = -15.2 \quad c = -32.5$$

Mc 650

Moon's Lib. Residuals

19

	a	b	c	Comp	Obs	$a-b$	v^2
1	- 32	+ 30	- 9	- 11	+ 38	+ 49	2401
2	33	30	0	- 3	+ 31	+ 34	1156
3	32	30	+ 10	+ 8	- 16	- 24	576
4	33	29	13	+ 9	- 71	- 80	6400
5	35	21	33	+ 22	+ 36	+ 14	196
6	33	+ 14	41	+ 22	- 44	- 26	676
7	32	6	46	+ 14	+ 47	+ 33	1089
8	33	- 1	45	+ 11	+ 36	+ 25	625
9	32	- 16	39	- 9	- 52	- 43	1849
10	33	- 21	33	- 21	+ 42	+ 63	3969
11	32	- 28	+ 16	- 44	- 89	- 45	2025

$$\Sigma v = 0 \quad \Sigma av = -4 \quad \Sigma bv = +1$$

$$\Sigma v^2 = 20962$$

Sq. of Mean error same value of Σv^2

$$2620$$

Probable error " " " "

$$\pm 57$$

Probable error " " " "

$$\pm 34.4$$

" " " of Σ

$$\pm 8.6$$

" " computed a

$$\pm 15.5$$

b

$$\pm 8.8$$

c

$$\pm 21.8$$

Hence for Moon's center

$$X = 17.4138 \pm 0.0008$$

$$P.E. in $a \pm 0".36$$$

$$y = 20.9102 \pm 0.0004$$

$$\pm 0".21$$

$$R = 1.9952 \pm 0.0005$$

$$\pm 0.25$$

Probable error of one measure

$$\pm 0".40$$

Largest Residual

$$0".93$$

See p 21 for corrected values

M

Moon's position

1910

V	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8
104.5	+4.4	+3.4	1.1	-	9	+3.2	2.2	-
110.2	+3.4	+3.4	2	-	0	3.0	2.2	2
115.2	+3.4	+3.4	2	+	10	3.0	2.2	2
120.2	+3.4	+3.4	2	+	10	3.0	2.2	2
125.2	+3.4	+3.4	2	+	10	3.0	2.2	2
130.2	+3.4	+3.4	2	+	10	3.0	2.2	2
135.2	+3.4	+3.4	2	+	10	3.0	2.2	2
140.2	+3.4	+3.4	2	+	10	3.0	2.2	2
145.2	+3.4	+3.4	2	+	10	3.0	2.2	2
150.2	+3.4	+3.4	2	+	10	3.0	2.2	2
155.2	+3.4	+3.4	2	+	10	3.0	2.2	2
160.2	+3.4	+3.4	2	+	10	3.0	2.2	2
165.2	+3.4	+3.4	2	+	10	3.0	2.2	2
170.2	+3.4	+3.4	2	+	10	3.0	2.2	2
175.2	+3.4	+3.4	2	+	10	3.0	2.2	2
180.2	+3.4	+3.4	2	+	10	3.0	2.2	2
185.2	+3.4	+3.4	2	+	10	3.0	2.2	2
190.2	+3.4	+3.4	2	+	10	3.0	2.2	2
195.2	+3.4	+3.4	2	+	10	3.0	2.2	2
200.2	+3.4	+3.4	2	+	10	3.0	2.2	2

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1910.2 1910.2 1910.2 1910.2 1910.2 1910.2 1910.2 1910.2 1910.2

MC 650

Moon's Libr.

Residuals

19

	c	b	a	Comp	obs	o-c	v^2
1	- 32	+ 30	- 9	- 11	+ 38	+ 49	2401
2	33	30	0	- 3	+ 31	+ 34	1156
3	32	30	+ 10	+ 8	- 16	- 24	576
4	33	29	13	+ 9	- 71	- 80	6400
5	32	21	33	+ 22	+ 36	+ 14	196
6	33	+ 14	41	+ 22	- 4	- 26	676
7	32	6	46	+ 14	+ 47	+ 33	1089
8	33	- 1	45	+ 11	+ 36	+ 25	625
9	32	- 16	39	- 9	- 52	- 43	1849
10	33	- 21	33	- 21	+ 42	+ 63	3969
11	32	- 28	+ 16	- 44	- 89	- 45	2025

$$\Sigma v = 0 \quad \Sigma av = -4 \quad \Sigma bv = +1$$

$$\Sigma v^2 = 20962$$

Sig of Mean error one value of σ^2

$$2620$$

Mean error " " "

$$\pm 57$$

Probable error " " "

$$\pm 34$$

" " " of σ

$$\pm 8.6$$

" " compensated a

$$\pm 15.5$$

b

$$\pm 8.8$$

c

$$\pm 21.8$$

Hence for Moon's center

$$X = 17.4138 \pm 0.0008$$

P.E. in arc

$$\pm 0".366$$

$$y = 20.9102 \pm 0.0004$$

$$\pm 0".211$$

$$R = 1.9952 \pm 0.0005$$

$$\pm 0.25'$$

Probable error of one measure

$$\pm 0".40$$

Largest Residual

$$0".93$$

See p 21 for corrected values

MC 650

20

Correction of Moon's Center resulting from
refraction corrections to Moon's limb

	Δn	$+ 50(x-x_0)$	Sum	Sum - 120	Corp	OC-C
1	+ 115	- 29	+ 94	- 26	+ 4	- 30
2	+ 120	0	120	0	+ 2	- 2
3	+ 114	+ 21	135	+ 15	- 0	+ 15
4	+ 110	+ 29	139	+ 19	- 2	+ 21
5	+ 60	+ 71	131	+ 11	- 4	+ 15
6	+ 25	+ 89	114	- 6	- 6	0
7	0	+ 100	100	- 20	- 4	- 16
8	0	+ 100	100	- 20	- 5	- 15
9	+ 35	+ 84	119	- 1	+ 1	- 2
10	+ 60	+ 71	131	+ 11	+ 3	+ 8
11	+ 104	+ 35	139	+ 19	+ 8	+ 17

The effect of these corrections may evidently
be closely represented by $a = +50$, $c = +120$
with the outstanding residuals above
these last give the normals

$$-11.59 \Delta a - 5.70 \Delta b + 11.00 \Delta c = +2$$

$$-0.55 \Delta a + 24.76 \Delta b - 5.70 \Delta c = +23$$

$$+19.09 \Delta a - 0.53 \Delta b + 11.59 \Delta c = +23$$

whence

$$-6.55 \Delta a + 21.80 \Delta b = +24$$

$$+6.90 \Delta a - 6.55 \Delta b = +25$$

$$4.94 \Delta a = +32$$

$$15.59 \Delta b = +48$$

$$\Delta a = +6.5 \quad \Delta b = +3.1 \quad \Delta c = +58.5$$

$$a = +56.5 \quad b = +3.1 \quad c = +128.5$$

MC. 620

Conversion of Mars's Color index to Mars's index

ΔM	$-10(1-x)$	$2m$	$2m - 100$	$2m - 100$	$2m - 100$
1	+ 11.7	- 8.8	+ 8.8	- 2.6	- 2.6
2	+ 12.0	0	0	0	0
3	+ 12.4	+ 2.1	+ 12.1	+ 12.1	+ 12.1
4	+ 12.8	+ 4.2	+ 12.2	+ 12.2	+ 12.2
5	+ 13.2	+ 6.3	+ 12.3	+ 12.3	+ 12.3
6	+ 13.6	+ 8.4	+ 12.4	+ 12.4	+ 12.4
7	+ 14.0	+ 10.5	+ 12.5	+ 12.5	+ 12.5
8	+ 14.4	+ 12.6	+ 12.6	+ 12.6	+ 12.6
9	+ 14.8	+ 14.7	+ 12.7	+ 12.7	+ 12.7
10	+ 15.2	+ 16.8	+ 12.8	+ 12.8	+ 12.8
11	+ 15.6	+ 18.9	+ 12.9	+ 12.9	+ 12.9
12	+ 16.0	+ 21.0	+ 13.0	+ 13.0	+ 13.0
13	+ 16.4	+ 23.1	+ 13.1	+ 13.1	+ 13.1
14	+ 16.8	+ 25.2	+ 13.2	+ 13.2	+ 13.2
15	+ 17.2	+ 27.3	+ 13.3	+ 13.3	+ 13.3
16	+ 17.6	+ 29.4	+ 13.4	+ 13.4	+ 13.4
17	+ 18.0	+ 31.5	+ 13.5	+ 13.5	+ 13.5
18	+ 18.4	+ 33.6	+ 13.6	+ 13.6	+ 13.6
19	+ 18.8	+ 35.7	+ 13.7	+ 13.7	+ 13.7
20	+ 19.2	+ 37.8	+ 13.8	+ 13.8	+ 13.8

The effect of these conversion may be seen in the following table. The standard reference is $a = +20$, $b = +100$.

There have been two conversions above.

$-11.00 \Delta a - 2.70 \Delta b + 11.00 \Delta c = +2$

$-0.20 \Delta a + 2.40 \Delta b - 2.70 \Delta c = +2.3$

$+10.00 \Delta a - 0.20 \Delta b - 11.00 \Delta c = +2.3$

$-0.20 \Delta a - 2.70 \Delta b = +2.3$

$+10.00 \Delta a - 0.20 \Delta b = +2.3$

$+10.00 \Delta a = +2.3$

$+10.00 \Delta a = +2.3$

$\Delta a = +0.2$

$\Delta b = +2.1$

$\Delta c = +12.8$

MC 650

20

Correction of Moon's Center resulting from refraction corrections to Moon's limb

	Δn	$+ 50(x-x_0)$	Sum	Sum - 120	Corp	O-C
1	+ 115	- 79	+ 94	- 26	+ 4	- 30
2	+ 120	0	120	0	+ 2	- 2
3	+ 114	+ 21	135	+ 15	- 0	+ 15
4	+ 110	+ 29	139	+ 19	- 2	+ 21
5	+ 60	+ 71	131	+ 11	- 4	+ 15
6	+ 25	+ 89	114	- 6	- 6	0
7	0	+ 100	100	- 20	- 4	- 16
8	0	+ 100	100	- 20	- 5	- 15
9	+ 35	+ 84	119	- 1	+ 4	- 2
10	+ 60	+ 77	131	+ 11	+ 2	+ 6
11	+ 104	+ 35	139	+ 19	+ 8	+ 17

The effect of these corrections may succinctly be closely represented by $a = +50$, $c = +120$ with the outstanding residuals above these last give the normals

$$-11.59 \Delta a - 5.70 \Delta b + 11.00 \Delta c = +2$$

$$-0.55 \Delta a + 24.76 \Delta b - 5.70 \Delta c = +23$$

$$+19.09 \Delta a - 0.53 \Delta b + 11.59 \Delta c = +23$$

whence

$$-6.55 \Delta a + 21.80 \Delta b = +24$$

$$+69.1 \Delta a - 6.55 \Delta b = +25$$

$$4.94 \Delta a = +32$$

$$15.59 \Delta b = +48$$

$$\Delta a = +6.5 \quad \Delta b = +3.1 \quad \Delta c = +8.5$$

$$a = +56.5 \quad b = +3.1 \quad c = +128.5$$

MC 650 New Residuals
(Sum of old residuals & correction residuals)

		v	v^2
1	+ 8	+ 19	361
2	+ 11	+ 32	1024
3	+ 11	- 9	81
4	- 50	- 59	3481
5		+ 29	841
6		- 26	676
7		+ 17	289
8		+ 10	100
9		- 45	2025
10		+ 71	5041
11		- 34	1156
			<hr/>
			15095

$$\Sigma^2 = 1887$$

Probable error one value	$\Sigma^2 \pm 29.2$
" " " "	$\Sigma \pm 7.3$
" " of a	± 13.1
	b ± 7.4
	c ± 18.4

$$X = 17^h. 4166 \pm 0^s. 0007 \quad \text{P.e. max} \quad \pm 0''. 30$$

$$y = 20. 9104 \pm 0. 0004 \quad \pm 0''. 17$$

$$z = 1. 9984 \pm 0. 0004 \quad \pm 0''. 21$$

$$\text{P.e. one observation} \quad \pm 0''. 33$$

$$\text{Largest Residual} \quad 0''. 82$$

See p 26 for final values

10

11

Sum of the residuals of the observations

10.5	11	+	1
10.01	12	+	2
12	13	-	3
13.43	14	-	4
14.1	15	+	5
15.0	16	-	6
15.9	17	+	7
16.0	18	+	8
16.0	19	-	9
17.0	20	+	10
17.1	21	+	11
17.2	22	-	12

18090

1887

= 3

Probable error of the observations

± 7.5

± 18.1

± 7.5

± 12.4

Probable error

$X = 17.416 \pm 0.0007$

$Y = 11.04 \pm 0.0004$

$Z = 10.00 \pm 0.0004$

$W = 10.00 \pm 0.0004$

$V = 10.00 \pm 0.0004$

$U = 10.00 \pm 0.0004$

MC 650 New Residuals

Sum of old residuals & correction residuals

		V	V ²
1	+	+ 19	361
2	+	+ 32	1024
3	-	- 9	81
4	-	- 59	3481
5		+ 29	841
6		- 26	676
7		+ 17	289
8		+ 10	100
9		- 45	2025
10		+ 71	5041
11		- 34	1156
		-134	15095

$$\Sigma^2 = 1887$$

Probable error one value	± 29.2
" " "	± 7.3
" " of a	± 13.1
	b
	± 7.4
	c
	± 18.4

$$X = 17^h. 4166 \pm 0^s. 0007 \quad \text{P. e. one} \quad \pm 0^s. 30$$

$$y = 20. 9104 \pm 0. 0004 \quad \pm 0^s. 17$$

$$z = 1. 9984 \pm 0. 0004 \quad \pm 0^s. 21$$

$$\text{P. e. one observation} \quad \pm 0^s. 33$$

$$\text{Largest Residual} \quad 0^s. 82$$

See p 26.

10.1	1.1	+
10.2	1.2	+
10.3	1.3	-
10.4	1.4	-
10.5	1.5	+
10.6	1.6	-
10.7	1.7	+
10.8	1.8	+
10.9	1.9	-
11.0	2.0	+
11.1	2.1	+
11.2	2.2	-
11.3	2.3	-
11.4	2.4	-
11.5	2.5	-
11.6	2.6	-
11.7	2.7	-
11.8	2.8	-
11.9	2.9	-
12.0	3.0	-

1887

E

10.1	1.1	+
10.2	1.2	+
10.3	1.3	-
10.4	1.4	-
10.5	1.5	+
10.6	1.6	-
10.7	1.7	+
10.8	1.8	+
10.9	1.9	-
11.0	2.0	+
11.1	2.1	+
11.2	2.2	-
11.3	2.3	-
11.4	2.4	-
11.5	2.5	-
11.6	2.6	-
11.7	2.7	-
11.8	2.8	-
11.9	2.9	-
12.0	3.0	-

10.1	1.1	+
10.2	1.2	+
10.3	1.3	-
10.4	1.4	-
10.5	1.5	+
10.6	1.6	-
10.7	1.7	+
10.8	1.8	+
10.9	1.9	-
11.0	2.0	+
11.1	2.1	+
11.2	2.2	-
11.3	2.3	-
11.4	2.4	-
11.5	2.5	-
11.6	2.6	-
11.7	2.7	-
11.8	2.8	-
11.9	2.9	-
12.0	3.0	-

MC 650

R.A. & Dec of Moon Center ²²

$$x = 17.4166$$

$$y = 20.9104$$

$$\begin{array}{rcl} -ax & + & 535 \\ -by & - & 489 \\ -cx & + & 46 \end{array}$$

$$\begin{array}{rcl} -ay & + & 480 \\ -cy & + & 1081 \\ -f & - & 1529 \end{array}$$

$$1845 = 17.4186$$

$$2247 = 20.9086$$

$$S - S_1 = 0.5814$$

$$\eta_1 = -1.0914$$

$$\Delta S = 0$$

$$-\eta_2 = +2$$

$$\begin{array}{lcl} \log S_1 & 9.76448 & \mu \\ \text{const} & 1.49136 & \\ \sec \delta & 0.04130 & \end{array}$$

$$\begin{array}{lcl} \eta_1 & -1.0913 & \\ \log \eta_1 & 0.03794 & \mu \\ \text{const} & 2.66745 & \end{array}$$

$$\log(x-A)^2 = 1.29714 \mu$$

$$\log(\delta - \delta') = 2.70539 \mu$$

$$\log(\alpha - A)^2 = -79^{\circ} 825'$$

$$\delta - \delta' = 507'' 40'$$

$$\begin{array}{lcl} \log S^2 & 9.5289 & \\ \log \delta & 9.6604 & \mu \\ \text{const} & 7.0520 & \end{array}$$

$$\log \eta_2 = 6.2413 \mu$$

$$A = 20^{\circ} 37' 25.00''$$

$$D = 24^{\circ} 29' 15.00''$$

$$\alpha - A = -19.83$$

$$\delta - D = 8 27.5$$

$$\alpha = 20 37 5.17$$

$$\delta = 24 37 42.5$$

These are positions for 1900.0

$$104 \mu \text{ parallax} = 35.46$$

$$+ 2 8.4$$

$$1910.0 \quad 20 \quad 37 \quad 40.63$$

$$- 24 \quad 35 \quad 35.4$$

MC 650

R.A. & Dec of Moon Center

$$X = 17.4166 \quad Y = 20.9104$$

$$\begin{array}{rcl} -dx & + & 535 \\ -dy & - & +39 \\ -dz & + & 46 \end{array} \quad \begin{array}{rcl} -dx & + & 480 \\ -dy & + & 1031 \\ -dz & - & 1529 \end{array}$$

$$1815 = 17.4156 \quad 2217 = 20.9086$$

$$S_{12} = -0.5814 \quad \eta_{12} = -1.0915$$

$$\Delta S = 0 \quad -\eta_2 = +2$$

$$\log S_1 = 9.76448 \quad \eta_1 = -1.0912$$

$$\text{const} = 1.49136$$

$$\log S = 0.04130$$

$$\log \eta_1 = 0.03794$$

$$\text{const} = 2.66745$$

$$\log(\alpha - A) = 1.29714$$

$$\log(\delta - D) = 2.70539$$

$$\log(\alpha - A) = -79.825$$

$$\delta - D = 507.45$$

$$\log S = 9.5289$$

$$\log S = 9.6604$$

$$\text{const} = 7.0520$$

$$\log \eta_2 = 6.2413$$

$$A = 20^\circ 37' 25.00''$$

$$D = 24^\circ 29' 10.00''$$

$$\delta - A = -19.83$$

$$\delta - D = 8.27.5$$

$$\alpha = 20 37 5.17$$

$$\delta = 24 37 42.5$$

These are positions for 1900. g. 1

$$\log \mu_{\text{proper}} = 35.47$$

$$+ 2.7.1$$

$$1900 = 20 37 40.64$$

$$- 24 35 35.4$$

14 C 650

23

Reduction of Moon to apparent place

1910 October 12

α	309	25		309	25
G	328.0	4.1	H	69.0	26.0
G+d	277	29	H+d	18.0	51.1

	0.73486		0.82850
$\tan \delta$	9.66058	$\sec \delta$	0.04130
$\sin G$	9.99629	$\sin H+d$	9.50933
$\cos G$	1.07729	$\cos H+d$	1.27787
$\cos G+d$	9.11474	$\cos H+d$	9.97606
	0.19203	$\sin \delta$	9.64925
			0.87318

$f + d^s$	537	$g \cos G+d$	+ 1.56
$\frac{1}{15} g \cos G+d$	+ 0.360	$h \cos (H+d) \sin \delta$	+ 7.47
$h \sin$	+ 0.449	$\cos \delta$	+ 7.00
Red.	+ 2.346	Red	+ 1.03

Hence moons apparent place is

 α 20^h 37^m 42^s.98 δ -24° 35' 34".3

Geocentric place Observed

 α 20^h 38^m 22^s.50 δ -23° 44' 6".2

Computed Parallax

+ 39°.52

+ 51' 27".9

From Ann. 15 ph. for date.

21°.90 + 0°.60

10".4 + 4".2

Sept 27

25

M. C. 1910

Observations of the apparent place of

1910 October 19

24 188 20 200 0
 0 20 20 20 20 20
 1 2 3 4 5 6 7 8 9 10 11 12

0.28280 0.28280 0.28280 0.28280 0.28280
 0.28280 0.28280 0.28280 0.28280 0.28280
 0.28280 0.28280 0.28280 0.28280 0.28280
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20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20

These were apparent place of
 computed from the observations

20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20
 20 20 20 20 20 20 20 20 20 20 20 20

1910 C 6.0

23

Reduction of Moon to apparent place.

1910 October 12

α	309	25		309	25
G	328°	4'.1	H	61°	26' 0
G+L	277	29	H+L	18°	51'

	0.73486		0.82850
tan δ	9.66128 m	sec δ	0.04730
sin $G+L$	9.99629 m	sin $H+L$	9.50933
$\cos G$	1.07729	$\cos H$	1.27727
$\cos G+L$	9.11474	$\cos H+L$	9.97606
	0.19203	$\tan \delta$	9.64925
			0.87328

f	+ 1° 537	$q \cos G+L$	+ 1.56
$\frac{1}{2} q \sin G+L$	+ 0.362	$h \cos G+L$	+ 7.36
$h \sin G+L$	+ 0.449	$\cos \delta$	+ 7.00
Red.	+ 2° 34.6	Red.	+ 1° 20

Hence - Moon's apparent place is

 α 20^h 37^m 42^s.98Computed Parallax
+ 39° 53 δ -24° 35' 34".2

+ 51' 27".4

Geocentric place Observed

From the Eph. for date.

 α 20^h 38^m 22^s.50

27°.90 + 0°.60

 δ -23° 44' 6".3

10".4 + 4".1

Sep 27

MC 657

Corrections

24

I. The plate so far discussed is MC 657

II. to p 3. Secular variation in δ with wrong sign
 Standard Declinations of stars 3 & 4 need correction by $+1''.23$
 or standard coordinates η by $+0^h.0027$

This introduces corrections to $\eta - \eta$ of -27 units
 of the 4th place for these two stars

Hence. (see p 11) the corrections to the plate constants
 are given by

$$9.45 \Delta d - 1.20 \Delta R = 0$$

$$1.89 \Delta d + 12.78 \Delta R = -14$$

$$\Delta d = -0.07 \quad \Delta R = -0.054 \quad \Delta f = +16$$

Changes in residuals

*	1	2	3	4	5	6
$\Delta \alpha$	-1	-2	-2	-3	-3	-3
$\Delta \delta$	-15	-20	-31	-28	-26	-13
Δc	+18	+16	+18	+16	+16	+16
Δ	+0	-10	-18	-15	-13	+0
$\Delta \eta$	0	0	-27	-27	0	0
$\Delta(\eta - c)$	0	+11	-10	-12	+13	0

Corrected $(\eta - c)$ see pp 12 and
 Plate 657

	-13	-6	+16	-20	+15	+14
Plate 650	-4	-14	+16	-22	+20	+4
657-650	-9	+8	0	+2	-3	+10

Covariance

MC 207

I. The table is for covariance in MC 207

II. Top 2. Section variance is 2 with covariance
 Determination of above 2 & 4 with variance of 1.25
 or 4.25 with covariance of 1.25
 This indicates covariance to 2-2 with
 after 4.25 for these two above
 Hence (see p 11) the covariance for the table is 1.25
 are now

$$\begin{aligned} 0.40 - 0.14 \Delta - 1.04 \Delta + 1.25 \Delta &= 0 \\ 1.04 - 0.40 \Delta - 1.25 \Delta + 1.25 \Delta &= 0 \\ \Delta &= 0.14 \end{aligned}$$

Changes in regression

	1	2	3	4	5
0.40	-	-	-	-	-
0.14	-	-	-	-	-
1.04	-	-	-	-	-
1.25	-	-	-	-	-
0.40	-	-	-	-	-
0.14	-	-	-	-	-
1.04	-	-	-	-	-
1.25	-	-	-	-	-
0.40	-	-	-	-	-
0.14	-	-	-	-	-
1.04	-	-	-	-	-
1.25	-	-	-	-	-

Covariance (2-2) is 1.25
 and

$$\begin{aligned} 1.25 - 0.40 \Delta - 1.04 \Delta + 1.25 \Delta &= 0 \\ 1.04 - 0.40 \Delta - 1.25 \Delta + 1.25 \Delta &= 0 \\ \Delta &= 0.14 \end{aligned}$$

MC 657

Corrections

24

I. The plate so far discussed is MC 657

II. to p 3. Secular variation in δ with wrong sign
 Standard Deviations of stars 3 & 4 need correction by $+1''.23$
 or standard coordinates η by $+0^h.0027$

This introduces corrections to $\eta - \eta$ of -27 units
 of the H^u plate for these two stars

Hence, (see p 11) the corrections to the plate constants
 are given by

$$9.45 \Delta d - 1.20 \Delta R = 0$$

$$1.89 \Delta d + 12.78 \Delta R = -14$$

$$\Delta d = -0.07 \quad \Delta c = -0.04 \quad \Delta t = +14$$

Changes in residuals

*	1	2	3	4	5	6
Δa	-1	-2	-2	-3	-3	-3
Δb	-10	-25	-21	-28	-26	-13
Δc	+18	+16	+18	6	+18	+10
Δ	+0	-10	-17	-15	-13	+0
cm	0	0	-27	-27	0	0
(0-6)	0	+11	-10	-12	+13	0

Corrected (P-C) see pp 12 and
 Plate 657

	-13	-6	+16	-20	+19	+14
Plate 650	-4	-14	+16	-22	+20	+4
657-650	-9	+8	0	+2	-3	+10

Corrections

25

Hence for corrected y's

mean-square difference.	65-0 - 50	$\pm 0^R.0021$
	65-0 - 50	± 0.00213
	650 - 651	± 0.00092

Same for x's

	65-1 - 50	± 0.00125
	650 - 50	± 0.00130
	650 - 651	± 0.00026

Probable mean errors both coordinates together

Comparison of plate & star plate $\pm 0^R.0012 = \pm 0''.55$

Comparison of two plates $\pm 0.0005 = \pm 0''.23$

Probable error of determination of position
corresponding to a given residual reading near Moon
($\frac{1}{16}$ of above) in Dec $\pm 0^R.00058 = \pm 0''.27$
R.A. $\pm 0.00036 = \pm 0''.16$

Correction to be applied to Moon's coordinates
for change of plate constants

$$\begin{aligned} \text{in } 65-1 \text{ at } &+ 2.5 \\ &+ 21.5 \\ &- 16 \end{aligned}$$

PL-600

$$\text{con } + 7 = + 0''.32$$

Reactions

It is for the purpose of

mean values of the following reactions
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}

It is for the purpose of

6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}

It is for the purpose of

mean values of the following reactions
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}

It is for the purpose of

mean values of the following reactions
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}

It is for the purpose of

6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}
 6.1×10^{-10} 6.1×10^{-10}

It is for the purpose of

Corrections

25-

Hence, for corrections y's

mean-square difference	650 - 55	$\pm 0^R.0021$
	650 - 55	± 0.00212
	650 - 651	± 0.00092

Same for x's

	651 - 55	± 0.00125
	650 - 55	± 0.0013
	650 - 651	± 0.00026

Mean ^{Probable} errors both coordinates together

Comparison of plate & star plate Probable Error
 $\pm 0^R.0012 = \pm 0''.53$

Comparison of two plates $\pm 0.0005 = \pm 0''.23$

Probable error of determination of position
 corresponding to a given residual reading, near mean
 ($\frac{1}{6}$ of above) $\Delta \alpha \pm 0^R.00058 = \pm 0''.27$
 $\Delta \delta \pm 0.00035 = \pm 0''.16$

Correction to be applied to Moon's
 coordinates for change of plate constants

Δx	+2.0
Δy	+21.5
Δz	-16

So $\pm 0^R.0007 = \pm 0''.32$

Corrections

26

MC 657

Moon's Center Residual of Equ. 11 should be
-189 instead of -89

modified normals

$$\begin{aligned}
 19.09 \Delta a - 0.55 \Delta b - 11.59 \Delta c &= +70 \\
 -0.55 &+ 24.76 &- 5.70 &= -186 \\
 -11.59 &- 5.70 &+ 11.00 &= +100 \\
 +6.90 \Delta a - 6.53 \Delta b &= +36 \\
 -6.63 &+ 21.80 &= +238 \\
 +4.94 \Delta a &= -108 \\
 +15.59 \Delta b &= -272
 \end{aligned}$$

$$\Delta a = -22.0 \quad \Delta b = -17.5 \quad \Delta c = -45.5$$

Changes in Residuals.

	1	2	3	4	5	6	7	8	9	10	11
a - f	0	+9	+12	+32	+39	+44	+44	+37	+31	+15	
b + 38	+38	+34	+33	+25	+17	+0	-2	-18	-25	-33	
c - 45	-45	-46	-46	-45	-46	-45	-46	-45	-46	-46	
Δm	-19	-11	-2	-1	+12	+10	-1	-4	-27	-40	-64
old n	+19	+32	-9	-59	+29	-26	+17	+10	-45	+71	-134

Correction to be applied to Moon's coordinates

new

$$\begin{aligned}
 \Delta a &+ 38 &+ 43 &- 2 &- 55 &+ 17 &- 36 &+ 18 &+ 14 &- 18 &+ 11 &- 70 \\
 \Delta b &+ 38 &+ 43 &- 2 &- 55 &+ 17 &- 36 &+ 18 &+ 14 &- 18 &+ 11 &- 70 \\
 \Delta c &- 45 &- 46 &- 46 &- 45 &- 46 &- 45 &- 46 &- 45 &- 46 &- 46 &- 46
 \end{aligned}$$

Σv^2

$$1444 + 324$$

$$1849 + 296$$

$$449 - 324$$

$$3364 - 12321$$

$$289 + 4900$$

$$1296 + 0.32$$

$$8291$$

$$26356$$

$$\text{Mean error of } n^2 = \pm 57.1$$

$$\text{Probable } n^2 = \pm 38.6 = 3$$

$$n = \pm 9.6 = \pm 0.45$$

$$a = \pm 17.5 \pm 0.82$$

$$b = \pm 9.8 \pm 0.46$$

$$c = \pm 24.5 \pm 1.16$$

1910phae p.001

1910phae p.001

1910phae p.001

1910phae p.001

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1910phae p.001

1910phae p.001

Corrections

26

MIC 657

Moon's Center Residual of Ears 11 had the
-189 instead of -89

modified normals

$$\begin{aligned} 19.0732 - 0.55 \Delta b &= 11.59 \Delta c = +70 \\ -0.55 &+ 24.76 &= 5.70 &= -186 \\ -11.59 &- 5.70 &+ 11.90 &= -100 \\ +6.90 \Delta a &+ 6.55 \Delta b &= +136 \\ -6.55 &+ 21.80 &= +238 \end{aligned}$$

$$+4.94 \Delta a = -108$$

$$+15.59 \Delta b = -272$$

$$\Delta a = -22.0 \quad \Delta b = -17.5 \quad \Delta c = -45.5$$

Changes in Residuals

a	-8	0	+9	+12	+22	+39	+44	+44	+37	+31	+15
b	+34	+35	+34	+33	+25	+17	+0	-2	-16	-25	-33
c	-45	-46	-45	-46	-45	-46	-45	-46	-45	-46	-46
Δa	-19	-11	-2	-1	+12	+10	-1	-4	-27	-40	-64
old Δa	+19	+32	-9	-59	+29	-20	+17	+10	-45	-71	-134
new											
O-C	+38	+43	-7	-55	+17	-36	+18	+17	-16	+11	-70

Σv^2

1444	324
1849	296
49	324
3204	12321
289	4900
1296	18065
8291	8291
	26356

Mean error of one $\sigma = \pm 57.1$

Probable " " $\sigma^2 = \pm 38.6 = \pm$

$\sigma = \pm 9.6 = \pm 0.45$

a $\pm 17.5 \pm 0.82$

b $\pm 9.8 \pm 0.46$

c $\pm 24.5 \pm 1.16$

Continued

1910

Observations of the 1910 Phaenomenon

1910

Observations of the 1910 Phaenomenon

1910

Observations of the 1910 Phaenomenon

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Observations of the 1910 Phaenomenon

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Observations of the 1910 Phaenomenon

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Observations of the 1910 Phaenomenon

1910

Observations of the 1910 Phaenomenon

Corrections

27

MC 657

Hence we have

$$\Delta x_0 = \frac{1}{2}a = -0^R.0011 = -0''57 = -0^S.037$$

$$\Delta y_0 = \frac{1}{2}b = -0^R.0009 = -0''41 + 0''32 (p. 25)$$

$$\Delta z_0 = \frac{1}{4}c = -0^R.0011 = -0''53$$

$$\text{Probable error of } x_0 = 0^R.0009 = \pm 0''41$$

$$\text{of } y_0 = 0^R.0005 = \pm 0''23$$

$$\text{of } z_0 = 0^R.0006 = \pm 0''29$$

$$\text{Moon's Radius} = 1.9973^R = 931''.8 \quad 0-c + 0''.3$$

Apparent of Moon's Center. 1900.0

$$20^h 37^m 51.13^s - 24^\circ 37' 42''.6$$

$$\text{Precession} \quad + 35.46 \quad + \quad 2 \quad 7.1$$

$$\text{Red. and app} \quad + 2.35 \quad + \quad 1.1$$

$$\text{Apparent} \quad 20^h 37^m 42.594^s - 24^\circ 35' 34.4''$$

$$\text{Parallax} \quad + 39.57 \quad + \quad 57 \quad 27.2$$

$$\text{Geocentric Place} \quad 20^h 38^m 22.45^s - 23^\circ 44' 7''.2$$

$$\text{Am. E/pla} \quad 21.90 \quad 44 \quad 10.4$$

$$0-c \quad + 0^S.55 \quad + 3''.7$$

which are the Final values

Radius. South end Hawaiian 925''.4
 Augmentation + 6''.1

Apparent Radius
 931''.5

Conclusion

MC 601

From our data

$$\Delta \alpha = 0.0011 - 0.0011 = 0.0000$$

$$\Delta \delta = 0.0000 - 0.0000 = 0.0000$$

$$\Delta \alpha = 0.0011 - 0.0011 = 0.0000$$

$$\Delta \delta = 0.0000 - 0.0000 = 0.0000$$

$$\Delta \alpha = 0.0000 - 0.0000 = 0.0000$$

$$\Delta \delta = 0.0000 - 0.0000 = 0.0000$$

$$\Delta \alpha = 0.0011 - 0.0011 = 0.0000$$

$$\Delta \delta = 0.0000 - 0.0000 = 0.0000$$

$$\Delta \alpha = 0.0011 - 0.0011 = 0.0000$$

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$$\Delta \alpha = 0.0011 - 0.0011 = 0.0000$$

$$\Delta \delta = 0.0000 - 0.0000 = 0.0000$$

$$\Delta \alpha = 0.0011 - 0.0011 = 0.0000$$

$$\Delta \delta = 0.0000 - 0.0000 = 0.0000$$

MC 657

Corrections

27

Hence we have

$$\Delta x_0 = \frac{1}{2}a = -0^R.0011 = -0''57 = -0^S.037$$

$$\Delta y_0 = \frac{1}{2}b = -0^R.0009 = -0''41 \text{ } 40''32 \text{ (p. 25)}$$

$$\Delta z_0 = \frac{1}{2}c = -0^R.0011 = -0''53$$

$$\text{Probable error of } x, \pm 0^R.0009 = \pm 0''41$$

$$\text{of } y, 0^R.0005 = \pm 0''23$$

$$\text{of } z, 0^R.0006 = \pm 0''29$$

$$\text{Moon's Radius} = 1.9973^R = 931''.8$$

Apparent of Moon's Center. 1900.0

$$20^h \quad 37^m \quad 5^s.13 \quad - \quad 24^\circ \quad 37' \quad 42''.6$$

$$\text{Refraction} \quad + \quad 35''.46 \quad + \quad 2 \quad 7.1$$

$$\text{Red. and L. app} \quad + \quad 2 \quad 35 \quad + \quad 1.1$$

$$\text{Apparent} \quad 20^h \quad 37^m \quad 42^s.54 \quad - \quad 24^\circ \quad 35' \quad 34.4$$

$$\text{Parallax} \quad + \quad 37 \quad 52 \quad + \quad 57 \quad 27.9$$

$$\text{Geocentric Place} \quad 20^h \quad 38^m \quad 22.46 \quad - \quad 23 \quad 44' \quad 6''.5$$

$$\text{Am. Eph} \quad 21.90 \quad 44 \quad 10.4$$

$$\text{S-C} \quad +0^S.56 \quad +3''.9$$

which are the Final values

Radius. Horizontal Meridian $925''.4$
 Augmentation $= 6''.1$

Apparent Radius

931''.5

58

Plate No 650

M. 410 Nov 23 24

Star

y

K

d

n

d

n

27.20	12355	1330	12493	5462
	9430	4070	11435	7500
	20	30	30	30
	17	15	510	10
	27.67	27.35	27.2058	2042

2	12000	2329	12069	4116
	11076	3821	12167	4490
25.20	52	16	7078	78
25.20	41	12	12	20
	1456	1459	23.0382	0376

3	12207	1372	12523	3920
20	10120	3649	476149	15702
	18	50	5349	10
	11	52	48	16
	2089	2085	20.8789	5779

4	12005	11040	13000	2030
16	4730	9074	5200	10007
17	51	20	43	64
	11048			
	8500	8445	16.7800	7777

Plate MC 650

M1910 Nov 23 29

Star	y		x	
1	d	n	d	n
27.30	12585 9833 34 89	1330 4071 70 15	13443 11435 36 39 510	5462 7502 10 60 62
	2752	2735	27. 2058	2042
2	12040 11086	2359 3821	12059 12167	4116 4490
23 20	82	16	8078	93
End 4219	41	13	72	20
	1456	1459	23. 0382	0376
3	12207	1572	13033	3925
20 15	10120	3649	4761 69	12702
	18	59 52	53 49	18 12
	11	52	48	36
	2089	2085	20. 8789	8779
4	12885	11048	13022	3070
16 17	4386	9572	5242	10869
faint	91	20 18	36 38	30
	89	11048	43	40
	8500	8495	16. 7800	7777

Plate MC 655.

M1910 Nov. 23

24

Star

y

x

	d	n	d	n
27. 50	12585 933 34 89	1330 4076 70 15	13443 11435 36 510	55462 7502 7060 62
	2752	2735	27. 2058	2042
2	12040 11086	2319 3821	12659 12167	4116 4490
23 20	82 41	16 13 50	8078 72	73 20
	1456	1459	23. 0382	0376
3	12207	1572	13533	3925
20	15 10120 18 11	3649 52 52	476169 5249 48	12702 18 36
	2089	2085	20. 8789	8779
4	12885	11042	13022	3070
16 17	4386 91 89	9372 20 18	5242 3238 43	10869 25 45 64
faint	8500	8495	16. 7800	7772

MO 650

30
M. 1910 Nov 23

Star	5	d	y	z	x	n
12. 31	11590	14790			12325	1157
	3565	6314			10340	9610
Bright	70 68	15 12			88	10
ford	603	78			30	50
6	8032	8014			82. 8466	8459
	11280	1789			12082	2225
12 19	3212	11065			10155	2931
	10	58 61			45 40	29
	902	80			2602	18
	9288	9280			12. 1941	1923

Fainter images elongated slightly in x

Means

Star	x	$x' = 35.5 - x$	$x' - \bar{x}$	-
1	27. 2050	8. 2950	-	965
2	23. 0379	12. 4621	+	496
3	29. 8784	15. 6216	+	1992
4	16. 7788	18. 7212	+	682
6	12. 1932	23. 3068	+	205
5	82. 8462	22. 6538	-	1619
	y	45.0 - y	y - 7	
1	30. 2742	14. 7258	+	2818
2	20. 1458	24. 8542	+	1642
3	15. 2087	29. 7913	+	951
4	17. 8498	27. 1502	+	548
6	19. 9284	25. 0716	-	66
5	31. 8023	13. 1977	+	610

M 110 550

M 1910 1905

Star	α	δ	α	δ	α	δ
12. 31	115190	14790	12325	1157		
	7565	6314	1034	9610		
Bright	70.64	10.12	38	10		
Good	603	78	300	50		
6	8032	8014	62. 8466	8459		
	11280	1789	12062	2225		
12. 19	3212	11045	10133	2931		
	10	58	45.11	29		
	902	80	2102	18		
	9288	9280	12. 1941	1923		

Fainter images elongated slightly in X

Means

tau	X	$X' = 35.5 - X$	$X' - E$	-
1	27. 2050	8. 2950	-	965
2	23. 0379	12. 4621	+	496
3	29. 8784	15. 6216	+	1992
4	16. 7788	18. 7212	+	682
6	12. 1932	23. 3068	+	205
5	82. 8462	22. 6538	-	1619
	γ	45.0 - γ	$\gamma - \eta$	
1	30. 2742	14. 7258	+	2818
2	20. 1458	24. 8542	+	1642
3	15. 2087	29. 7913	+	951
4	17. 8498	27. 1502	+	548
6	19. 9284	25. 0716	-	66
6	31. 8023	13. 1977	+	610

MC 650

Moon limb

Mean 1910 Nov 23

	d	h	d	h
Scotch				
near pole	12 100	23 26	119 50	14 40
18. 26	105 75	38 54 68	95 17	38 69
	75 62	82 70	08 12	20 70
	12	16	60	40
	26. 15 32	15 55	24 40	24 31
y = 26		120 62	120 78	32 40
x = 19 +		65 10	65 35	87 1
		40 20	00 20	52
Oblique		58	79	28
		19. 55 38	55 60	55 13
y = 25			124 78	35 27
x = 20 +			73 30 10	86 90
			06 25	82 20
			78	30
y = 23		20.	125 7 60	51 56
x = 20 +			124 30	28 67
			97 47 58	52 60
			40 42	67 53
			47	62
Scotch		20.	26 87	26 94
near pole				
19. 22	112 71	21 70	130 35	23 00
	8106	53 18	100 41	53 08
	098 06	12	38 39	07
	62	67	47	29 2
	22. 31 65	31 46	19. 30 00	30 40

M.C. 650

Mean time

Mean 1910 Nov 3

Search	d	y	n	d	x	n
mean pole	12 100		23 26	119 50		14 40
15. 26	10 57 5		3 54 68	95 17		38 69
	75 62		5 70	08 12		20 75
	12		15	60		40
	26. 15 32		15 55	24 40		24 31
y = 26			120 62	120 78		32 40
x = 19 +			65 10	65 35		8 75 1
			40 20	20 20		52
Oblique			58	79		38
			19. 55 38	55 60		55 13
4 = 25				124 78		35 27
x = 20 +				73 30 10		86 80 80
				08 25		52
				78		30
y = 23			20.	125 7 60		51 56
x = 20 +				124 30		25 87
				97 47 58		52 60
				40 42		67 53
				47		62
Scold			20.	26 87		26 94
mean pole	112 71		21 70	130 35		23 00
19. 22	8106		5318	100 41		5 20 8
	098 06		12	35 39		07
	62		67	47		29 2
	22. 31 65		31 46	19. 30 00		30 40

MC 650 Plate Constants

Compare p 11

Equations of form $x - S = a + by + cz$ $x - S$ $y - T$

12.11	a	+	22.95	b	+	c	=	+	241	+	1804
21.56	a	+	21.75	b	+	c	=	-	244	+	364
15.58	a	+	13.83	b	+	c	=	+	1292	+	1714
17.47	a	+	26.61	b	+	c	=	+	1644	+	769

9.45	a	-	1.20	b	=	-	485	-	1440
1.89	a	+	12.78	b	=	+	1936	-	945
-1.89		+	0.24		=	+	97	+	288
			13.02	b	=	+	2033	-	657
9.45	a	=			-	298	-	1507	

$$a = -31.6 \quad b = +156.1 \quad d = -158.9 \quad c = -50.4$$

c =	+	241	-	1292	+	1644	+	1804	+	364
	+	383	+	492	+	532	+	1928	+	3426
	-	3550	-	2160	-	4158	+	1159	+	1046
c =	-	2956	-	2960	-	2962	+	4885	+	4886

- Reduction to Standard. X^S

Star	1	2	3	4	6	5
ax	-265	-395	-491	-592	-738	-722
ay	+2265	+3854	+4630	+4228	+3917	+2054
c	-2959	-2959	-2959	-2959	-2959	-2959
Comp	-959	+500	+1180	+677	+220	-1627
x-S	-965	+496	+1192	+682	+205	-1619
o-c	-6	-4	+12	+	5	-10
o-c Plate 650	+9	-5	+9	+	5	-14
651-650	-13	+	1	+3	0	+1

Compare p 11

9.45 a	-	1.206	= -	485	-	1440
1.89 a	+	12.78 b	= +	1936	-	925
-1.89	+	0.24	= +	97	+	288
		13.02 b	= +	2033	-	657
9.45 a	=		-	298	-	11501

$$a = -31.6 \quad b = +156.1 \quad d = -158.9 \quad c = -50.4$$

$$C = \begin{array}{r} + 241 \\ + 353 \\ - 6520 \end{array} \quad \begin{array}{r} - 1292 \\ + 492 \\ - 2160 \end{array} \quad \begin{array}{r} + 644 \\ + 352 \\ - 4158 \end{array} \quad \begin{array}{r} + = \\ + 1504 \\ + 1924 \\ + 1659 \end{array} \quad \begin{array}{r} + 3\frac{3}{4}26 \\ - 1100 \end{array}$$

$$C = -2956 - 2960 - 2962 \quad + 4885 \quad + 4890$$

- Reduction to Standard, X^3

Star	1	2	3	4	6	5
αx	- 265	- 375	- 491	- 592	- 738	- 722
Δy	+ 2265	+ 385	+ 4630	+ 4228	+ 3917	+ 2084
c	- 2959	- 2959	- 2959	- 2959	- 2959	- 2959
Comp	- 959	+ 500	+ 1180	+ 677	+ 220	- 1627
$x - \bar{x}$	- 965	+ 496	+ 1192	+ 682	+ 205	- 1619
$O - C$	- 6	- 4	+ 142	+ 5	- 10	+ 8
$O - C$ plate 657	+ 4	- 5	+ 4	+ 5	- 14	+ 8
$\Delta 1 - 652$	- 3	+ 1	+ 3	0	+ 1	0

MC 650

Reduction to Standard y.

Star	1	2	3	4	6	5
dx	- 1333	1975	2466	2964	3097	3617
ey	- 731	1244	1495	1364	1262	663
f	+ 4886	4886	4886	4886	4886	4886
Comp	+ 2822	1667	+ 925	558	- 73	+ 606
y-y	+ 2818	+ 1642	+ 951	548	- 66	+ 609
O-C	- 4	- 25	+ 26	- 10	+ 7	+ 4
O-C(651)	- 13	- 17	+ 26	- 8	+ 4	+ 14
657-650	- 9	+ 8	0	+ 2	- 3	+ 10

Average residual in x 8 in y 13 together 10.5

Average difference 657-650 1.3 5 3.3

MC 650		Reduction to Standard y				
Star	1	2	3	4	6	5
dx	- 1338	1975	2466	2964	3697	3612
dy	- 731	1244	1495	1364	1262	668
f	+ 4886	4886	4886	4886	4886	4886
Comp	+ 22	1684	+ 1925	+ 558	73	- 606
y-y	+ 2818	+ 1642	+ 951	548	- 66	- 690
O-C	- 4	- 25	+ 26	- 10	+ 7	+ 4
O-C(657)	- 13	- 17	+ 26	- 8	+ 4	+ 14
657-650	- 9	+ 8	0	+ 2	- 3	+ 10
Average residual in x		8	- 4	13	10.5	
Average difference 657-650		1.3	5	3.3		

MC 650

Moon's Limb

Point	x	$x - x_0$	Refraction	Corrected $(x - x_0)^2$
1	26.1544	+ 1.9444	+ 36	3.7947
2	26.0000	+ 1.7900	+ 33	3.2159
3	25.0000	+ 0.7900	+ 14	0.6263
4	23.0000	- 1.2100	- 22	1.4696
5	22.3156	- 1.8944	- 35	3.6019

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	Δ
1	18.2436	- 0.4414	0.1948	3.9895	+ 103
2	19.5531	+ 0.8681	0.7536	3.9695	- 97
3	20.5758	+ 1.8308	3.3518	3.9786	- 11
4	20.2690	+ 1.5840	2.5090	3.9785	- 7
5	19.3005	+ 0.6155	0.3788	3.9807	+ 15

Approximate center $x_0 = 18.685$ $y_0 = 24.210$

Correction for refraction $\Delta y = (a - e) y - y_0 = 0.00184 (y - y_0)$

Assumed $a^2 = 3.9792$

$\Delta x_0 = \frac{1}{2}a$ $\Delta y_0 = \frac{1}{2}b$ $\Delta(x_0) = 0$

$$\begin{array}{rcl}
 - 0.44a & + 1.94b & + c = + 103 \\
 + 0.87 & + 1.79 & = - 97 \\
 + 1.83 & + 0.79 & = - 11 \\
 + 1.58 & - 1.21 & = - 7 \\
 + 0.62 & - 1.89 & = + 15
 \end{array}$$

Normals

$$\begin{array}{rcl}
 + 7.19a - 0.97b + 4.46c & = & - 152 \quad a = -55.3 \\
 - 0.91a + 12.71b + 1.42c & = & - 2 \quad \text{wt } 2.82 \\
 + 4.46a + 1.42b + 5.00c & = & + 3 \quad h = -10.0 \\
 - 3.98a - 1.27b - 4.46c & = & - 3 \quad \text{wt } 8.7 \\
 - 1.27a - 0.40b - 1.42c & = & - 1 \quad c = +52.6 \\
 3.21a - 2.18b & = & - 155 \quad \text{OK} \\
 - 2.18a + 12.30b & = & - 3 \\
 - 0.39a + 2.18b & = & - 1 \\
 2.82a & = & - 156
 \end{array}$$

Current
in sec

Reference

1910

2

1905

1910	1905	1910	1905	1910	1905
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

A. 1910 (X-X)

(X-X)

(X-X)

X

1910	1905	1910	1905	1910	1905
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1910 1905 1910 1905 1910 1905

1910 1905 1910 1905 1910 1905

1910 1905 1910 1905 1910 1905

1910 1905 1910 1905 1910 1905

1910	1905	1910	1905	1910	1905
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1910

1910	1905	1910	1905	1910	1905
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

1910	1905	1910	1905	1910	1905
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MC 650

Moon's limb

Point	y	$x - x_0 - y_0$	Refraction	Corrected ($x - y_0$) ²
1	26.1544	+ 1.9444	+ 36	3.7947
2	26.0000	+ 1.7900	+ 33	3.2159
3	25.0000	+ 0.7900	+ 14	0.6263
4	23.0000	- 1.2100	- 22	1.4695
5	22.3156	- 1.8944	- 35	3.6019

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	Δ
1	18.2436	- 0.4414	0.1948	3.9895	+103
2	19.5531	+ 0.8681	0.7536	3.9695	- 97
3	20.5758	+ 1.8308	3.3518	3.9781	- 11
4	20.2690	+ 1.5840	2.5090	3.9783	- 7
5	19.3005	+ 0.6155	0.3788	3.9807	+ 15

Approximate center $x_0 = 18.685$ $y_0 = 24.210$ Correction for refraction $\Delta y = (a - c)(y - y_0) = 0.00184(y - y_0)$ Assumed $a^2 = 3.9792$

$$\Delta x_0 = \frac{1}{2}a \quad \Delta y_0 = \frac{1}{2}b \quad \Delta(x_0^2) = 0$$

$$\begin{array}{rcl}
 - 0.44a & + 1.94b & + c = + 103 \\
 + 0.87 & + 1.79 & = - 97 \\
 + 1.83 & + 0.79 & = - 11 \\
 + 1.58 & - 1.21 & = - 7 \\
 + 0.62 & - 1.89 & = + 15
 \end{array}$$

Normals

$$\begin{array}{rcl}
 + 7.19a & - 0.94b & + 4.46c = - 152 \quad a = -05.3 \\
 - 0.91a & + 12.71b & + 1.42c = - 2 \quad \text{at } 2.22 \\
 + 4.46a & + 1.42b & + 5.00c = + 3 \quad b = -10.0 \\
 & & \text{at } 8.7 \\
 - 3.98a & - 1.27b & - 4.46c = - 3 \\
 - 1.27a & - 0.40b & - 1.42c = - 1 \quad c = \pm 52.6 \\
 3.21a & - 2.18b & = - 153 \\
 - 2.18a & + 12.30b & = - 3 \quad \text{OK} \\
 - 0.39a & + 2.18b & = - 1 \\
 2.82a & & = - 2
 \end{array}$$

Chole to p35-

From the plate constants of pp 11 & 34
we find

$$\begin{aligned} x_2 &= x_1 - 0.24, +132.74, -2912 & x_2 - x_1 &= -185- \\ y_2 &= y_1 -131.14, -1.44, +335-1 & y_2 - y_1 &= \end{aligned}$$

A line for the moon's center. the coordinates
 x, y , would be approximately

$$x_1 = 16.8365 \quad y_1 = 20.5793$$

MC 650

Moons limb

Residuals

30-

	1	2	3	4	5	$2\sqrt{2}$
a	+24	-48	-105	-87	-34	20 25
b	-19	-18	-8	+12	+19	70 86
c	+53	+53	+53	+53	+33	20 25
Comp	+58	-18	-56	-23	+38	225
obs	+103	-97	-11	-17	+15	529
O-C	+45	-84	+45	+15	-28	11890
$\Sigma av = -2$		$\Sigma br = -2$		$\Sigma v = +2$		$\Sigma^2 = 5945$

Coordinates of Center

In arc

$$X = 18.6822 \pm 0.0015$$

$$\pm 0''.69$$

p.c one measure

$$y = 24.2095 \pm 0.00085$$

$$\pm 0.39$$

$$\sigma n = \pm 12.5$$

$$n = 1.9961$$

$$= \pm 0''.58$$

Reduction to R.A. & Dec.

Corrected coordinates

30-5-x	16.8478	Corrected	45-0-y	20.7905	Corrected
-ax +	532	+533	-ay +	1047	+1039
-bx -	3244	-3212	-bx +	2673	+2675
-c +	2959	+2459	-c -	4886	-4886
18+E	16.8425	8458	22+y =	20.6739	6731
Σ	-1.1575	1542	η	-1.3261	-1.3269
ΔS	=	0	$-\eta_2$	+	7
log Σ	0.06352		η_1	-1.3254	-1.3262
const	1.49136		log η_1	0.12235	
sec δ	0.04153		const	2.66745	
tan $\delta - A$	1.59641		tan $\delta - D$	2.78980	
$\alpha - A$	-395.48	-39.37	$\delta - D$	-616''.3	-616''.7
Σ^2	0.127		δ	-24	29 15
tan δ	9.660		δ	-24	39 31.3 31''.7
const	7.082				
	6.839				

11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-

$x = 18.852 \pm 0.0010$
 $y = 24.207 \pm 0.0006$
 $z = 1.111 \pm 0.0003$

11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-
11880	23-	21+	22+	21-	21-	21-

MC 650

Moons limb

Residuals

	1	2	2	4	5	2v ²
a	+24	-48	-105	-87	-34	20.25
b	-19	-18	-8	+15	+19	70.56
c	+53	+53	+53	+53	+33	20.25
Comp	+58	-13	-56	-22	+38	22.5
Obs	+103	-97	-	-7	+15	5.29
Σ	+45	-84	45	+15	-23	11890
$\Sigma av = -2$			-2	$2v = -2$		$\Sigma = 5945$

Coordinates of Center

$$X = 18.6822 \pm 0.0015$$

$$Y = 24.2095 \pm 0.0008$$

$$Z = 1.9961$$

In arc

$$\pm 0''.69$$

$$\pm 0.39$$

$$R_0 = \pm 10$$

p.c. one measure

$$\sigma R = \pm 12.5$$

$$= \pm 0''.58$$

Reduction to R.A. & Dec.

35-5-x 16.8478 Correction Σ in back of p 34 (yellow) 45-0-y 20.7905 Correction

ax +	532	+1	-dx +	1047	-10
ay -	3244	+32	-ay +	2673	+2
c +	2959	+33	-c -	4886	

$$18 + \Sigma = 16.8425 \quad 22 + y = 20.6739 \quad -8$$

$$\Sigma = -1.1575 \quad y = -1.3261$$

$$\Delta \Sigma = 0 \quad +33 \quad -y_2 = 7$$

$$\log \Sigma = 0.06352 \quad y_1 = -1.3254 \quad -8$$

$$\text{const} = 1.49136$$

$$\text{Sec } \delta = 0.04153$$

$$\tan \delta - A = 1.59641$$

$$\alpha - A = -395.48 + 0''.11$$

$$\Sigma^2 = 0.127$$

$$\tan \delta = 9.660$$

$$\text{const} = 7.052$$

$$6.822$$

$$\text{Lumi} = 0.12235$$

$$\text{const} = 2.66745$$

$$\tan \delta - D = 2.78980$$

$$\delta - D = -616''.3 \quad -0.4$$

$$\delta D = -24.29$$

$$\delta = -34.89 \quad 31''.3 \quad -0''.4$$

MC 650

Reduction to Ephemeris place ³⁶

Moon	20	36	45.52	63.5	-	24	39	81.3	31.7
1900									
Procession		+	35.46		+		2.	7.1	
Rad. adl. app		+	2.35		+			1.1	
Apparent place	20	37	23.33	44	-	24	37	23.7	5
Parallax		+	29.60		+		51	38	3
True place	20	37	52.93	53.04	-	23	45	44.8	45.2
Ephemeris	20	37	52.38		-	23	45	47.5	
O-C			+ 0.55		+			2.7	
Concor			+ 0.66		+			2.3	

using the observed place of the moon in computing the parallax we find +29.59 + 51 38.1

^P which will be used below (p 40) for the final value

Mc 650 Reduction to Ephemeris place 36

					Cor.				Cor.
Moon's	20	36	40.3	635	-	24	39	31.3	31.7
1900									
Parallax		+	35.46		+		2	7.1	
Red. ad l. opp		+	2.35		+			1.1	
Apparent	20	37	23	3344	-	24	37	23.1	3.0
Place									
Parallax	+		29.60		+		5.1	38.3	
True place	20	37	52.48	53.04	-	23	45	44.8	45.2
Ephemeris	20	37	52.38		-	23	45	47.0	
O-C			+0.55		+			2.7	
Cor			40.63		+			2.3	

MC 650 more points on Niros curve

mass 37
"1960 Nov 20"

	χ		χ
$x = 20$	d	\sim	d
$y = 22+$	13 3 48	20 35	3°
	6 2 70 58	9 1 52 45	
	7 2 64	4 9 53	
	58	30	
	22. 90 89	71 19	

 $y = 24$
 $x = 20 +$

12 5 20	33 37
58 71 75	99 96 80
62 65	92 90

38

18

20.

66 64

66 65

 $y = 24.2$
 $x = \text{max.}$

115 22

23 23

47 87

90 80 70

80 85

62 60-68

40

74

20.

67 57

67 54

 $x = 20$
 $y = 20 +$

121 95

27 62

57 62

98 10

57 60

11 11

91

68

20. 70 32

70 50

 $x = 19$

118 31

21 15

 $x = 18.7$

118 40

720 99

 $y = 20 +$

100 55

38 50

 $y = \text{max}$

97 95

41 38 44

55 50

84 80

90 98

36 40

30

10

31

100

26. 17 78

17 66

26. 20 48

20 41

MC 650 more points on moons bands

7/10/10

4

X

	d	n	d	n
X = 20	13 3 48	20 30		3
4 = 22+	6 2 70 58	9 1 52 45		
	7 2 64	4 9 35		
	58	3		

22. 70 89 71 19

4 = 24
X = 20 +

12 5 20 33 37
48 71 75 99 96 SC
62 65 92 75

38

18

20.

66 64

66 65

4 = 24.2
X = max

11 5 22

23 28

47 67

90 60 75

80 65

66 60 68

40

74

20.

67 51

67 54

X = 20
4 = 20 +

12 1 9 5 27 62
57 62 98 10
5 7 60 11 11
9 1 60

25. 70 32 70 50

X = 19
4 = 20 +

11 8 31 21 15
100 55 38 20
55 50 24 20
30 10

26. 17 78 17 66

X = 18.7

11 6 40

20 94

4 = max

97 95

41 58 45

90 98

36 40

31

100

26. 20 48 20 41

	y	y - y ₀	Ref.	Corrected y - y ₀	
6	22.7099	-1.5001	-28	2.2587	
7	24.0000	-0.2100	-3	0.0441	
8	24.2---	0.---		0.0000	
9	25.7041	+0.4941	+28	2.2408	
10	26.1772	+1.9672	+36	3.8840	
11	26.2044	+1.9944	+37	3.9924	
	x	x - x ₀	(x - x ₀) ²	(x - x ₀)(y - y ₀)	
6	20.0000	+1.3150	+1.7292	3.9879	+87
7	20.6664	+1.9814	+3.9259	3.9700	-92
8	20.6753	+1.9903	+3.9615	3.9615	-177
9	20.0000	+1.3150	+1.7292	3.9700	-92
10	19.0000	+0.3150	+0.0992	3.9732	-60
11	18.7---	0.---	0.0000	3.9924	+132

(p 34) Assumed x₀ = 18.685 y₀ = 24.210 A₀ = 3.9792

Partial Normal Equations

$$+11.44a + 0.20b + 6.92c = -557^v$$

$$+0.20a + 12.42b + 3.78c = -103^v$$

$$+6.92a + 3.78b + 6.00c = -202^v$$

Mc. 220 Tuller means of lower part

2	2	2	2
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20

2	2	2	2
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20
220.20	220.20	220.20	220.20

220.20 220.20 220.20 220.20

220.20 220.20 220.20 220.20

$$\begin{aligned}
 &+ 11.412 + 0.202 + 0.202 + 0.202 \\
 &+ 0.202 + 0.202 + 0.202 + 0.202 \\
 &+ 0.202 + 0.202 + 0.202 + 0.202
 \end{aligned}$$

MC 650 Further means of known time 38

	y	y - y ₀	Ref.	Corrected H-401 ²
6	22.7049	-1.5001	-28	2.2587
7	24.0000	-0.2100	-3	0.0441
8	24.2	0		0.0000
9	25.7041	+0.4941	+28	2.2408
10	26.1772	+1.9672	+36	3.8640
11	26.2044	+1.9944	+37	3.9924

	x	x - x ₀	(x - x ₀) ²	(x - x ₀)(y - y ₀)	
6	20.0000	+1.3150	+1.7292	3.9879	+87
7	20.6664	+1.9814	+3.9259	3.9700	-92
8	20.6753	+1.9903	+3.9615	3.9615	-177
9	20.0020	+1.3150	+1.7292	3.9700	-92
10	19.0000	+0.3150	+0.0992	3.9732	-60
11	18.7	0	0.0000	3.9924	+132

p 34) Assumed x₀ = 18.685 y₀ = 24.210 A₀ = 3.9792

Partial Normal Equations

$$+11.44a + 0.20b + 6.92c = -537$$

$$+0.20a + 12.92b + 3.75c = -103$$

$$+6.92a + 3.75b + 6.00c = -202$$

ORIGINAL REPRODUCED

a
b
c
d
e
f
g
h
i
j
k
l
m
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o
p
q
r
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y
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19C 650 Moon's Lure

Complete normals

39

$$\begin{aligned}
 18.63 a + 0.71 b + 11.38 c &= -709 \\
 -0.71 a + 25.13 b + 5.17 c &= -105 \\
 +11.38 a + 5.17 b + 11.00 c &= -199 \\
 \\
 -11.77 a - 5.35 b - 11.38 c &= +206 \\
 -5.35 a - 2.43 b - 5.17 c &= +94 \\
 \\
 +6.86 a - 6.06 b &= +503 \\
 -6.06 a + 22.70 b &= -11 \\
 \\
 -1.62 a + 6.06 b &= -3 \\
 +6.06 a - 5.35 b &= -446 \\
 \\
 +5.24 a &= -506 \\
 +17.35 b &= -457
 \end{aligned}$$

$$a = -96.6 \quad b = -26.3 \quad c = +93.8 \quad \text{wt } 2.9$$

Residuals

	1	2	3	4	5	6	7	8	9	10	11
a	+43	-84	-176	-153	-59	-126	-190	-192	-126	-30	0
b	-57	-47	-21	+32	+50	+40	+5	0	-29	-51	-52
c	+94	+94	+94	+94	+94	+94	+94	+94	+94	+94	+94
a b	+86	-37	-103	-27	+85	+8	-91	-198	-61	+13	+42
b c	+103	-97	-41	-7	+15	+87	-92	-177	-92	-60	+132
b-c	+17	-60	+92	+20	-70	+89	-1	-79	-31	-73	+90

$$\begin{aligned}
 \Sigma v^2 & 289 \\
 & 3600 \\
 & 8464 \\
 & 400 \\
 & 4900 \\
 & 4761 \\
 \hline
 & 22414
 \end{aligned}$$

$$\begin{aligned}
 & 1 \\
 & 6241 \\
 & 961 \\
 & 5329 \\
 & 8100 \\
 \hline
 & 20632 \\
 & 43046
 \end{aligned}$$

$$\begin{aligned}
 \text{Mean error on list of } v^2 & \pm 73.2 \\
 \text{Prob " " } r^2 & \pm 49.4 \\
 & a \pm 21.6 \\
 & b \pm 11.9 \\
 & c \pm 29.
 \end{aligned}$$

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19C 650 Moon's Lure Complete Normals

39

$$\begin{aligned}
 18.63 a + 0.71 b + 11.38 c &= -709 \\
 -0.71 a + 25.13 b + 5.17 c &= -105 \\
 +11.38 a + 5.17 b + 11.00 c &= -199 \\
 -11.77 a - 5.35 b - 11.38 c &= +206 \\
 -5.35 a - 2.43 b - 5.17 c &= +94 \\
 +6.86 a - 6.06 b &= +503 \\
 -6.06 a + 22.70 b &= -11 \\
 -1.62 a + 6.06 b &= -3 \\
 +6.06 a - 5.35 b &= -446 \\
 +6.24 a &= -506 \\
 +17.35 b &= -457
 \end{aligned}$$

$$a = -96.5 \quad b = -26.3 \quad c = +93.8 \quad \text{wt } 2.9$$

Residuals

1	2	3	4	5	6	7	8	9	10	11
+43	-84	-176	-153	-39	-126	-191	-192	-126	-30	0
-57	-47	-21	+32	+50	+40	+5	0	-39	-87	-12
+94	+94	+9	+14	+94	+94	+94	+94	+94	+94	+94
+86	-37	-103	-27	+85	+8	-91	-198	-61	+12	+42
+103	-97	-141	-7	+15	+57	-92	-177	-42	-60	+132
+17	-60	+92	+20	-20	+89	-1	-79	-31	-73	+90

ΣV^2	289	1	Mean error in dist of $\sqrt{2}$	± 73.20
3600	6241	Part	"	± 49.4
8464	961	"	"	± 21.6
400	5329	"	"	± 11.9
4900	8100			± 29
4761				
22414	20632			
	43046			

MC 650 Final results

40

Moons Center

in arc

$$\begin{aligned}
 X &= 18.6802 \pm 0.0011 & \pm 0'' 50 \\
 Y &= 24.2087 \pm 0.0006 & \pm 0'' 28 \\
 Z &= 1.11.9971 \pm 0.0007 & \pm 0934'' 7 \pm 0'' 34
 \end{aligned}$$

$$P. e. \text{ lobe of crater } \pm 0.002 \quad \pm 0'' 62$$

Corrections to values on p 36

$$\begin{aligned}
 \text{New measures} \quad \Delta X &= -20 = -0'' 94 = -0^s 07 \\
 \Delta Y &= -6 = -0'' 28
 \end{aligned}$$

$$\begin{aligned}
 \text{Comp. stars} \quad \Delta Y &= +7 = +0'' 32 \\
 \text{see p}
 \end{aligned}$$

Resulting values corrected.

2900.0	20 ^h	36 ^m	45 ^s .44	56	-240	39'	31'' 3	31'' 7
Apparent		37	23.26	37		37	23.1	23.5
Parallax		+	29.59			57	24.1	
Geocentric		37	52.26	96	-23	45	48.0	45.4
N.A.			52	38				

$$O-C \text{ correction} \quad + 0^s 58 \pm 0^s 039 \quad + \quad 2'' 7 \pm 0'' 40$$

$$O-C, plate 651 \quad + 0^s 58 \pm 0^s 033 \quad + \quad 3'' 2 \pm 0'' 37$$

p

$$D \text{ off. } ^{667-651} \quad - 0.03 \pm 0^s 050 \quad + \quad 1'' 4 \pm 0'' 60$$

Very satisfactory

$$d \text{ corresponds to } \text{measured } d \quad + \quad 1'' 9$$

Seventeen micrometer 925'' 4

Any mention + 6.0

Compass

931'' 4

O-C $\pm 0'' 3$

40

Final results

1910

Base line

$$x = 15.602 \pm 0.001$$

$$y = 24.707 \pm 0.001$$

$$z = 1.11971 \pm 0.0007$$

$$a = 1.00000 \pm 0.00000$$

Conversion to radius in h 32

$$\Delta x = -0.04 - 0.02$$

$$\Delta y = -0.04 - 0.02$$

$$\Delta z = -0.04 - 0.02$$

$$\Delta a = -0.04 - 0.02$$

$$\Delta b = -0.04 - 0.02$$

$$\Delta c = -0.04 - 0.02$$

$$\Delta d = -0.04 - 0.02$$

$$\Delta e = -0.04 - 0.02$$

$$\Delta f = -0.04 - 0.02$$

$$\Delta g = -0.04 - 0.02$$

$$\Delta h = -0.04 - 0.02$$

$$\Delta i = -0.04 - 0.02$$

$$\Delta j = -0.04 - 0.02$$

$$\Delta k = -0.04 - 0.02$$

$$\Delta l = -0.04 - 0.02$$

$$\Delta m = -0.04 - 0.02$$

$$\Delta n = -0.04 - 0.02$$

$$\Delta o = -0.04 - 0.02$$

$$\Delta p = -0.04 - 0.02$$

$$\Delta q = -0.04 - 0.02$$

$$\Delta r = -0.04 - 0.02$$

MC 650 Final results

40

Moon's Center

In arc

$$X = 16.6802 \pm 0.0011$$

$$\pm 0'' 60$$

$$Y = 24.2087 \pm 0.0006$$

$$\pm 0'' 28$$

$$Z = 1.119971 \pm 0.0007$$

$$\pm 0.934'' 7 \pm 0'' 34$$

$$P. e. \text{ of } 1 \text{ obs of } \text{center} \pm 0.002 \pm 0'' 62$$

Corrections to values on p 30

New measures

$$\Delta X = -20 = -0'' 94 = -0'' 07$$

$$\Delta Y = -6 = -0'' 28$$

Comp. stars

$$\Delta Y = +7 = +0'' 32$$

See p

Resulting values

Com

Com

$$4900.0 \quad 20'' \quad 38'' \quad 45.45 \quad 56 \quad -240 \quad 39' \quad 21'' \quad 3 \quad 31.7$$

$$\text{Apparent} \quad 37 \quad 23.26 \quad 37 \quad 37 \quad 52.1 \quad 23.5$$

$$\text{Geocentric} \quad 37 \quad 52.86 \quad 96 \quad -23 \quad 45 \quad 44.8 \quad 52.2$$

O-C Com

$$+ 0.58 \pm 0.039 + 2'' 3 \pm 0.40$$

O-C. plate 651

$$+ 0.56 \pm 0.033 + 3.2 \pm 0.37$$

p

O eff. ⁶⁶⁷⁻⁰¹

$$+ 0.03 \pm 0.050 + 1.6 \pm 0.60$$

Very satisfactory

440

Faint handwritten text at the top of the page.

Faint handwritten text at the top of the page.

Faint handwritten text.

Faint handwritten text.

$$X = 15.600 \pm 0.001$$

$$Y = 24.000 \pm 0.001$$

$$Z = 1.000 \pm 0.001$$

$$A = 0.000 \pm 0.001$$

Faint handwritten text.

$$B = 0.000 \pm 0.001$$

$$C = 0.000 \pm 0.001$$

$$D = 0.000 \pm 0.001$$

Faint handwritten text.

$$E = 0.000 \pm 0.001$$

$$F = 0.000 \pm 0.001$$

$$G = 0.000 \pm 0.001$$

$$H = 0.000 \pm 0.001$$

$$I = 0.000 \pm 0.001$$

$$J = 0.000 \pm 0.001$$

Faint handwritten text at the bottom of the page.

Taken 1940 Nov 19

41

MC 762

Purveyon Test place

H1910 Dec 23

Star	X		a	y
1	24325	13076	13345	1407
9 13	7679	7704	11268	3481 71
	81	69	69	21 78
	32	54	39	20
9.	5352	5365 13.	2076	2070
2	4364	12580	12431	2858
10 23	5013	1193	2064	8224 24
	2821	22	60	34 33
	74	62	20	28
10.	0656	0653 23.	5363	5359
3	1515	13265	12744	1539
19 30	7525	7360	8048	6224 22
	29	68 64	45	39 30 23
	28	58	35	40
19.	6004	5997 30.	4692	4690
Purveyon	2054	14712	12319	3282
17 21	9730	7538	10530 40	5046 50
Diffuse	2027	4049	28 32	42
Diffraction imp	602	694	08	82
17.	7132	7157 21.	1785	1764
4	2545	12235	14767	2740
27 16	2915	11840	10330	7182 74
	15	46	30	89 80
	58	34	57	48
23.	0370	0382 16	4430	4436

MC 762

Puoyon

Test piece

H1210 Rec 23

Star

x

y

1

2325 13076

13246 1404

9.15

7679 7704

11268 13481 71

876 708

69 71 78

32 54

39 29 20

9. 5352 5365 13. 2076 2070

2

21324 12580

12431 2858

10.23

213013 11142

7064 8224 24

10 24 21 720

60 83 33

11913 74 62

20 78 28

10.90 656 0653 23. 5363 5359

3

1515 12265

12744 1639

19.30

7325 7360

8448 6229 22

9. 5329 6664

20745 31 11

28 58

35 40

19.0 6005 5497 30. 4692 4690

Puoyon

2274 1476

12319 282

17.21

9753 7338

10330 50 50

Distance

0030 7 4041

7824 32 42

position w.p.

10020 694

08 62

6

17. 7132 1157 21. 1785 1764

4

2545 12225

14767 2700

27.16

2915 11840

10330 7182 74

15 46

30 59 50

58 34

57 48

23. 0370 028216 4430 4436

M C O'Brien Paragon

M 1910 Dec 23 ⁰²

Star	X		Y	
5-	3327	12790	13971	3091
26. 20	3395	12688 ⁹⁰	6129	10922
on R. line	95	710 26.78	20 28	18
X different	50	92	51	95
	26. 0068	0096	20. 7829	7826
6	1890	12710	11669	3429
25- 30	2810	11781	2758	12368
	10 18	7170	53	7125
	11913	18	59	78
	25. 0921	0937	30. 8905	8895

Mean coordinates

	X	Y
1	9. 5358	13. 2073
2	10. 0654	23. 5361
3	19. 6000	30. 4691
4	23. 0376	16. 4433
5	26. 0082	20. 7828
6	26. 0929	30. 8900
Paragon	17. 7144	21. 1774

196 062

Pumpkin

42

Sta

X

Y

5-

3327

142790

13771

3041

26 2D

3325

126580

26829

10922

on R. line

35

710 78

52020

28507 18

X different

30

72

2251

215

26. 0068

0096

20.

7829

7826

6

78170

12710

126669

3479

23 30

2510

11757

12738

54 12302

10 18

7170

502

7171 21

11913

18

3339

72

25. 0921

0937

30.

8905

8895

Mean coordinates

Standard for reduction of other plates

1

9. 5358

9013. 2073

2

10. 0654

23. 5361

3

19. 6000

30. 4691

4

23. 0376

16. 4433

5

26. 0082

20. 7828

6

25. 0929

30. 8900

Pumpkin

17. 7144

21. 1774

MC 763

Pwcyon

M 1911 Jan 6

43

Star

X

Y

1	1868	12771	2919	13461
9.13	83.10	63.05	5356	10983
	10	03	83	98
	69	48	39	69
9.	6441	6452	2460	2470
2	3612	12384	1338	12909
10.23	53.11	106.53	7124	7172
	22.38	60.33	52	71
	14	29	75	62
10.	1711	1724	5785	5789
3	1685	12253	12901	13096
9.30	5740	5799	8029	7960
	36	95	25	61
	98	40	891	85
19.	7044	7048	5137	5132
Argon	1147	12846	12468	14192
11.21	9304	41312	46295	11969
use	68	1925	0158	2070
13	58	30	54	85-80
17.	8209	8207	2200	2218
4	4381	11060	2343	16459
15	840	9566	7224	11504
Argon	41	20	30	59
	93	50	51	40
23.	1460	1489	4883	4893

19C 762

Pawson

17 1911 Jan 6 ⁴⁴

Yarn

x

y

5	3714	12050	2829	1373740
26. 20	4845	10840	11132 ¹²	642924
Fan shaped	3541	90	18 ¹⁴	3841 ³¹
mt	30	53	39 ²⁰	17
26	1120	1160	8283	8286
6	2882	12028	2258	
25- 30	4846	10659	11618	13735
good	50	59	18	4352
	900	24	66	5752
				18
25. 1961	1968	9352	9364	

Mean

Coordinates

x

y

1	9.6446	13.2465
2	10.1718	23.5787
3	19.7046	30.5132
4	23.1474	76.4888
5	26.1140	20.8284
6	28.1964	30.9358

Pawson 17.8208

221.2209

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19C 762

Princeton

1911 Jan 6 44

x

R-S

y

5°	3714	12050	2629	13.73740
26 20	4845	10640	1113	52179
	30	90	11	31
	30	50	39	17
26	1120	1160	8283	8286
6	2852	12628	2258	
25 30	4846	10659	11018	13235
	50	59	18	435
26	900	124	66	18
25	1961	1968	9352	9364

Mean

Condensation

x

y

1	9.6446	13.2465
2	10.1718	23.5787
3	19.7046	30.5132
4	23.1474	16.4888
5	26.1140	20.8284
6	28.1964	30.9358

Princeton 17.8208

21.2209

Reduction of 14C 763 to 14C 762 as standard ⁴⁵

			X-5	4-7
1	9.53 a	+ 13.21 b + c =	+ 1088	+ 392
2	10.06 a	+ 23.54 b + c =	+ 1064	+ 426
3	19.60 a	+ 30.47 b + c =	+ 1046	+ 441
4	23.04 a	+ 16.44 b + c =	+ 1098	+ 455
5	26.01 a	+ 20.78 b + c =	+ 1058	+ 456
6	25.09 a	+ 30.89 b + c =	+ 1035	+ 458
P ₁₂	39.19 a	+ 67.22 b + 3c =	+ 3198	+ 1259
P ₁₂	74.14 a	+ 68.11 b + 3c =	+ 3191	+ 1369
145	58.58 a	+ 50.43 b + 3c =	+ 3244	+ 1303
236	54.75 a	+ 84.90 b + 3c =	+ 3146	+ 1325

$$\begin{aligned}
 & \left\{ \begin{aligned} & + 34.95 a + 0.89 b & = & - & 7 & + & 110 \\ & - 3.83 a + 34.47 b & = & - & 99 & + & 22 \\ & + 3.83 a + 0.10 b & = & - & 1 & + & 12 \\ & + 0.10 a + 0.89 b & = & + & 3 & - & 1 \end{aligned} \right.
 \end{aligned}$$

$$35.05 a = \quad = - 4 + 109$$

$$34.57 b = - 100 + 34$$

 Δy
 $a =$
 Δy

$$a = -0.11 \quad b = -2.189$$

$$d = + 3.10 \quad e = + 0.99$$

1-1	+	2-2	+	3-3	+	4-4	+	5-5	+	6-6	+	7-7	+	8-8	+	9-9	+	10-10	+	11-11	+	12-12	+	13-13	+	14-14	+	15-15	+	16-16	+	17-17	+	18-18	+	19-19	+	20-20	+	21-21	+	22-22	+	23-23	+	24-24	+	25-25	+	26-26	+	27-27	+	28-28	+	29-29	+	30-30	+	31-31	+	32-32	+	33-33	+	34-34	+	35-35	+	36-36	+	37-37	+	38-38	+	39-39	+	40-40	+	41-41	+	42-42	+	43-43	+	44-44	+	45-45	+	46-46	+	47-47	+	48-48	+	49-49	+	50-50	+	51-51	+	52-52	+	53-53	+	54-54	+	55-55	+	56-56	+	57-57	+	58-58	+	59-59	+	60-60	+	61-61	+	62-62	+	63-63	+	64-64	+	65-65	+	66-66	+	67-67	+	68-68	+	69-69	+	70-70	+	71-71	+	72-72	+	73-73	+	74-74	+	75-75	+	76-76	+	77-77	+	78-78	+	79-79	+	80-80	+	81-81	+	82-82	+	83-83	+	84-84	+	85-85	+	86-86	+	87-87	+	88-88	+	89-89	+	90-90	+	91-91	+	92-92	+	93-93	+	94-94	+	95-95	+	96-96	+	97-97	+	98-98	+	99-99	+	100-100	+	101-101	+	102-102	+	103-103	+	104-104	+	105-105	+	106-106	+	107-107	+	108-108	+	109-109	+	110-110	+	111-111	+	112-112	+	113-113	+	114-114	+	115-115	+	116-116	+	117-117	+	118-118	+	119-119	+	120-120	+	121-121	+	122-122	+	123-123	+	124-124	+	125-125	+	126-126	+	127-127	+	128-128	+	129-129	+	130-130	+	131-131	+	132-132	+	133-133	+	134-134	+	135-135	+	136-136	+	137-137	+	138-138	+	139-139	+	140-140	+	141-141	+	142-142	+	143-143	+	144-144	+	145-145	+	146-146	+	147-147	+	148-148	+	149-149	+	150-150	+	151-151	+	152-152	+	153-153	+	154-154	+	155-155	+	156-156	+	157-157	+	158-158	+	159-159	+	160-160	+	161-161	+	162-162	+	163-163	+	164-164	+	165-165	+	166-166	+	167-167	+	168-168	+	169-169	+	170-170	+	171-171	+	172-172	+	173-173	+	174-174	+	175-175	+	176-176	+	177-177	+	178-178	+	179-179	+	180-180	+	181-181	+	182-182	+	183-183	+	184-184	+	185-185	+	186-186	+	187-187	+	188-188	+	189-189	+	190-190	+	191-191	+	192-192	+	193-193	+	194-194	+	195-195	+	196-196	+	197-197	+	198-198	+	199-199	+	200-200	+	201-201	+	202-202	+	203-203	+	204-204	+	205-205	+	206-206	+	207-207	+	208-208	+	209-209	+	210-210	+	211-211	+	212-212	+	213-213	+	214-214	+	215-215	+	216-216	+	217-217	+	218-218	+	219-219	+	220-220	+	221-221	+	222-222	+	223-223	+	224-224	+	225-225	+	226-226	+	227-227	+	228-228	+	229-229	+	230-230	+	231-231	+	232-232	+	233-233	+	234-234	+	235-235	+	236-236	+	237-237	+	238-238	+	239-239	+	240-240	+	241-241	+	242-242	+	243-243	+	244-244	+	245-245	+	246-246	+	247-247	+	248-248	+	249-249	+	250-250	+	251-251	+	252-252	+	253-253	+	254-254	+	255-255	+	256-256	+	257-257	+	258-258	+	259-259	+	260-260	+	261-261	+	262-262	+	263-263	+	264-264	+	265-265	+	266-266	+	267-267	+	268-268	+	269-269	+	270-270	+	271-271	+	272-272	+	273-273	+	274-274	+	275-275	+	276-276	+	277-277	+	278-278	+	279-279	+	280-280	+	281-281	+	282-282	+	283-283	+	284-284	+	285-285	+	286-286	+	287-287	+	288-288	+	289-289	+	290-290	+	291-291	+	292-292	+	293-293	+	294-294	+	295-295	+	296-296	+	297-297	+	298-298	+	299-299	+	300-300	+	301-301	+	302-302	+	303-303	+	304-304	+	305-305	+	306-306	+	307-307	+	308-308	+	309-309	+	310-310	+	311-311	+	312-312	+	313-313	+	314-314	+	315-315	+	316-316	+	317-317	+	318-318	+	319-319	+	320-320	+	321-321	+	322-322	+	323-323	+	324-324	+	325-325	+	326-326	+	327-327	+	328-328	+	329-329	+	330-330	+	331-331	+	332-332	+	333-333	+	334-334	+	335-335	+	336-336	+	337-337	+	338-338	+	339-339	+	340-340	+	341-341	+	342-342	+	343-343	+	344-344	+	345-345	+	346-346	+	347-347	+	348-348	+	349-349	+	350-350	+	351-351	+	352-352	+	353-353	+	354-354	+	355-355	+	356-356	+	357-357	+	358-358	+	359-359	+	360-360	+	361-361	+	362-362	+	363-363	+	364-364	+	365-365	+	366-366	+	367-367	+	368-368	+	369-369	+	370-370	+	371-371	+	372-372	+	373-373	+	374-374	+	375-375	+	376-376	+	377-377	+	378-378	+	379-379	+	380-380	+	381-381	+	382-382	+	383-383	+	384-384	+	385-385	+	386-386	+	387-387	+	388-388	+	389-389	+	390-390	+	391-391	+	392-392	+	393-393	+	394-394	+	395-395	+	396-396	+	397-397	+	398-398	+	399-399	+	400-400	+	401-401	+	402-402	+	403-403	+	404-404	+	405-405	+	406-406	+	407-407	+	408-408	+	409-409	+	410-410	+	411-411	+	412-412	+	413-413	+	414-414	+	415-415	+	416-416	+	417-417	+	418-418	+	419-419	+	420-420	+	421-421	+	422-422	+	423-423	+	424-424	+	425-425	+	426-426	+	427-427	+	428-428	+	429-429	+	430-430	+	431-431	+	432-432	+	433-433	+	434-434	+	435-435	+	436-436	+	437-437	+	438-438	+	439-439	+	440-440	+	441-441	+	442-442	+	443-443	+	444-444	+	445-445	+	446-446	+	447-447	+	448-448	+	449-449	+	450-450	+	451-451	+	452-452	+	453-453	+	454-454	+	455-455	+	456-456	+	457-457	+	458-458	+	459-459	+	460-460	+	461-461	+	462-462	+	463-463	+	464-464	+	465-465	+	466-466	+	467-467	+	468-468	+	469-469	+	470-470	+	471-471	+	472-472	+	473-473	+	474-474	+	475-475	+	476-476	+	477-477	+	478-478	+	479-479	+	480-480	+	481-481	+	482-482	+	483-483	+	484-484	+	485-485	+	486-486	+	487-487	+	488-488	+	489-489	+	490-490	+	491-491	+	492-492	+	493-493	+	494-494	+	495-495	+	496-496	+	497-497	+	498-498	+	499-499	+	500-500	+	501-501	+	502-502	+	503-503	+	504-504	+	505-505	+	506-506	+	507-507	+	508-508	+	509-509	+	510-510	+	511-511	+	512-512	+	513-513	+	514-514	+	515-515	+	516-516	+	517-517	+	518-518	+	519-519	+	520-520	+	521-521	+	522-522	+	523-523	+	524-524	+	525-525	+	526-526	+	527-527	+	528-528	+	529-529	+	530-530	+	531-531	+	532-532	+	533-533	+	534-534	+	535-535	+	536-536	+	537-537	+	538-538	+	539-539	+	540-540	+	541-541	+	542-542	+	543-543	+	544-544	+	545-545	+	546-546	+	547-547	+	548-548	+	549-549	+	550-550	+	551-551	+	552-552	+	553-553	+	554-554	+	555-555	+	556-556	+	557-557	+	558-558	+	559-559	+	560-560	+	561-561	+	562-562	+	563-563	+	564-564	+	565-565	+	566-566	+	567-567	+	568-568	+	569-569	+	570-570	+	571-571	+	572-572	+	573-573	+	574-574	+	575-575	+	576-576	+	577-577	+	578-578	+	579-579	+	580-580	+	581-581	+	582-582	+	583-583	+	584-584	+	585-585	+	586-586	+	587-587	+	588-588	+	589-589	+	590-590	+	591-591	+	592-592	+	593-593	+	594-594	+	595-595	+	596-596	+	597-597	+	598-598	+	599-599	+	600-600	+	601-601	+	602-602	+	603-603	+	604-604	+	605-605	+	606-606	+	607-607	+	608-608	+	609-609	+	610-610	+	611-611	+	612-612	+	613-613	+	614-614	+	615-615	+	616-616	+	617-617	+	618-618	+	619-619	+	620-620	+	621-621	+	622-622	+	623-623	+	624-624	+	625-625	+	626-626	+	627-627	+	628-628	+	629-629	+	630-630	+	631-631	+	632-632	+	633-633	+	634-634	+	635-635	+	636-636	+	637-637	+	638-638	+	639-639	+	640-640	+	641-641	+	642-642	+	643-643	+	644-644	+	645-645	+	646-646	+	647-647	+	648-648	+	649-649	+	650-650	+	651-651	+	652-652	+	653-653	+	654-654	+	655-655	+	656-656	+	657-657	+	658-658	+	659-659	+	660-660	+	661-661	+	662-662	+	663-663	+	664-664	+	665-665	+	666-666	+	667-667	+	668-668	+	669-669	+	670-670	+	671-671	+	672-672	+	673-673	+	674-674	+	675-675	+	676-676	+	677-677	+	678-678	+	679-679	+	680-680	+	681-681	+	682-682	+	683-683	+	684-684	+	685-685	+	686-686	+	687-687	+	688-688	+	689-689	+	690-690	+	691-691	+	692-692	+	693-693	+	694-694	+	695-695	+	696-696	+	697-697	+	698-698	+	699-699	+	700-700	+	701-701	+	702-702	+	703-703	+	704-704	+	705-705	+	706-706	+	707-707	+	708-708	+	709-709	+	710-710	+	711-711	+	712-712	+	713-713	+	714-714	+	715-715	+	716-716	+	717-717	+	718-718	+	719-719	+	720-720	+	721-721	+	722-722	+	723-723	+	724-724	+	725-725	+	726-726	+	727-727	+	728-728	+	729-729	+	730-730	+	731-731	+	732-732	+	733-733	+	734-734	+	735-735	+	736-736	+	737-737	+	738-738	+	739-739	+	740-740	+	741-741	+
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Reduction of 14C 765 to 14C 762 as standard 45

X				X-5	4-7
	a	b	c		
1	9.53	+ 13.21	+ c =	+ 1088	+ 392
2	10.06	+ 23.54	+ c =	+ 1064	+ 426
3	19.60	+ 30.47	+ c =	+ 1046	+ 441
4	23.04	+ 16.44	+ c =	+ 1098	+ 430
5	26.01	+ 20.78	+ c =	+ 1058	+ 436
6	26.09	+ 30.89	+ c =	+ 1035	+ 458
A	17.71	21.18			
	39.19	+ 67.22	+ 3c =	+ 3198	+ 1259
	74.14	+ 68.11	+ 3c =	+ 3191	+ 1369
	58.58	+ 50.43	+ 3c =	+ 3244	+ 1303
	54.75	+ 84.90	+ 3c =	+ 3145	+ 1325

+ 34.95	a	+ 0.89	b	= -	7	+ 110
- 3.83	a	+ 34.47	b	= -	99	+ 22
+ 3.63	a	+ 0.10	b	= -	1	+ 12
+ 0.10	a	+ 0.89	b	= +	3	- 1

$$35.05 a = \quad \quad \quad = - \quad 4 \quad + \quad 109$$

$$34.57 b = - \quad 100 \quad + \quad 33$$

$$\Delta y \quad a = \quad \Delta y$$

$$a = -0.11 \quad b = -2.89 \quad c = +3.10 \quad f = +0.99$$

MC 200 to MC 205

Reverberation

$\tau = \tau$	$\tau = \tau$	$\tau = \tau$	$\tau = \tau$	$\tau = \tau$	$\tau = \tau$
1.00	+	1.00	+	1.00	+
2.00	+	2.00	+	2.00	+
3.00	+	3.00	+	3.00	+
4.00	+	4.00	+	4.00	+
5.00	+	5.00	+	5.00	+
6.00	+	6.00	+	6.00	+
7.00	+	7.00	+	7.00	+
8.00	+	8.00	+	8.00	+
9.00	+	9.00	+	9.00	+
10.00	+	10.00	+	10.00	+
11.00	+	11.00	+	11.00	+
12.00	+	12.00	+	12.00	+
13.00	+	13.00	+	13.00	+
14.00	+	14.00	+	14.00	+
15.00	+	15.00	+	15.00	+
16.00	+	16.00	+	16.00	+
17.00	+	17.00	+	17.00	+
18.00	+	18.00	+	18.00	+
19.00	+	19.00	+	19.00	+
20.00	+	20.00	+	20.00	+
21.00	+	21.00	+	21.00	+
22.00	+	22.00	+	22.00	+
23.00	+	23.00	+	23.00	+
24.00	+	24.00	+	24.00	+
25.00	+	25.00	+	25.00	+
26.00	+	26.00	+	26.00	+
27.00	+	27.00	+	27.00	+
28.00	+	28.00	+	28.00	+
29.00	+	29.00	+	29.00	+
30.00	+	30.00	+	30.00	+
31.00	+	31.00	+	31.00	+
32.00	+	32.00	+	32.00	+
33.00	+	33.00	+	33.00	+
34.00	+	34.00	+	34.00	+
35.00	+	35.00	+	35.00	+
36.00	+	36.00	+	36.00	+
37.00	+	37.00	+	37.00	+
38.00	+	38.00	+	38.00	+
39.00	+	39.00	+	39.00	+
40.00	+	40.00	+	40.00	+
41.00	+	41.00	+	41.00	+
42.00	+	42.00	+	42.00	+
43.00	+	43.00	+	43.00	+
44.00	+	44.00	+	44.00	+
45.00	+	45.00	+	45.00	+
46.00	+	46.00	+	46.00	+
47.00	+	47.00	+	47.00	+
48.00	+	48.00	+	48.00	+
49.00	+	49.00	+	49.00	+
50.00	+	50.00	+	50.00	+
51.00	+	51.00	+	51.00	+
52.00	+	52.00	+	52.00	+
53.00	+	53.00	+	53.00	+
54.00	+	54.00	+	54.00	+
55.00	+	55.00	+	55.00	+
56.00	+	56.00	+	56.00	+
57.00	+	57.00	+	57.00	+
58.00	+	58.00	+	58.00	+
59.00	+	59.00	+	59.00	+
60.00	+	60.00	+	60.00	+
61.00	+	61.00	+	61.00	+
62.00	+	62.00	+	62.00	+
63.00	+	63.00	+	63.00	+
64.00	+	64.00	+	64.00	+
65.00	+	65.00	+	65.00	+
66.00	+	66.00	+	66.00	+
67.00	+	67.00	+	67.00	+
68.00	+	68.00	+	68.00	+
69.00	+	69.00	+	69.00	+
70.00	+	70.00	+	70.00	+
71.00	+	71.00	+	71.00	+
72.00	+	72.00	+	72.00	+
73.00	+	73.00	+	73.00	+
74.00	+	74.00	+	74.00	+
75.00	+	75.00	+	75.00	+
76.00	+	76.00	+	76.00	+
77.00	+	77.00	+	77.00	+
78.00	+	78.00	+	78.00	+
79.00	+	79.00	+	79.00	+
80.00	+	80.00	+	80.00	+
81.00	+	81.00	+	81.00	+
82.00	+	82.00	+	82.00	+
83.00	+	83.00	+	83.00	+
84.00	+	84.00	+	84.00	+
85.00	+	85.00	+	85.00	+
86.00	+	86.00	+	86.00	+
87.00	+	87.00	+	87.00	+
88.00	+	88.00	+	88.00	+
89.00	+	89.00	+	89.00	+
90.00	+	90.00	+	90.00	+
91.00	+	91.00	+	91.00	+
92.00	+	92.00	+	92.00	+
93.00	+	93.00	+	93.00	+
94.00	+	94.00	+	94.00	+
95.00	+	95.00	+	95.00	+
96.00	+	96.00	+	96.00	+
97.00	+	97.00	+	97.00	+
98.00	+	98.00	+	98.00	+
99.00	+	99.00	+	99.00	+
100.00	+	100.00	+	100.00	+

Reduction of 14C 765 to 14C 762 as standard 45

X				X-5	4-7
1	9.53 a	+ 13.21 b	+ c =	+ 1088	+ 392
2	10.06 a	+ 23.54 b	+ c =	+ 1064	+ 426
3	19.60 a	+ 30.47 b	+ c =	+ 1046	+ 441
4	23.04 a	+ 16.44 b	+ c =	+ 1098	+ 430
5	26.01 a	+ 20.78 b	+ c =	+ 1058	+ 436
6	26.09 a	+ 30.89 b	+ c =	+ 1035	+ 458
A	17.71	21.18			
	39.19 a	+ 67.22 b	+ 3c =	+ 3198	+ 1259
	74.14 a	+ 68.11 b	+ 3c =	+ 3191	+ 1369
	58.58 a	+ 50.43 b	+ 3c =	+ 3244	+ 1303
	54.75 a	+ 84.90 b	+ 3c =	+ 3145	+ 1325
f	+ 34.95 a	+ 0.89 b	= -	7	+ 110
	- 3.83 a	+ 34.47 b	= -	99	+ 22
	+ 3.63 a	+ 0.10 b	= -	1	+ 12
	+ 0.10 a	+ 0.89 b	= +	3	- 1
	35.05 a =		= -	4	+ 109
		34.57 b	= -	100	+ 33
	Δy	a =	Δy		
	a = -0.11	b = -2.89	d = 3.10	e = 0.99	

Reduction of MC 763 cont.

46

+ 3198	+ 1267
-as + 4	-ds - 122
-by + 195	-ey - 66
3c 3397	+ 1071
c2 + 1132	+ 357

Reduction. x

star	1	2	3	4	5	6	Paragon
c	+ 1132	1132	1132	1132	1132	1132	1132
as	- 1	- 2	- 2	- 3	- 3	- 3	- 2
by	- 38	- 68	- 87	- 48	- 60	- 89	- 61
Comp	+ 1093	1063	1043	1081	1069	1040	1069
WDS	88	64	46	98	58	35	1064
o-c	- 5	+ 1	+ 3	+ 17	- 11	- 5	- 5
f	+ 357	357	357	357	357	357	357
ds	+ 30	32	61	73	82	77	56
ey	+ 13	- 23	+ 30	+ 16	- 21	+ 31	+ 21
Comp	400	412	448	446	460	465	434
y-y	392	426	441	455	456	458	435
o-c	- 8	+ 14	- 7	+ 11	- 4	- 7	+ 1

Σv^2	mx	495	my	496
Σ^2		124		124

Possible error of one difference between plates

± 7.5

± 7.5

u

± 0.35

± 0.35

Reduction of MC 963 cont.

46

+ 3198	+ 1257
- ds + 4	- 122
- by + 195	- 66
30 3397	+ 1071
C = + 1132	+ 357

Reduction	X						
Star	1	2	3	4	5	6	Perigon
C	+ 1132	1132	1132	1132	1132	1132	1132
ds	- 281	2	2	2	2	2	2
by	- 38	- 68	- 57	- 48	- 60	- 89	- 61
Comb	+ 1093	1063	1043	1081	1069	1040	1069
WDS	88	64	46	98	58	35	1064
O-C	- 5	+ 1	+ 3	+ 17	- 11	- 5	- 5
f	+ 357	357	357	357	357	357	357
ds	+ 30	32	61	78	82	77	506
by	+ 13	23	30	16	21	31	21
Comb	400	412	448	446	460	465	434
WDS	392	426	441	452	456	458	425
O-C	- 18	+ 14	+ 7	+ 14	- 4	7	+ 1

$\sum v^2$ in x 495

in y 496

$\sum z$ 124

124

Probable error of one difference between plates

± 7.5

± 7.5

± 1.1

± 1.1

Purveyor plates

Computation of Standard Coordinates

57

		Positions of Stars.				1875.0			
						mag			
1	7 ^h 36 ^m 56. ^s 36	+	6 ^h 34'	47.8	8.3	AG	Lp2	4068	
2	7 36 43.79		5 14 36.1	7.4			Lp2	4063	
3	7 31 49.15		4 19 30.7	8.7		Albany		2936	
4	7 29 55.31		6 8 12.9	5.9			Lp2	3965	
5	7 28 24.46		5 34 6.6	8.1			Lp2	3949	
6	7 28 58.06		4 15 36.7	8.2		Albany		2912	

Systematic corrections to these. Boss. P.C.C. pp 300, 11

$$AG Lp2 + 0^s.005 - 0''.05$$

$$AG Albany + 0.006 + 0.22$$

+ magnitude equation

$$Lp2: 8.3 - .054$$

$$7.4 - .044$$

$$5.9 - .026$$

$$8.1 - .052$$

Albany

$$8.7 - .068$$

$$8.2 - .062$$

The position of Purveyor still needs correction for parallax

$$\Delta x = \pi R \cos D / \sin(A - \alpha)$$

$$\Delta y = \pi R (\sin D \cos \delta - \cos D \sin \delta \cos A)$$

$$\Delta x + 0.79 \pi \pi = 0''.32$$

$$\Delta y = -0.37 \pi \pi = 0''.32$$

$$\Delta x = +0''.25 = +0.0005$$

$$\Delta y = -0.12 = -0.0002$$

Purveyor Boss P.C.C. center of gravity of stars

$$1900.0 \quad \alpha \quad 7 \quad 34 \quad 4.108 \quad \delta \quad + \quad 5^{\circ} \quad 28' \quad 53''.38$$

$$\text{Red. to } 1875.0 \quad - \quad 1 \quad 18.600 \quad + \quad 3 \quad 44 \quad 45$$

$$\text{C.G. 1875} \quad 7 \quad 32 \quad 45.508 \quad 5^{\circ} \quad 32' \quad 37''.83$$

$$\text{Red. to } 1910.9 \quad - \quad 0.47 \quad - \quad 1.01$$

$$\text{P. 14 back to } 1910.9 \quad - \quad 1.677 \quad - \quad 36.94$$

$$\text{Position } 1910.9 \rightarrow 7 \quad 32 \quad 43.789 \quad 5^{\circ} \quad 37' \quad 59''.88$$

Equinox 1875 April 1910.9

P. 1000

Comparison of Standard

P. 1000

1	7	30	40.30	1	24	40.30	40.30
2	7	30	40.30	2	24	40.30	40.30
3	7	31	40.30	3	24	40.30	40.30
4	7	32	40.30	4	24	40.30	40.30
5	7	33	40.30	5	24	40.30	40.30
6	7	34	40.30	6	24	40.30	40.30

2nd + 3rd

1	7	30	40.30	1	24	40.30	40.30
2	7	31	40.30	2	24	40.30	40.30
3	7	32	40.30	3	24	40.30	40.30
4	7	33	40.30	4	24	40.30	40.30
5	7	34	40.30	5	24	40.30	40.30
6	7	35	40.30	6	24	40.30	40.30

1	7	30	40.30	1	24	40.30	40.30
2	7	31	40.30	2	24	40.30	40.30
3	7	32	40.30	3	24	40.30	40.30
4	7	33	40.30	4	24	40.30	40.30
5	7	34	40.30	5	24	40.30	40.30
6	7	35	40.30	6	24	40.30	40.30

Pawson plates

Computation of Standard Coordinates

47

Positions of Stars 1875.0

1	7 ^h 36 ^m 56.36	+ 6° 34' 47.8	8.2 AG	Lp2	40 68
2	7 36 43.79	5 14 36.1	7.4	Lp2	40 63
3	7 31 49.15	4 19 30.7	8.7	Albany	29 36
4	7 29 53.31	6 8 12.9	5.9	Lp2	39 65
5	7 28 24.46	5 34 6.6	8.1	Lp2	39 49
6	7 28 58.06	4 15 36.7	8.2	Albany	29 12

Systematic corrections to stars Boss. P.C.C. pp 200, 11

10 Lp2 +0.005 - 0".05

10 Albany +0.006 +0.22

4 magnitude equation

Lp2	Albany
8.3 - .054	8.7 - .068
7.4 - .044	8.2 - .062
5.9 - .026	
8.1 - .052	

The position of Pawson will need correction for parallax

$$\Delta x = \pi R \cos D / \sin(A - \alpha)$$

$$\Delta y = \pi R (\sin D \cos \delta - \cos D \sin \delta \sin \alpha)$$

$$\Delta x = +0.79 \pi = 0".22$$

$$\Delta y = -0.37 \pi = -0".12$$

$$\Delta x = +0.25 = +0.0005$$

$$\Delta y = -0.12 = -0.0002$$

Pawson

Boss

P.C.C.

center of gravity

1900.0	10	7 34	4.108	5 + 5" 24' 53".38
Red. to	-	1	18.600	+ 3 44 45
1875.0				
C.G. 1875	7	32	45.508	5-0 32' 37" 89
Red. to				
mean star 1910.9	-		0.42	- 1.91
P. 17 back to	-		1.673	- 36 98
1910.9	7	32	43.789	5-0 31' 53" 84
Red. to C.G.	-		0.42	- 1.01

Computation of Standard Coordinates 48

with Corrected Star-places & scale value 466".50

$$\xi = [8.50724] (\alpha - A + \Delta\alpha) + \frac{\xi(\xi^2 + \eta^2)}{398000} \quad \text{Sept 8, 13}$$

$$\eta = [7.33115] (\delta - 0 + \Delta\delta) + [7.0534] \xi^2 \tan \delta$$

($\kappa = 15.4222$)

Center assumed at $A = 7^h 32^m 36^s$ $D = 5^\circ 25' 30''$

In this case the mean is upside down. so long
values of ξ & η must be changed.

Star 1

α	7 36 56.31	δ	+ 6 34 47.8
$\alpha - A$	+ 4 21.31	$\delta - D$	+ 1 9 17.8
$\alpha - A + \Delta\alpha$	+ 261.30	$\delta - D + \Delta\delta$	+ 4158.4
\log	2.41714	\log	3.61892
$\cos \delta$	9.99713	\cos	7 33115
\cos	8.50724	$\log \eta_0$	0.95007
$\log \xi_0$	0.92154	$\log \xi^2$	1.8430
ξ_0	+ 8.3466	$\tan \delta$	9.0619
ξ_2	+ 31	\cos	7.0534
$-\xi$	+ 8.3497	$\log \eta_1$	7.9583
κ_{701}	9.5358	η_0	+ 8.9140
\log	17 8855	η_1	+ 0091
$\kappa - \xi$	- 1145	$-\eta$	+ 8.9231
		η_{701}	13.2073
		$\log \eta$	22 1304
		$\eta - \eta$	+ 1304

Computation of Standard Coordinates 48

with Corrected Star-places & single value 466".30

$$\xi = [8.50724] (\alpha - A + \Delta\alpha) + \frac{\xi(\xi' - \eta')}{298000} \quad \text{Sept 8, 13}$$

$$\eta = [7.33115] (\delta - 0 + \Delta\delta) + [7.0534] \xi^2 \tan \delta$$

$\delta = 15.42551$

Center assumed at $A = 7^h 32^m 34^s$ $D = 5^h 24^m 30^s$

In this case the sign is opposite above so the signs of ξ & η must be changed.

Star 1

α	7 36 56.31	δ	+ 6 24 47.8
$\alpha - A$	+ 4 21.31	$\delta - 0$	+ 1 9 17.8
$\alpha - A + \Delta\alpha$	+ 261.30	$\delta - 0 + \Delta\delta$	+ 4158.4
\log	2.41714	\log	3.61892
$\cos \delta$	9.99713	\cos	7.33115
\cos	8.50724	$\cos \eta_0$	0.95007
$\log \xi_0$	0.92154	$\log \xi^2$	1.8430
ξ_0	+ 8.3466	$\tan \delta$	9.0619
ξ_2	+ 31	\cos	7.0534
ξ	+ 8.3497	$\log \eta_1$	7.9583
η_{20}	9.5358	η_0	+ 8.9140
η_{21}	17.8855	η_1	+ 0.091
$\eta - \xi$	- 1145	$-\eta$	+ 8.9231
		η_{20}	13.2073
		η_{21}	22.1304
		$\eta - \eta$	+ 1304

Star 2

3

4

49

α	7 36 43.75	7 31 49.09	7 29 55.29
$\alpha-A$	+ 4 8.75	- 0 45.91	- 2 39.71
$\alpha-A+\delta A$	+ 2 48.74	- 45.91	- 159.71
l_r	2. 39575	1. 66191 m	2. 20333 m
$l_{cos\delta}$	9. 99818	9. 99877	9. 99751
l_{δ_0}	0. 90117	0. 16792 m	0. 70808 m
δ_0	+ 7. 9647	- 1. 4720	- 5. 1060
δ_2	+ 13	0	- 7
$-S$	+ 7. 9660	- 1. 4720	- 5. 1067
X	10 0654	19. 6000	23. 0376
$X-E$	+ 314	+ 1280	- 691
S	+ 5 14 26.1	+ 19 30.9	6 8 12.9
$S-D$	- 11 3.9	- 1 5 59.1	+ 0 42 42.9
$S-D+\delta S$	- 663.9	- 3959.5	+ 2562.9
l_{eq}	2. 82210 m	3. 59765 m	3. 40873
	15325		
$l_r \eta_1$	0. 15325	0. 92880 m	0. 73988
δ_2	1 802	0. 336	0. 416
$\tan\delta$	8. 962	8. 878	9. 031
l_{η_2}	7. 817	6. 267	7. 500
η_1	- 1. 4232	- 8. 4878	+ 5. 4939
η_2	+ 66	+ 2	+ 32
$- \eta$	- 1. 4276	- 8. 4876	+ 5. 4971
η	23. 5361	30 4691	+ 16 4433
$\eta-\eta$	+ 1086	+ 188	- 596

Star 2

2

4

$$\begin{aligned}
 a & 7.36 \quad 42.75 \\
 a-H & + 4 \quad 5.75 \\
 x-H+SA & + 248.74
 \end{aligned}$$

$$\begin{aligned}
 7 & 31 \quad 49.04 \\
 - & 0 \quad 45.91 \\
 - & \quad 41.91
 \end{aligned}$$

$$\begin{aligned}
 7 & 29 \quad 55.29 \\
 - & 2 \quad 39.71 \\
 - & \quad 159.71
 \end{aligned}$$

$$\begin{aligned}
 Lr & 2.39575 \\
 Lcos\delta & 9.99518
 \end{aligned}$$

$$\begin{aligned}
 1.66191 \\
 9.99877
 \end{aligned}$$

$$\begin{aligned}
 2.20333 \\
 9.99751
 \end{aligned}$$

$$L\delta_0 \quad 0.90117$$

$$0.16792$$

$$0.70808$$

$$\begin{aligned}
 S_0 & + 7.9647 \\
 S_2 & + \quad 13
 \end{aligned}$$

$$\begin{aligned}
 -1.4720 \\
 0
 \end{aligned}$$

$$\begin{aligned}
 -5.1060 \\
 7
 \end{aligned}$$

$$\begin{aligned}
 -S & + 7.9660 \\
 X & 10 \quad 0654
 \end{aligned}$$

$$\begin{aligned}
 -1.4720 \\
 19.6000
 \end{aligned}$$

$$\begin{aligned}
 -5.1067 \\
 23.0376
 \end{aligned}$$

$$x-E \quad + 0.314$$

$$+ 1.280$$

$$- 691$$

$$S + 5.14.26.1$$

$$4 \quad 19.30.9$$

$$6 \quad 8 \quad 12.9$$

$$S-O \quad - \quad 11.3.9$$

$$-1 \quad 5.59.1$$

$$+0 \quad 42.42.9$$

$$S-O+SD \quad - \quad 663.9$$

$$- 3959.5$$

$$+ 2562.9$$

$$\begin{aligned}
 Lr & 2.82210 \\
 & 153.25
 \end{aligned}$$

$$3.59765$$

$$3.40873$$

$$Lr \eta_1 \quad 0.15325$$

$$0.92850$$

$$0.73988$$

$$\begin{aligned}
 S_2 & 1.802 \\
 Lcos\delta & 8.962
 \end{aligned}$$

$$\begin{aligned}
 0.236 \\
 8.878
 \end{aligned}$$

$$\begin{aligned}
 1.416 \\
 9.031
 \end{aligned}$$

$$L\eta_2 \quad 7.817$$

$$6.267$$

$$7.500$$

$$\begin{aligned}
 M_1 & -1.4232 \\
 M_2 & + \quad 66
 \end{aligned}$$

$$\begin{aligned}
 -8.4878 \\
 + \quad 2
 \end{aligned}$$

$$\begin{aligned}
 +5.4939 \\
 + \quad 32
 \end{aligned}$$

$$-M \quad -1.4276$$

$$-8.4876$$

$$+5.4971$$

$$U \quad 23.5361$$

$$30.4691$$

$$+16.4433$$

$$q-M + 1085$$

$$+ 185$$

$$- 596$$

Star 5-

6

Puckon.

α 7 28 24.40
 $\alpha-A$ - 4 40.60
 $\alpha-A-\alpha$ - 230.59

7. 28 58.01
 - 3 3 36.99
 - 216.98

7 32 43.79
 + 8.79

\log 2. 38896 m
 $\cos \delta$ 9. 99795

2. 33642 m
 9. 99879

0. 94400
 9. 99797

$\log \Sigma$ 0. 90415 m

0. 84245 m

9. 44921

Σ_0 - 8. 0198
 Σ_2 - 13

- 6. 9575
 - 22

+ 0. 2813
 0

- Σ + 8. 0278
 \times 26. 0082

- 6. 9597
 25 0929

+ 0. 2813
 17. 7144

$\Sigma-S$ - - 129

+ ~~1526~~
 + 1332

+ - 43

δ + 5 34 6.6

4 15 36.9

5 21 59.8

$\delta-D$ + 8' 36.6

- 1 9 53.1

+ 6 29.8

$\delta-D+\delta D$ + 5-16.6

- 4193.6

+ 389.8

\log 2. 71315

3. 62259 m

2. 59084

$\log \eta_1$ 0. 04430

0. 95374 m

9. 92299

$\log \Sigma^2$ 1. 808
 $\tan \delta$ 8. 989

1. 685
 8. 874

8. 000
 8. 986

$\log \eta_2$ 7. 850

7. 692

5. 039

η_1 + 1. 1074

- 8. 9896

+ 0. 8386

η_2 + 20

+ 49

0

- η + 1. 1148

- 8. 9855

+ 0. 8386

γ 20 7828

30 8900

21 1774

$\gamma-\eta$ - 1028

- 955

+ 130

Star 5-

6

Peyou

α	7	28	24.40	7.	28	56.01	7	32	48.79
A	-	A	40.60	-	3	36.99	+		8.79
-84	-		250.57	-		216.98			
δ			2.38896	2.	33642				0.94400
δ			9.99795	9.	99879				9.99797
ϵ_0			0.90465	0.	84245				9.44921
ϵ_0	-		8.0198	-	6.9575				+0.8813
ϵ_2	-		13		22				0
-5	+		8.0216	-	6.9597				+0.2813
X			26.0052	25	0929				17.7144
X-5	-		129	+	2526				243
				+	1332				
δ	+	5	34 6.6	4	15 36.9		5	31	59.8
$\delta-D$	+		8' 36.6	-	1 9 53.1		+	6	29.8
$\delta-D+D$	+		5-16.6	-	4193.6		+		389.8
log			2.71315	3.	62259				2.59084
log q_1			0.04430	0.	95374				9.92899
log q_2			6.808	1.	685				9.000
log q_3			8.989	8.	874				8.986
log q_4			7.850	7.	682				5.039
q_1	+		1.1074	-	8.9896		+		0.8356
q_2	+		71	+	41				0
- q_1	+		1.1145	-	8.9855		+		0.8356
y			20 7828	30	8900				21 1774
4-y	-		1027	-	955		+		130

Reduction of Catalogue Places

57

I Preliminary correction for orientation

$$\Delta(x-5) = -144 (y-13) \quad \Delta(y-7) = +144 (x-10)$$

Star	1	2	3	4	5	6	A
$x-5$	-1145	+314	+1280	-691	-129	+1332	-43
Corr	-30	-1517	-2516	-495	-1121	-2576	-1178
Sum	-1175	-1203	-1236	-1186	-1250	-1244	-1221
add	1216						
O-C	+41	+13	-20	+30	-34	-28	-5
$y-7$	+1304	+1180	-185	-596	-1027	-965	+130
Corr	-63	+9	+1382	+1877	+2305	+2173	+1111
Sum	+1241	+1194	+1197	+1281	+1278	+1218	+1241
Subt	-1235						
O-C	+6	-41	-38	+46	+43	-17	+6

The final residuals on the next page show

(N) 12 comp. stars 1211 m.v. 33 m.y.
including Poryon 1345 " 58 " y

Taking both x & y together, the probable error of comparison of one coordinate is

Comparison stars $\pm 9.7 = \pm 0".45$

Including Poryon $\pm 9.0 = \pm 0".42$

O-C for Poryon (Plate - Catalogue)

m.v. -12 = -0".58 = -0".037 m.y. +5 = +0".23

Very
Satisfactory!

Reduction of Catalogue Places

57

I Preliminary correction for orientation

$$\Delta(x-5) = -144(y-13) \quad \Delta(y-4) = +144(x-10)$$

Star	1	2	3	4	5	6	A
$x-5$	-1145	+314	+1280	-691	-129	+1332	-43
Corr	-30	-1517	-2516	-495	-1121	-2576	-1178
Sum	-1175	-1203	-1236	-1186	-1250	-1244	-1221
add	1216						
O-C	+41	+13	-20	+30	-34	-28	-5
$y-4$	+1304	+1180	-145	-596	-1027	-963	+130
Corr	-63	+9	+1382	+1877	+2300	+2173	+1111
Sum	+1241	+1194	+1197	+1281	+1278	+1218	+1241
Subt	-1235						
O-C	+6	-41	-38	+46	+43	-17	+6

The final residuals on the next page gave
 (Nv) two comp. stars 1211 m.v. 33 m.v.
 including Puvyon 1342 m.v. 58 m.v.

Taking both x & y together, the probable error of comparison of one coordinate is

$$\text{Comparison stars } \pm 9.7 = \pm 0".45$$

$$\text{Including Puvyon } \pm 9.0 = \pm 0".42$$

O-C for Puvyon (Plate - Catalogue)

$$\Delta x - 12 = -2".36 = -0".337 \text{ m.v. } \Delta y = +0".33$$

Very Satisfactory!

Reduction continued. For equations
see p 45

82

	Δy	Δy
$39.2 a + 67.2 b + 3c =$	$+34$	-73
$74.1 a + 68.1 b + 3c =$	-32	$+72$
$68.6 a + 50.4 b + 3c =$	$+37$	$+95$
$64.8 a + 84.9 b + 3c =$	-35	-96
$+34.9 a + 0.9 b$	$= -66$	$+145$
$-3.8 a + 34.5 b$	$= -72$	-191
$357.0 a$	$= -64$	$+150$
$84.6 b$	$= -79$	-175

$a = -1.83$ $b = -2.27$ $d = +4.28$ $e = -5.05$
 $c = +87$ $f = +33$

Reduction of X by

Star	1	2	3	4	5	6	A
ax	-17	-19	-36	-43	-48	-46	-30.5
by	-30	-53	-69	-37	-47	-70	-48.2
c	+86	+86	+86	+86	+86	+86	+86
comp	+39	+16	-19	+6	-9	-30	+7
obs	+41	+13	-20	+30	-34	-28	-5
O-C	+2	-7	-7	+24	-25	+7	-12
Δy	+41	+43	+84	+98	+112	+108	+76.5
ey	-67	-119	-154	-83	-105	-102	-107.5
f	+33	+33	+33	+35	+33	+33	+33
comp	+14	-43	-32	+48	+39	-15	+4
obs	+6	-41	-38	+46	+43	-17	+6
O-C	-8	-5	+18	-9	-3	-19	-1
O-C	+2	+2	-1	-2	+4	-2	+5

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Reduction continued. For equations
see p 43

32

	Δx	Δy
$34.2 a + 67.2 b + 30 =$	$+ 24$	$- 73$
$74.1 a + 68.1 b + 30 =$	$- 32$	$+ 72$
$68.6 a + 50.4 b + 30 =$	$+ 37$	$+ 96$
$64.8 a + 84.9 b + 30 =$	$- 32$	$- 96$
$+ 34.9 a + 0.9 b =$	$- 66$	$+ 145$
$- 3.8 a + 34.5 b =$	$- 72$	$- 191$
$347.0 a =$	$- 64$	$+ 150$
$34.6 b =$	$- 79$	$- 175$

$$a = -1.83 \quad b = -2.27 \quad d = +4.28 \quad e = -5.08$$

$$c = +87 \quad f = +33$$

Reduction of X by

Star	1	2	3	4	5	6	A
Δx	-17	-19	-30	-43	-48	-46	-30.5
Δy	-30	-53	-69	-37	-47	-80	-48.2
c	+86	+86	+86	+86	+80	+86	+86
$\cos p$	+39	+18	-19	+6	-9	-30	+7
\cos	+41	+13	-20	+30	-34	-28	-5
$O-C$	+2	-1	-1	+24	-25	+2	-12
Δx	+41	+43	+84	+98	+112	+108	+70.5
Δy	-67	-119	-154	-83	-105	-146	-107
f	33	33	33	33	33	33	33
$\cos p$	4	-43	-32	-48	-39	-157	+1
\cos	+6	-41	-38	+46	+43	-17	+6
$O-C$	+2	+2	-1	-2	+4	-2	+5

1
9.2
103
19pt
174
23

MC 754

Purizon

Miles 1911 Jan 18

stan

Images very faint

	1	2	3	4	5
9.13	12735 8362 70 ⁵⁵ 33	13068 7442 47 64	1059 4743 49.44 69	1675- 8008 06 81	
	9. 56 29	56 22	36 83	36 72	
2	124571	13285	13468	1471	2443
10 23	5490824700 8788 42	1203140 69 70	8432 31 79	549082 8188 67	
	10. 14 20	14 25	69 56	69 68	
3	11650	12450	1260	1780	
19 30	8734 40 62 40	5346 50 58	7103 04 70	5958 53 806	
	19. 70 92	71 08	58 38	58 40	
Purizon	14316	12790	1756	3358	
17 21	12120 5933 299	4971 82 7270 802	4730 2928 48	10366 70 6271 72	
	17. 78 17	78 26	2975	3000	
4	12908	13388	3641	3361	
23 16	3710 96 698 99 879	12557 48 90	9034 31 39	7963 68 88	
	23. 08 19	08 38	5393	5409	

MC 754

Purizon

Miles 1911 Jan 18

Star

Maps very good

		α	X	λ		α	Y	λ
1								
9.13		12735-		13068		1039		1675-
		8362		7442		4743		8008
		70 ⁵⁵		47		4944		06
		33		64		69		81
		9. 5629		5622		3683		3672
2		12451		13285		1471		2442
10 23		5490		4700		8432		5490 83
		81 ⁸⁸		69 ⁵		2335-		81 88
		42		70 ⁵		31		57
		10. 1420		1425		79		6968
						6956		
3		11650		12450		1260		1760-
19 30		8734		5346		7103		5958
		62		50		04		52
		40		58		70		806
		19. 70.92		7108		5838		5840
Purizon		1431.46		12790		1756		3358
17 21		12125-		4971		4730		10366 70
		2933		7270		2928		6-71
		2989		802		48		72
		17. 7817		7826		2975		3000
4		17908		13388		3641		3361
23 16		3710 96		12551		9034		7963
		698 99		48		31		68
		809		90		39		88
		23. 0819		0838		5393		5409

MC 059

star		X		Y	
5-					
26	20	13050 3764 65 62 39	13040 12317 09 ²⁴ 22 26 50	3192 11847 48 84	1721 3050 52 28
		26. 0726	0721	8662	8676
6					
25-	30	125-26 4381 69 73 76 24	14374 12410 02 20 09 85	2633 12383 76 85 20	3118 3340 40 22
		25. 2051	2065	9761	9782

Mean Coordinates.

	X	X - standard	Y	Y - standard
1	9. 5626	+0.268	13. 3678	+ .1605
2	10. 1422	+0.768	23. 6962	+ .1601
3	19. 7100	+1.100	30. 5839	+ 1.448
4	23. 0828	+0.452	16. 5401	+ 0.968
5	26. 0724	+0.642	20. 8669	+ 0.841
6	25. 2058	+1.129	30. 9772	+ 0.872

Progen 17. 7822 +0.678 21. 2988 + 1.214

14C 759

x		y	
5	13050	13040 ²⁴	3192
26	3764	1231709	1721
	65	2226	3050
	62	50	52
	39	84	28
26.0726	0721	8662	8676
6	12526	14374	2633
25	30	1241002	3118
	158169	12383	3300
	7276	2009	7685
	24	85	40
		20	22
25.2051	2065	9761	9782

Mean Conclunates.

	x	x - standard	y	y - standard
1	9.5626	+0268	13.3678	+1605
2	10.1422	+0768	23.6962	+1601
3	19.7100	+1100	30.5839	+1148
4	23.0828	+0452	16.5401	+0968
5	26.0724	+0642	20.8669	+0841
6	25.2058	+1129	30.9772	+0872

Progen 17.7822 +0678 21.2988 +1214

MC 859 Reduction to Standard MC 862

I Approximate correction for orientation

$$\Delta x = +50 y \quad \Delta y = +50 x$$

Star	$x - \bar{x}$	$50 y$	Sum	Diff from mean
1	+ 268	- 668	- 400	+ 6
2	+ 268	- 1185	- 417	- 11
3	+ 1100	- 1539	- 429	- 23
4	+ 452	- 827	- 375	+ 31
5	+ 642	- 1043	- 401	+ 5
6	+ 1129	- 1548	- 419	- 13
A	+ 678	- 1065	- 387	+ 19
mean			- 406	

	$y - \bar{y}$	$+ 60 x$	Sum	Diff from mean
1	+ 1600	+ 478	+ 2083	- 38
2	1601	+ 507	2108	- 13
3	1148	+ 986	2134	+ 13
4	968	+ 1154	2122	+ 1
5	841	+ 1304	2145	+ 23
6	872	+ 1260	2132	+ 11
Mean	1214	+ 889	2103	- 18
mean			2121	

Mf 759 Reduction to Standard Mc 762

I Approximate correction for orientation

$$\Delta x = +50 y \quad \Delta y = +50 x$$

Star	$x - \bar{x}$	$50 y$	Sum	Diff from mean
1	+ 268	- 668	- 400	+ 6
2	+ 768	- 1185	- 417	- 11
3	+ 1100	- 1529	- 429	- 23
4	+ 452	- 827	- 375	+ 31
5	+ 642	- 1043	- 401	+ 5
6	+ 1129	- 1548	- 419	- 13
A	+ 678	- 1065	- 387	+ 19
mean			- 406	

	$y - \bar{y}$	$+ 60 x$	Sum	Diff from mean
1	+ 1600	+ 478	+ 2083	- 38
2	1601	+ 507	2108	- 13
3	1148	+ 986	2134	+ 13
4	968	+ 1154	2122	+ 8
5	841	+ 1304	2145	+ 23
6	872	+ 1260	2132	+ 11

Program 1214 + 889 2103 - 18

mean 2121

Reduction of plate 759. cont

Mean equations. see p 46

	x	y
$39.2 a + 67.2 b + 3c =$	-28	-38
$74.1 a + 68.1 b + 3c =$	$+23$	$+30$
$58.6 a + 50.4 b + 3c =$	$+42$	-14
$54.8 a + 54.9 b + 3c =$	-47	$+11$
$+34.9 a + 0.9 b$	$= +57$	$+73$
$-3.8 a + 34.5 b$	$= -89$	$+25$
$30 a$	$= +53$	$+72$
$34.6 b$	$= -83$	$+31$

$$a = +1.57 \quad b = -2.40 \quad c = +25$$

$$d = +2.06 \quad e = +0.90 \quad f = -60$$

Red. of x

	2	3	4	5	6	Perman
c	+25	+25	+25	+25	+25	+25
as	+14	+15	+29	+34	+38	+36
by	-32	-57	-73	-37	-50	-74
comp	+5	-11	-19	+22	+13	-13
obs	+6	-11	-23	+31	+5	-13
o-c	+1	0	-4	+9	-8	0
comp	+5	-11	-19	+22	+13	-13
obs	+6	-11	-23	+31	+5	-13
o-c	+1	0	-4	+9	-8	0
Red. of y						
f	-60	-60	-60	-60	-60	-60
ds	+20	+21	+40	+48	+54	+52
ey	+12	+21	+27	+15	+19	+28
comp	-28	-18	+7	+3	+13	+20
obs	-38	-13	+13	+1	+23	+11
o-c	-10	+5	+6	-2	+10	-9

Mean residual for comparison obs

Reduction of plate 759. cont

Mean equations. see p 46

	x	y
39.2 a + 67.2 b + 3c =	-78	-38
74.1 a + 68.1 b + 3c =	+23	+35
58.6 a + 50.4 b + 3c =	+42	-14
54.8 a + 84.9 b + 3c =	-47	+11
+34.9 a + 0.9 b	= +51	+73
-3.8 a + 34.5 b	= -89	+25
35 a =	+53	+72
34.6 b =	-83	+31

$a = +1.51$ $b = -2.40$ $c = +24$
 $d = +2.06$ $e = +0.90$ $f = -60$

Red. of x	2	3	4	5	6	Perigee
c + 24	+24	+24	+24	+24	+24	+24
as + 14	+15	+29	+34	+38	+36	+26
by - 32	-51	-73	-37	-50	-74	-51
Comp + 5	-11	-19	+22	+13	-13	0
obs + 6	-11	-23	+31	+5	-13	+19
o-c + 1	0	-4	+9	-8	0	+19
Red. of y						
f - 60	-60	-60	-60	-60	-60	-60
ds + 20	+21	+40	+48	+52	+52	+36
ey + 12	+21	+27	+15	+19	+28	+19
Comp - 28	-18	+7	+3	+13	+20	-5
obs - 38	-13	+13	+1	+22	+11	-18
o-c - 10	+5	+6	-2	+10	-9	-13

Average residual for comparison stars

MC 760

Pewyon

 57
 Meas 1911 Jan 26?
 "Thursday"

Star

x

y

1.

16880

3684

7600

14045

9.13

13018

7050

4605¹⁰11335²⁰

20

50

13

33

83

85

090

43

9. 3866

3863

13. 2713

2711

2

17378

3635

5890

13693

9.4 23

8095

12910

11595

7681

48⁰⁰

11

94⁰⁰

84

80

25

77

95

9. 9287

9266

23. 6012

6012

3

13791

1789

2873

11724

14 30

9002

6482

4080

6486

06⁰³

84

88⁷⁸

88

8820

95

49

17

19. 5707

4690

30. 5220

5234

4

~~1824313730~~~~4470~~

1110

23 16

~~9820~~~~6220~~

9388

6165

~~70~~~~68~~

21

62

14443

10091

16. 4934

5941

4

14142

2373

22. 16

5230³⁰

12306

30

15⁰⁶

69

83

22. 8936

8925

MC 760

Pewyom

 57
 Tues 1911 Jan 26?
 "Thursday"

star

x

4

1.	16880	3684	7100	14045
9.13	13018	7050	9808	11335
	20	50	13 ¹⁰	3330
	83	85	090	43
9.	3866	3863	13. 2713	2711

2	17378	3635	5890	13693
9.4 23	8095	12910	11898	7681
	48 ⁰⁰	11	94 ⁰⁰	84
	80	25	77	90
9.	9287	9265	23. 6012	6012

3	13991	1789	2873	11724
14 30	9002	6482	4080	6486
	0603	84	8678	88
	4820	98	49	17
19.	5802	4690	30. 5220	5234

4	1224313	30	4470	1110
23 16	9326	6220	9388	6165
	20	68	71	62
			14443	10099
			16. 4934	4941

4	14142	2372		
22. 16	5230	12006		
	30 ³⁰	1506		
	68	83		
22.	8936	8925		

140 7600
 Prayon
 Reason Right side up. unlike type 3 previous plates

17. 21	12805	2830 1736	3 590	11870
	7081	8584 7470 84	5-90 10	95-29
	86 83	88 10 80 67 90	12	3130
	34	12800 45	74	62
17. 57 38	5749	5800	21. 23 23	23 39
	5744			
5-				
26- 20	14220	3200	20 45	13100
	55-68	119 10	103 21	48040
	72 70	15	18	6599
	53	53	17	3084
25. 86 78	8660	20. 82 97		82 85
6	11470	4008	40 18	14294
24 30	1865-58 61	13653	13378	459080
	75 52 57	58 50	75-80	40 84
	98	124	13990	65
24. 96 38	9631	30. 93 86		93 88

mean Coordinates

1	9. 3864	13. 2712
2	9. 9276	23. 6012
3	19. 4696	30. 5227
4	22. 8930	16. 4938
5	25. 8669	20. 8291
6	24. 9634	30. 9382

Prayon 17. 5741 21. 2331

14C 760 Prvion
 Resonance Night side up. unlike ~~type~~ 3 previous plates

Prvion

x

y

17. 21	12805	2830	1736	3590	11870
	7081	8588	7470	5908	9529
	86	93	88	10	2130
	34	12400	435	74	62
17. 5738	5749	5740	21. 2323	2339	
5-		5744			
26- 20	14220	3240	2048	13110	
	5568	11910	10321	48040	
	7220	15	18	0599	
	53	53	18	3084	
25. 8678	8660	20. 8297	8285		
6	11470	4008	4018	14294	
24 30	186558	13653	13378	46905	
	75	5259	75	4081	
	98	124	13990	85	
24. 9638	9631	30. 9386	9378		

Mean Coordinates
 x

y

1	9.3864	13. 2712
2	9.9276	23. 6012
3	19.4696	30. 5227
4	22.8930	16. 4938
5	25.8669	20. 8291
6	24.9634	30. 9382

Prvion 17. 5741

21. 2331

MC 760 Reduction to MC 762 as standard

59

Approx. correction for refraction $\Delta R = -114 + 1639$
 $\Delta y = +11x - 75.2$

Star	1	2	3	4	5	6	Parallax
$x - \bar{x}$	-1494	-1378	-1304	-1446	-1413	-1295	-1403
$+11y$	-146	260	-336	-181	-229	-340	-234
Sum	-1640	-1628	-1640	-1637	-1642	-1635	-1637
$0 - C$	-	1	1	2	3	4	2

Extraordinarily close agreement. Cannot be further improved

$y - \bar{y}$	+639	+651	+536	+525	+463	+482	+557
$+11x$	+103	+109	+214	+252	+285	+275	+193
Sum	+742	+760	+750	+757	+748	+757	+750
$0 - C$	-10	+8	-2	+5	-4	+5	-2

These can be very slightly improved

$$399.51d + 09.21e + 3f = -4$$

$$74.1d + 68.1e + 3f = +6$$

$$55.6d + 50.41e + 3f = +19$$

$$64.5d + 84.91e + 3f = +11$$

$$31.2a + 0.9b = +10$$

$$3.8a + 34.5b = +20$$

$$d = +0.3, e = +0.6, f = +16$$

f	+18	-18	-18	-18	-18	-18	+18
25	+3	+3	+6	+7	+8	+7	+5
10	+8	+14	+19	+10	+18	+21	+13
100	-7	-3	+7	-1	+3	+10	0
10	-10	+8	-2	+5	-4	+5	-2
$0 - C$	-3	+5	-9	+4	-7	+5	-2

$$\text{Average residual in } x = 2 = 0''.09$$

$$\text{in } y = 5.5 = 0''.26$$

Extremely good.

MC 760 Reduction to MC 760 as standard

Approx. correction for overfitting $\Delta x = -11.4 + 16.39$
 $\Delta y = +11.2 - 75.7$

Star	1	2	3	4	5	6	Paragon
$V - \Sigma$	-1494	-1378	-1304	-1446	-1413	-1295	-1403
$\rightarrow 11.4$	-146	260	-336	-151	-229	-340	-234
Sum	-1640	-1118	-1640	-1637	-1642	-1636	-1637
$d - c$	-1	+1	-1	+2	-3	+4	+2

Extraordinary, close agreement. Can not be further improved

$y - y$	+639	+652	+526	+505	+462	+452	+557
$+11.2$	+103	+109	+214	+252	+285	+275	+193
Sum	+742	+760	+740	+757	+747	+727	+750
$d - c$	-10	+8	-2	+5	-4	+5	-2

There can be very slightly improved

$$39.1d + 67.2e + 2f = -4$$

$$74.1d + 68.1e - 3f = +6$$

$$51.6d + 10.4e + 3f = +9$$

$$64.6d + 24.9e - 3f = +12$$

$$25.2a + 0.9b = +10$$

$$2.1a + 34.2b = +20$$

$$d = +0.2, e = +0.6, f = +16$$

f	-10	-18	-18	-18	-18	-18	-18
aE	+3	+3	+6	+7	+8	+7	+5
bq	+8	+14	-19	+10	+18	+21	+13
Cmp	-7	-3	+7	-1	+3	+10	0
ds	-10	+2	-2	+5	-4	+2	-2
dC	-3	+5	-9	+4	-7	+5	-2

Analogy residual in $x = 2 = 1.0''09$

$\ln y = 5.5 = 0''.20$

Exhaustively good.

17C 761

Pavonon

meas Jan 28 1911

600

Star	x	rem good place	y	
1	9.13	125572 240394 38896 64	17782 11865- 62 05-	13111 5582 7868 11140 70 41 3099 608
	9.	5-8 36	5-8 53	13. 5-5-36 5-5-44
2	10.23	53-11 5555- 58 26	14385- 14328 1822 57	14823 25 5914 20 14 12 13 6425- 10339 43 45-
	10.	00 44	00 62	23. 8896 8898
3	14 30	5836 748272 7075 52	14610 9961 60 10	12613 2418 14341 30-41 78 598 12429
	19.	46 31	4650	30. 9265 9252
4	23 16	3358 3870 72 72	13400 12868 70 00	12269 3574 2884 12448 7680 50 5-2 70-
	23	0513	0531	16. 9373 9374
Pavonon	17.21	2830 961008 15-1609 50	14420 7650 5-241 48 57 40 56 08	12228 13115 608891 4220 9788 22 26 09
	17	6768	6765	21. 6136 6108

17C 761

Pavillon

Lucas Jan 26, 1911

66

Star		near foot plate		
1	9.13	12 6 12	17732	13111
		2403 94	11865	7268
		388 96	62	70
		64	05	3099
9.	58 36	58 53	13.	55 36
				55 44
22	53 11	14 385	14 523	25
23	55 15	14 385	5914	20
Run R line	58	12 22	14	12
	26	57	12	43
10.	00 44	00 62	23.	8896
				8898
4	5836	14610	12613	2418
4-30	748-72	9961	143-1 41	11682
	70 75	60	35	78
	52	10	378	12417
19.	46 31	4650	30.	9268
				9252
16	2358	13400	12269	3574
23 16	3810	12468	2884	12448
	72	90	76 50	50
	72	00	52	70
23	05 13	05 31	16.	9373
				9374
Pavillon	2830	14420	12228	13115
17. 21	9610 08	7550 52 41	60289	9220 21
	15 109	48 51 00	97 58	22
	50	18	50	09
17	6768	6765	21.	6136
				6108

Mc 761

Prayer on

meas 1911 Jan 28

Star

x

y

5					
216.521	2170	13324	11346	2254	
	11938	3649 ⁴⁰	8250	5337	
	48 ³⁹	46	54 ⁵³	35	
	86	29	12	50	
26. 9756	9783		21. 3084	3086	
6			16840	15145	
24. 30	2150	13370	12778	9204	
	16682	3651	7284	0249	
	7884	52	20	46	
	70	70			
24. 9510	9518		31. 4054	4056	

means

Star

x

y

1	9.5544	13.5540
2	10.0053	23.8597
3	19.4640	30.9258
4	23.0522	16.9374
5	25.9770	21.3085
6	24.9514	31.4053
Prayer on	17.6766	21.6121

Mc 761

Princeton

June 1, 1957

Star

X

y

26.21

2170

13324

11346

2254

11438

364940

8250

5339

4839

46

5453

38

86

29

12

53

26. 9756

9783

21. 3084

3086

6

25. 34

7150

13370

16840

15145

16582

3851

12778

9204

7854

52

72

0299

70

20

20

46

24. 9510

9518

31. 4054

4056

Means

for further improvement

Star

y

1

9. 5844

13. 5540

2

10. 0053

23. 8897

3

19. 4640

30. 9258

4

23. 0522

16. 9374

5

25. 9770

21. 3085

6

24. 9514

31. 4053

Princeton

17. 6766

21. 6121

MC 761 Approximate Reduction

	Star 1	2	3	4	5	6	Perman
X-E	+486	-601	-1360	+146	-312	-1415	-378
+108y	+1462	+2580	+3340	+1829	+2301	+3392	+2344
Sum	+1949	+1979	+1980	+1975	+1989	+1977	+1966
Sub	1975						
O-C	-26	+4	+5	0	+14	+2	-9

4-7	+3467	+3536	+4567	+4941	+5257	+5153	+4347
-108x	-1035	-1081	-2102	-2490	-2806	-2695	-1909
Sum	+2432	+2455	+2465	+2451	+2451	+2460	+2438
Sub	2452						
O-C	-20	+3	+15	-1	-1	+8	-14

Equations for further improvement

$$\begin{array}{rcl}
 39.2a + 67.2b + 3c & = & -17 \quad -2 \\
 74.1a + 68.1b + 3c & = & +26 \quad +6 \\
 58.6a + 80.4b + 3c & = & -12 \quad -22 \\
 54.7a + 84.9b + 3c & = & +11 \quad +26 \\
 34.98a + 0.9b & = & +33 \quad +8 \\
 -3.8a + 24.5b & = & +23 \quad +48
 \end{array}$$

$$\begin{array}{rcl}
 35.0a & = & +33 \quad +10 \quad a = +0.9 \quad b = +0.8 \quad c = -35 \\
 34.6b & = & +27 \quad +49 \quad d = +0.3 \quad e = +1.41 \quad f = -36
 \end{array}$$

Refined Reduction

X	1	2	3	4	5	6	Perman
C	-35	-35	-35	-35	-35	-35	-35
as	+9	+9	+18	+21	+23	+22	+16
by	+11	+19	+24	+13	+17	+20	+17
Corr	-19	-7	+3	-1	+5	+12	-2
obs	-26	+4	+5	0	+14	+2	-9
O-C	-7	+11	-2	-1	+9	-10	-7

MC 761		Approximate Reduction						Perigee
	Station 1	2	3	4	5	6		
$x - \bar{x}$	+456	-601	-1360	+146	-312	-1415	-278	
$y - \bar{y}$	+1462	+2580	+3340	+1829	+2301	+3392	+2344	
$z - \bar{z}$	+1949	+1979	+1980	+1975	+1989	+1977	+1966	
\bar{x}	1976							
\bar{y}								
\bar{z}								
$\sigma - \bar{\sigma}$	-26	+4	+5	0	+14	+2	-9	
$\eta - \bar{\eta}$	+3407	+3536	+4567	+4941	+5257	+5113	+4347	
$\delta - \bar{\delta}$	-1035	-1081	-2102	-2490	-2806	-2695	-1909	
$\epsilon - \bar{\epsilon}$	+2432	+2455	+2465	+2451	+2451	+2460	+2438	
$\bar{\eta}$	2462							
$\bar{\delta}$								
$\bar{\epsilon}$								
$\sigma - \bar{\sigma}$	-20	+3	+15	-1	-1	+8	-14	

Equations for further improvement

$$39.2a + 67.2b + 3c = -17 \quad -2$$

$$74.1a + 66.1b + 3c = +26 \quad +6$$

$$56.6a + 80.4b + 3c = -12 \quad -22$$

$$56.2a + 81.9b + 3c = +11 \quad +26$$

$$34.98a + 0.9b = +33 \quad +6$$

$$+3.8a + 84.2b = +23 \quad +48$$

$$35.0a = +32 \quad +10 \quad a = +0.9 \quad b = +0.8 \quad c = -3.5$$

$$34.6b = +27 \quad +49 \quad d = +0.3 \quad e = +1.41 \quad f = +3.6$$

Final Reduction

	1	2	3	4	5	6	Perigee
x							
C	-35	-35	-35	-35	-35	-35	35
ΔS	+9	+9	+12	+21	+22	+22	+16
$\Delta \eta$	+11	+19	+24	+13	+17	+25	+17
Corr.	-19	-7	+7	-1	+5	+12	-2
σ	-26	+4	+5	0	+14	+2	-9
ϵ	-7	+11	-2	-1	+9	-10	-7

MC 761 Final Reduction y

Star	1	2	3	4	5	6	Procyon
f	-36	-36	-36	-36	-36	-36	-36
Δ5	+3	+3	+6	+7	+8	+7	+5
Δy	+18	+32	+43	+23	+29	+43	+30
Corp	-15	+12	+13	-6	+1	+14	-1
β15	-20	+3	+15	-1	-1	+8	-14
0-C	-5	+3	+2	+5	-2	-6	-13

Table of final residuals for Procyon.

(Plate MC 762 as standard)

Residuals in sense of coordinates on this plate and opposite to that of microns x and y

	$x - \bar{x}$	Diff from mean $\frac{1}{\sqrt{2}}$	$y - \bar{y}$	Diff from mean $\frac{1}{\sqrt{2}}$
Plate 762	0	-2	0	+5
763	-5	-7	+1	+6
764	-7	-9	-13	-8
765	+2	0	-2	+3
766	+19	+17	-13	-8
Mean	+2		-5	

 $2\sqrt{2}$

423

198

Probable error one plate in x ± 10.3 in y ± 7.0 Probable error " " " ± 6.8 " ± 4.7 Ratio in arc ± 0.32 ± 0.21

Amazingly good.

Residuals for meridian plates (including parallax) in same sense

$$x - \bar{x} = +7$$

$$y - \bar{y} = -3$$

Final Results
 Mc 261

Star	1	2	3	4	5	6	7
α	-24	-24	-24	-24	-24	-24	-24
δ	+3	+3	+3	+3	+3	+3	+3
ρ	+11	+11	+11	+11	+11	+11	+11
θ	-11	-11	-11	-11	-11	-11	-11
ϕ	-20	-20	-20	-20	-20	-20	-20
ψ	-11	-11	-11	-11	-11	-11	-11

Table of final results for Program

(Puls Mc 261 as standard)

Residuals in units of standard deviation for each star

Approximate to last of measurement in each star

Star	1	2	3	4	5	6	7
α	-24	-24	-24	-24	-24	-24	-24
δ	+3	+3	+3	+3	+3	+3	+3
ρ	+11	+11	+11	+11	+11	+11	+11
θ	-11	-11	-11	-11	-11	-11	-11
ϕ	-20	-20	-20	-20	-20	-20	-20
ψ	-11	-11	-11	-11	-11	-11	-11

Star 1

Residuals over one place ± 10.3
 Residuals over two places ± 6.2
 Residuals over three places ± 0.52

Standard Error

Residuals for standard error in each place

$X - \bar{X} = \epsilon$

McC 761 Final Reduction

Station	1	2	3	4	5	6	Proyom
f	-36	-36	+26	-26	-16	-36	-44
LS	+3	+3	-6	+7	+8	+7	+5
y	+18	+32	+43	+23	+29	+45	+30
wp	-10	+12	+12	-6	+1	+14	-1
bs	-20	+2	+10	-1	-1	+8	-14
OC	-5	+3	+2	+5	-2	-6	-12

Table of final residuals for Proyom.

(Plate McC 762 as standard)

Residuals in sense of coordinates on this plate, and opposite to that of increases x and y

	$x - \bar{x}$	Diff from mean \bar{y}	$y - \bar{y}$	Diff from mean \bar{x}
Plate 762	0	-2	0	+3
762	-5	-7	+1	+6
761	-7	-9	-13	-8
760	+2	0	-2	+3
759	+19	+7	-13	-8
Mean	+2		-5	

$2\sqrt{2}$

423

198

Probable error one plate in $x \pm 10.3$ in $y \pm 7.0$

Probable error " " " ± 6.8 " ± 4.7

Ditto in arc $\pm 0".32$ " $\pm 0".21$

Analogously found.

Residuals for medium plate, including plates 1 in same sense

$$x - \bar{x} = +7$$

$$y - \bar{y} = -3$$

Table 1. *Continued*

Star	1910	1911	1912	1913	1914	1915	1916
1	1.2	1.1	1.0	0.9	0.8	0.7	0.6
2	1.5	1.4	1.3	1.2	1.1	1.0	0.9
3	1.8	1.7	1.6	1.5	1.4	1.3	1.2
4	2.1	2.0	1.9	1.8	1.7	1.6	1.5
5	2.4	2.3	2.2	2.1	2.0	1.9	1.8
6	2.7	2.6	2.5	2.4	2.3	2.2	2.1
7	3.0	2.9	2.8	2.7	2.6	2.5	2.4
8	3.3	3.2	3.1	3.0	2.9	2.8	2.7
9	3.6	3.5	3.4	3.3	3.2	3.1	3.0
10	3.9	3.8	3.7	3.6	3.5	3.4	3.3

Table 2. *Continued*

Star	1910	1911	1912	1913	1914	1915	1916
11	4.2	4.1	4.0	3.9	3.8	3.7	3.6
12	4.5	4.4	4.3	4.2	4.1	4.0	3.9
13	4.8	4.7	4.6	4.5	4.4	4.3	4.2
14	5.1	5.0	4.9	4.8	4.7	4.6	4.5
15	5.4	5.3	5.2	5.1	5.0	4.9	4.8
16	5.7	5.6	5.5	5.4	5.3	5.2	5.1
17	6.0	5.9	5.8	5.7	5.6	5.5	5.4
18	6.3	6.2	6.1	6.0	5.9	5.8	5.7
19	6.6	6.5	6.4	6.3	6.2	6.1	6.0
20	6.9	6.8	6.7	6.6	6.5	6.4	6.3

Table 3. *Continued*

Star	1910	1911	1912	1913	1914	1915	1916
21	7.2	7.1	7.0	6.9	6.8	6.7	6.6
22	7.5	7.4	7.3	7.2	7.1	7.0	6.9
23	7.8	7.7	7.6	7.5	7.4	7.3	7.2
24	8.1	8.0	7.9	7.8	7.7	7.6	7.5
25	8.4	8.3	8.2	8.1	8.0	7.9	7.8
26	8.7	8.6	8.5	8.4	8.3	8.2	8.1
27	9.0	8.9	8.8	8.7	8.6	8.5	8.4
28	9.3	9.2	9.1	9.0	8.9	8.8	8.7
29	9.6	9.5	9.4	9.3	9.2	9.1	9.0
30	9.9	9.8	9.7	9.6	9.5	9.4	9.3

M 0877

80 hours

14 Dec 1911 Jan 31 60

Exp 1 - Stan 1 (12. 15)

Stan 2 (14 26)

X	Y
13845	2975
7996	8820
98	18
32	80

X	Y
4001	14262
6972	11284
77	88
08	60

X	Y
5844	5841
2972	2975
4000	14270
8705	9565
54	50
36	79

X	Y
5771	4702
4700	

X	Y
13498	3920
11047	6348
4048	49
88	17

X	Y
3450	3430
5330	6323

X	Y
13491	3906
11105	6278
04	75
80	07

X	Y
3383	3370
7051	7052

X	Y
13841	2970
8050	8720
7475	1226
38	78

X	Y
5763	5744
5548	5565

X	Y
13503	3897
11151	6243
49	43
90	97
3348	3346

X	Y
13852	2967
8162	8655
57	55
45	72

X	Y
5688	5685
6320	6321

X	Y
13509	3858
11208	6193
08	8990
90	908
3296	3292

X	Y
13867	1965
8758	4275
4444	79
60	72

X	Y
5611	7011
7013	

X	Y
12519	2900
10274	5730
69	2014
05	18
3243	3216

2

M 0877

50 rows

64

10000 1111 1111 31

Expt 1 - Stan 1 112 10 1
X Y

13845 2975 4001 14262
7996 8820 6972 11254
98 18 77 88
32 80 08 60

5844 5841 2972 2975

2 13841 2972 4000 14270
8055 8745 8705 9565
54 50 10 65
36 74 011 60

5784 5771 4702 4700

3 13841 2970 4007 14271
8050 8720 9539 8570
7426 1226 61 08
38 78 17 70

5763 5744 5548 5565

4 13852 2967 3010 14270
8162 8635 9240 7948
57 55 24 30 49 70
45 72 15

5688 5685 6320 6321

5 13867 1965 3006 13278
8754 7582 10028 6255
44 44 79 20 22 65 16
60 72 15

5416 5611 7011 7013

Stan 2 114 20 1
X Y

13495 3920 2121 11680
11047 6348 7461 6310
4048 49 52 55
88 17 31 72

3460 3430 5330 5323

13491 3906 4130 11620
11105 6278 11129 4616
04 75 80 87 32
80 07 33 72

3383 3370 7051 7052

13503 3897 3128 12671
11151 6243 11027 4771
49 42 29 72
90 36 70

3348 3346 7894 7900

13507 3898 3132 12684
11208 6193 11110 4000
08 59 04 99
90 35 75

3296 3292 8672 8679

12519 2900 3132 11683
10274 5730 12508 2308
69 20 14 10 08
05 08 35 88

3242 3216 9374 9372

MC 877

Jan 31 1911 65

Exp 1	Star 3 21.23		Star 4 (S Orion)		Star 5 (S Orion)		Star 6 (S Orion)	
	X	Y	X	Y	X	Y	X	Y
	13900	3133	4985	12026	14358	4020	2761	12255
	6112	10910	16475	6028	4470	13840	6763	8240
	2018	05-04	79	23	70	90	6868	36
	849	40	90	18	58	22	70	49
	7783	7768	5990	5995	9888	9868	4002	4015
2	13918	2120	3990	12025	14360	4025	2765	12251
	6184	9848	11708	0098	4309	4530	13833	7448
	84	55-50	00	09	30	27	501	05
	10	34	90	18	59	32	70	45
	7726	7720	7712	7711	9829	9898	5732	5742
3	12928	2112	3985	11022	14320	3010	1764	12261
	5231	9815	12856	3448	4600	11767	8362	5668
	1421	0919	58	58	595	65	5762	64
	78	25	42	22	62	17	70	55
	7697	7692	8866	8569	9764	9749	6592	6591
4	12935	1124	3990	12020	14370	3010	1766	12258
	5280	8758	13222	22	2685	4674	12695	9129
	80	6861	22	16	53	5074	70398	20
	24	33	90	16	73	16	70	53
	7646	7631	9332	9333	9697	9683	7358	7363
5	12925	1110	3991	12020	13370	2014	765	12258
	5358	8675	14018	1994	3720	10	11600	8006
	4150	6177	20	8990	1618	5043	0099	20
	28	22	89	18	70	20	78	48
	7575	7558	0030	0027	9654	9624	8027	8030

1742

MC 877

Jan 31 1911 65

Star 3 21.03		Star 4 18.00		Star 5 16.00		Star 6 15.00	
X		X		X		X	
13900	3133	4940	12026	14358	4020	2761	12253
6112	10910	16475	6028	4470	13840	6763	8240
2018	05-04	79	23	70	70	68	68
849	40	90	18	58	22	70	49
7783	7768	5990	5990	9868	9868	4002	4015
2							
13918	2120	3990	12026	15360	4025	2765	12257
6164	9648	11708	4309	4530	13833	7448	6505
84	53-50	60	98	09	30	501	05
10	34	90	18	59	32	70	45
7726	7720	7712	7711	9829	9798	5732	5742
3							
13920	2112	3985	11022	14370	3010	1764	12261
5231	9815	12356	3408	4600	11767	8362	5668
14-21	09-19	58	58	52	545	54	62
78	25	92	22	62	17	70	53
7697	7692	8366	8569	9764	9749	6592	6591
4							
12935	1124	3990	14370	3010	1766	12258	
5280	8758	13322	12020	4670	12695	9129	4845
80	6861	22	2685	83	80	703	98
24	33	90	16	73	16	70	53
7646	7631	9332	9333	9697	9683	7358	7363
5							
12925	1110	3991	12020	13370	2014	765	12258
5368	8675	14018	1994	3720	10	11610	8806
41	50	677	20	8990	16	15	50
28	22	89	18	70	20	75	48
75-75	7555	0030	0027	9654	9624	8027	8030

MC 877 Mean Coordinates

X	Star 1	2	3	A
Exp 1	12. 5841	14. 3440	21. 7796	16. 9878
2	5778	3376	7723	9814
3	5754	3347	7694	9756
4	5686	3294	7638	9690
5	5614	3230	7565	9639

mean 12. 5735 14. 3337 21. 7679 16. 9755

y Exp 1	15. 2974	26. 5326	23. 5992	21. 4008
2	4701	7052	7712	6737
3	5556	7897	8568	6592
4	6320	8674	9332	7358
5	7012	9373	24. 0028	8028

mean 15. 5343 26. 7665 23. 8326 21. 6345

Differences from Mean

Exp	Star 1	Δx	2	3	AA	Star 1	Δy	2	3	A
1	+	106	+103	+97	+123	-	2339	-2337	-2334	-2337
2	+	43	+39	+46	+59	-	612	-613	-614	-608
3	+	19	+10	+15	+1	+	243	+232	+242	+247
4	+	49	-43	-49	-65	+	1007	+1009	+1006	+1013
5	-	121	-107	-114	-116	+	1699	+1708	+1702	+1683

Mean Coordinates				
Exp	Star 1	2	3	A
1	12. 5841	14. 3440	21. 7796	16. 9878
2	5778	3376	7723	9814
3	5754	3347	7694	9756
4	5686	3294	7638	9690
5	5614	3230	7565	9639
Mean	12. 5935	14. 3337	21. 7679	16. 9755
Exp	15. 2974	26. 5326	23. 5992	21. 4008
2	4701	7052	7712	6737
3	5556	7897	8568	6592
4	6320	8674	9332	7358
5	7012	9373	10028	8028
Mean	15. 5343	26. 7665	23. 8326	21. 6345

Differences from Mean									
Δx					Δy				
Exp	Star 1	2	3	AA	Star 1	2	3	A	
1	+ 106	+ 103	+ 97	+ 123	- 2339	- 2337	- 2334	- 2337	
2	+ 43	+ 39	+ 46	+ 59	- 612	- 613	- 614	- 608	
3	+ 19	+ 10	+ 15	+ 1	+ 243	+ 232	+ 242	+ 247	
4	+ 49	- 43	- 49	- 65	+ 1007	+ 1009	+ 1006	+ 1013	
5	- 121	- 107	- 114	- 116	+ 1699	+ 1708	+ 1702	+ 1693	

MC 877

Reduction

67

Assuming uniform scale-value orientation, the above differences should be constant. Their mean values for the comparison stars, and the residuals for all stars, are as follows

X - mean					Y - mean					
Mean	1	2	3	4	Mean	1	2	3	4	
Exp	+102	+4	+1	-5	+21	-2337	-2	0	+3	0
2	+43	0	-4	+3	+16	-613	+1	0	-1	+5
3	+15	+4	-5	0	-14	+239	+4	-7	+3	+8
4	-44	-5	+1	+3	-21	+1007	0	+2	-1	+6
5	-114	-7	+7	0	-2	+1703	-4	+5	-1	-20

For the comparison stars we have $[p.v.] = 241 \text{ m}\mu$
 $136 \text{ m}\mu$
 As 8 means have been derived from 15 quantities in getting the residuals, the mean error of one measure, taking X & Y together is ± 5.1 & the probable error $\pm 3.4 = \pm 0''.16$ which is very good.

The values of $[p.v.]$ for star A are $1338 \text{ m}\mu$ & $525 \text{ m}\mu$
 from mean error $\text{m}\mu = \pm 18.3$ " $\text{m}\mu = \pm 11.4$
 Prob error " $= \pm 12.3$ or $\pm 0''.57$ " ± 7.7 or $\pm 0''.36$

There appears to be some systematic error amounting at maximum to about $1''.0$

It is however desirable to repeat the measures of the X coordinates of star A

Reflection

MC 877

Assuming uniform scattering, the amount of light scattered by a surface is proportional to the cosine of the angle of incidence. For the surface shown, the scattered light is as follows:

p - mean		p - mean	
1	2	3	4
105	102	101	100
104	103	102	101
103	104	103	102
102	105	104	103
101	106	105	104
100	107	106	105
99	108	107	106
98	109	108	107
97	110	109	108
96	111	110	109
95	112	111	110
94	113	112	111
93	114	113	112
92	115	114	113
91	116	115	114
90	117	116	115
89	118	117	116
88	119	118	117
87	120	119	118
86	121	120	119
85	122	121	120
84	123	122	121
83	124	123	122
82	125	124	123
81	126	125	124
80	127	126	125
79	128	127	126
78	129	128	127
77	130	129	128
76	131	130	129
75	132	131	130
74	133	132	131
73	134	133	132
72	135	134	133
71	136	135	134
70	137	136	135
69	138	137	136
68	139	138	137
67	140	139	138
66	141	140	139
65	142	141	140
64	143	142	141
63	144	143	142
62	145	144	143
61	146	145	144
60	147	146	145
59	148	147	146
58	149	148	147
57	150	149	148
56	151	150	149
55	152	151	150
54	153	152	151
53	154	153	152
52	155	154	153
51	156	155	154
50	157	156	155
49	158	157	156
48	159	158	157
47	160	159	158
46	161	160	159
45	162	161	160
44	163	162	161
43	164	163	162
42	165	164	163
41	166	165	164
40	167	166	165
39	168	167	166
38	169	168	167
37	170	169	168
36	171	170	169
35	172	171	170
34	173	172	171
33	174	173	172
32	175	174	173
31	176	175	174
30	177	176	175
29	178	177	176
28	179	178	177
27	180	179	178
26	181	180	179
25	182	181	180
24	183	182	181
23	184	183	182
22	185	184	183
21	186	185	184
20	187	186	185
19	188	187	186
18	189	188	187
17	190	189	188
16	191	190	189
15	192	191	190
14	193	192	191
13	194	193	192
12	195	194	193
11	196	195	194
10	197	196	195
9	198	197	196
8	199	198	197
7	200	199	198
6	201	200	199
5	202	201	200
4	203	202	201
3	204	203	202
2	205	204	203
1	206	205	204

The comparison shows the same (p. 105) 100

At 8 mean the distance from 12. 100

By the method the mean for four years is 1.0

The method (p. 105) for the 100 is 1.0

For the 100 is 1.0

For the 100 is 1.0

For the 100 is 1.0

For the 100 is 1.0

For the 100 is 1.0

HC 877

Reduction

67

 x - mean y - mean

Mean	1	2	3	A	Mean	1	2	3	A	
1	+102	+44	+1	-5	+21	-2337	-2	0	+3	0
2	+43	0	-4	+2	+16	-613	+1	0	-1	+5
2	+45	+4	-5	0	-14	+239	+4	-7	+3	+8
4	-44	-5	+1	+3	-21	+1007	0	+2	-1	+6
5	-114	-7	+7	0	-2	+1703	-4	+5	-1	-20

For the comparison stars we have $(p.v.) = 241$ in x & 136 in y
 & 8 means have been derived from 15 quantities in
 getting the residuals. the mean error for x measures taking
 y together is ± 5.1 & the probable error is 3.4 or ± 0.16
 inch is very good.

The values of $(p.v.)$ for star A are 1338 in x & 525 in y

Mean error in $x = \pm 18.3$ in $y = \pm 11.4$

Prob error " ± 12.3 or ± 0.57 " ± 7.7 or ± 0.36

There appears to be some systematic error
 amounting at maximum to about $1''.0$

It is however desirable to repeat the measures of
 the x coordinates of star A

9867	+117	+10	-11	225
9803	+53	+10	-11	100
				121
9754	+4	-11	-2	576
				49
9682	-68	-24	-8	<u>1071</u>
9643	-107	+7	+4	268
<hr/>				
249			+32	

9700

2

$$\Sigma = \pm 16.3$$

$$5.3$$

6745
5378
1202

466
934
563

$$\Sigma = \pm 11.0$$

$$\pm 0.57$$

169
64
169
676
225
1303
325
a+b =

465
66
-5
-3
+14
+18
+14
+4
+8
+12
+17
-5
-9
-14
45
-22
-17
-4
-26

+13 +16 -15 -18 +13
-0 -8

I	II	Refs		
+21	+13	+8	64	
+16	+8	+8	64	
-14	-13	-1	1	28
-21	-26	+5	25	
-2	+10	-17	284	
			<hr/>	
			443	

111
56

ϵ^2 2 means

Mean error 1 mean = 7.5

Prob "

$$\sigma_{1.0} = \pm 0''.23$$

146

55

111

P. e

Redirection

assuming uniform scale value distribution, the above figures should be constant. These mean values for the comparison stars, and the reference point stars are as follows

X - mean

Y - mean

Mean 1 2 3 4 5 1 2 3 4

MC 877. Remasured X of star 4

Plate turned so that X-coordinates appear horizontal instead of vertical. then making measurement reverse

Exp	too near R	1	2	3	4	5	5 - integrated
D	11962	11965	11968	11966	11968		
	2073	2108	2198	1226	2305		
	84	43	94	74	98		
	52	52	60	63	62		
A	16.9872	9807	9763	9692	9665		
R	2304	2358	2358	1354	2310		
	12230	12459	12112	11038	12008		
	30	65	14	38	98		
	68	69	69	64	64		
	9862	9799	9746	9673	9641		
Means	9867	9803	9754	9682	9653		
Scal mean	9752	+ 56	+ 2	- 20	- 99		
For comp	+ 102	+ 43	+ 15	- 44	- 114		
stars	+ 13	+ 8	- 13	- 26	+ 15		
0-c							

mean error ± 18.0

Prob. error $\pm 12.1 = \pm 0.56$ Periodically as same

