1911phac

KG
11366
v.879

II
9 2 0 1 2 2
2 2 2 3 3

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Hofstetter Bros.
INCORPORATED.
Blank Book Manufacturers
LITHOGRAPHERS & STATIONERS
Nos.
247-253 So. AMERICAN STREET,
Telephone Connection. PHILADELPHIA.

Parties desiring a book like this can by giving us the number marked on end of this slip and Lettering for book have it made without further description.

No.
18688

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Harvard lunar Plates.

(Measures and Reductions).

Mary Fowler.

Volume III.

Plate no.	Date	Pagg.
920	1911. Feb. 15	1
921	1911 Feb 15	18
922	1911. Feb. 15	36
932	1911 Feb 18	56

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

MC 920 1912 Oct 15 1

Comparison Stars

	1			2			3		
	no		mag	no		mag	no.		mag
C	1655		8.9	C 1657		7.0	C 1664		8.2
	x = 25.6	y = 28.7		x = 23.8	y = 13.1		x = 18.1	y = 27.9	
C	12h 7m	58.19		12h 8m	49.30		12h 11m	51.25	
L		.21			36			27	
E		13			30			27	
mean	12 7	58.18		12 8	49.32		12 11	51.26	
Prec	+	33.79		+	33.77		+	33.79	
1911	12 8	31.97		12 9	23.09		12 12	25.05	
A	12 12	27.		12 12	27		12 12	27.	
α − A	− 3	55.03		− 3	3.91		−	1.95	
sin(α−A)	− 235.02			− 183.90			−	1.95	
log "	2.371111 m			2.264588 m			0.290035 m		
" cosδ	9.999996			9.999950			9.999995		
" ξ0	0.878311 m			0.771132 m			8.797227 n		
ξ0	− 7.5563			− 5.9064			− 0.0627		
ξ1	− 20			− 16			0		
ξ	25.5583			23.9080			18.0627		
x	25.6211			23.8056			18.1095		
x − ξ	− 628			+ 1024			− 468		

signs of x and y are changed.

Decl.									
C	+0° 47′	46.″2		+2° 49′	00.″7		+0° 54′	28.″6	
L		46.0			01.6			28.9	
E		46.0			00.3			28.3	
mean	+0 47	46.1		+2 49	00.9		+0 54	28.6	
Prec	− 3	40.4		− 3	40.3		− 3	40.2	
1911	+0 44	05.7		+2 45	20.6		+0 50	48.4	
D	+1 37	12		+1 37	12		+1 37	12.	
δ − D	− 53	6.3		+1 8	8.6		− 46	23.6	
tan(δ−D)	− 3186.6			+ 4089.1			− 2783.8		
log "	3.503353 m			3.611163			3.444464 m		
" η0	0.833448 n			0.942278			0.775794 n		
" tanδ	8.10822			8.68824			8.16344		
" δ″	1.7566			1.54826			7.5944		
" η1	6.9182			7.27284			2.8112		
η0	− 6.8310			+ 8.7656			− 5.9674		
η1	+ 8			+ 19			0		
η	28.8302			13.2325			27.9674		
4	28.7436			13.1554			27.9617		
4 − η	+ 866			+ 771			+ 57		

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

NC 920 1912 Oct 15 1

Comparison Stars.

	1		mag	2		mag	3		mag
C	16 55		8.9	C	16 57	7.0	C	16 64	8.2
	x = 25.6	y = 28.7		x = 23.8	y = 13.1		x = 18.1	y = 27.9	
C	12h 7m	58.99		12h 8m	49.30		12h 11m	51.25	
∠		.21			36			27	
ε		13			30			27	
mean	12 7	58.18		12 8	49.32		12 11	51.26	
Prec	+	33.79		+	33.77		+	33.79	
1911	12 8	31.97		12 9	23.09		12 12	25.05	
A	12 12	27.		12 12	27		12 12	27.	
α − A	− 3	55.03		− 3	3.91		−	1.95	
sec(α−A)	−	235.02		−	183.90		−	1.95	
log "	2.371111	m		2.264589	m		0.290003	m	
" cos δ	9.999996			9.999950			9.999995		
ξ₀	0.878831	m		0.771132	m		9.797722	m	
ξ₀	− 7.5563			− 5.9064			− 0.0627		
ξ₁	−	20		−	16			0	
ξ	25.5583			23.9080			18.0627		
x	25.6211			23.8056			18.1095		
x − ξ	−	628		+	1024		−	468	

signs of x and y are changed.

Decl.										
C	+0°	47′	46.″2	+2°	49′	00.″7	+0°	54′	28.″6	
∠			46.0			01.6			28.9	
ε			46.0			00.3			28.3	
mean	+0	47	46.1	+2	49	00.9	+0	54	28.6	
Prec	−	3	40.4	−	3	40.3	−	3	40.2	
1911	+0	44	05.7	+2	45	20.6	+0	50	48.4	
D	+1	37	12	+1	37	12	+1	37	12.	
δ − D	−	53	6.3	+1	8	8.6	−	46	23.6	
tan(δ−D)	−	3186.6		+	4089.1		−	2783.8		
log "	3.503353	m		3.611163			3.444464	m		
" η₀	0.834488	m		0.942778			0.775799	m		
" tan δ	8.1082			8.6824			8.1634			
" ξ″	1.7566			1.5426			1.5944			
" η₁	6.9182			7.2784			2.8412			
η₀	− 6.8310			+ 8.7656			− 5.9674			
η₁	+	8		+	19			0		
η	2.888302			1.322525			2.796741			
4	2.874366			1.315564			2.796174			
4 − η	+	8666		+	7721		+	567		

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 920 — 1912 Oct 15 — 2

Comparison Stars and Standard coordinates.

4/C	no.	mag.
	1672	8.5
	x = 9.2 y = 32.0	
C	12h 16m 30.64	
L		68
E		61
Mean	12 16 30.64	
Prec	+ 33.79	
1911	12 17 4.43	
A	12 12 27	
α-A	+ 4 37.43	
sin(α-A)	+ 277.41	
log "	2.443113	
" Eδ	9.99999	
" ξ0	0.95036	
ξ0	+ 8.92206	
ξ1	+ 39	
ξ	9.07761	
x	9.1578	
x-ξ	− 817	

5/C	no.	mag.
	1678	8.8
	x = 3.1 y = 20.2	
	12h 19m 33.89	
		90
		85
	12 19 33.88	
	+ 33.75	
	12 20 7.63	
	12 12 27.	
	+ 7 40.63	
	+ 460.54	
	2.66327	
	9.99977	
	1.17028	
	+ 14.8007	
	+ 80	
	3.1913	
	3.1446	
	+ 467	

Decl		
C	+0° 23′ 50.2″	+1° 56′ 15.7″
L	50.6	15.8
E	50.3	15.3
mean	+0 23 50.4	+1 56 15.6
Prec	− 3 39.9	− 3 39.7
1911	+0 20 10.5	+1 52 35.9
D	+1 37 12	+1 37 12
δ-D	−1 17 01.5	+ 15 23.9
tan(δ-D)	− 4622.3	+ 923.9
log "	3.66486m	2.96562
" η0	0.99601m	0.29677
" tanδ	7.76829	8.5154
" ξ²	1.9007	23406
" η1	6.7224	7.9094
η0	− 9.9085	+ 1.9805
η1	+ 5	+ 81
η	31.9080	20.0114
y	31.9959	20.1548
y-η	− 879	− 1434

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 920 1912 Oct 15 2

Comparison Stars and Standard Coordinates

4 C	no.	mag.	5 C	no.	mag.
	1672	8.5		1678	8.8
	x = 9.2 y = 32.0			x = 3.1 y = 20.2	
C	12h 16m 30.64			12h 19m 33.89	
4	68			90	
E	61			85	
Mean	12 16 30.64			12 19 33.88	
Prec	+ 33.79			+ 33.75	
1911	12 17 4 43			12 20 7 63	
A	12 12 27			12 12 27.	
x-A	+ 4 37.43			+ 7 40.63	
Sin(x-A)	+ 277.41			+ 460.54	
log "	2.443 13			2.663 27	
" cos δ	9.999 99			9.999 77	
" ξ0	0.950 36			1.170 28	
ξ0	+ 8.920 0			+ 14.800 7	
ξ1	+ 39			+ 80	
ξ	9.076 1			3.191 3	
x	9.157 8			3.144 6	
x-ξ	- 817			+ 467	
Rack					
C	+ 0° 23' 50.2"			+ 1° 56' 15.7"	
4	50.6			15.8	
E	50.3			15.3	
Mean	+ 0 23 50.4			+ 1 56 15.6	
Prec	- 3 39.9			- 3 39.7	
1911	+ 0 20 10.5			+ 1 52 35.9	
D	+ 1 37 12			+ 1 37 12	
δ-D	- 1 17 01.5			+ 15 23.9	
tan(δ-D)	- 4622.3			+ 923.9	
log "	3.664 86 m			2.965 62	
" η0	0.996 01 m			0.296 77	
" tan δ	7.768 29			8.515 4	
" ξ²	1.900 7			2340 6	
" η1	6.722 4			7.909 4	
η0	- 9.908 5			+ 1.980 5	
η1	+ 5			+ 91	
η	31.908 0			20.011 4	
4	31.495 9			20.154 8	
4-η	- 879			- 1434	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Oct. 15. 3

Mean measured coordinates and coordinates of center of plate

Star	x	y	R.A.	
1	25.6211	28.7436	12 8 32	0 44 6
2	23.8056	13.1554	9 23	2 45 21
3	18.1095	27.9617	12 25	0 50 48
4	9.1578	31.9959	17 4	0 20 10
5	3.1446	20.1548	20 8	1 52 36
	5 | 79.84	| 2201	67 32	6 33 01
	15.97	24.40	12 13 30	1 18 36
	-18.00	465	- 1 03	+ 18 36
	- 2.03	1200	12h 12m 27	1 37 12
	31	1440		
	203	960		
	609	+1116.00		
	-62.593	18' 36"		
	1' 3"			

Preliminary Reduction.

Star	x-3	+1064	+9x	-24	(-2597)
1	-628	+3047	+230 = +2649	-57 = +2592	: -5
2	+1024	+1394	+214 = +2632	-26 = +2606	: +9
3	- 468	+2963	+163 = +2658	-56 = +2602	: +5
4	- 817	+3392	+ 82 = +2657	-64 = +2593	: -4
5	+ 467	+2136	+ 28 = +2631	-40 = +2591	: -6
	x	+1044 ✓			
Means	-17.3439 ✓	+2285	+156 ✓		= -17.3595 ✓

Star	y-m	-105x	+64	+1653	
1	+866	-2690	+173	= -1651	= +2
2	+771	-2499	+ 79	= -1649	= +4
3	+ 57	-1901	+168	= -1676	= -23
4	-879	- 961	+192	= -1648	= + 5
5	-1434	- 329	+121	= -1642	= +11
Means	-21.9670 ✓	-1821 ✓	+132 ✓		= -21.9706 ✓

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 920 1912 Oct. 15 3

Mean measured coordinates and coordinates of centre of plate

Star	x	y	R.A.					
1	25.6211	28.7436	12	8	32	0	44	6
2	23.8056	13.1554		9	23	2	45	21
3	18.1095	27.9617		12	25	0	50	48
4	9.1578	31.9959		17	4	0	20	10
5	3.1446	20.1548		20	8	1	52	36
5	79.84	12201		67	32	6	33	01
	1597	24.40	12	13	30	1	18	36
	-1800	465		- 1	03	+	18	36
	- 203	1200	12h	12m	27	1	37	12
	31	1440						
	203	960						
	609	1116.00						
	-625.93	18' 36"						
	1' 3"							

Preliminary Reduction.

Star	x-3	+1064	+926		-24	(-2597)
1	- 628	+3047	+ 239	= +2649	-57	= +2592 : -5
2	+1024	+1394	+ 214	= +2632	-26	= +2606 : +9
3	- 468	+2964	+ 163	= +2659	-56	= +2602 : +5
4	- 817	+3392	+ 82	= +2657	-64	= +2593 : -4
5	+ 467	+2136	+ 28	= +2631	-40	= +2591 : -6
		+1094				
	17.3439	+2285	+ 156			= ~~17.32~~83
						-17.3595

Star	y-m.	-105x	+64		+1653	
1	+866	-2690	+ 173	= -1651		= +2
2	+771	-2499	+ 79	= -1649		= +4
3	+ 57	-1901	+ 168	= -1676		= -23
4	- 879	- 961	+ 192	= -1648		= + 5
5	-1434	- 329	+ 121	= -1642		= +11
	21.9670	-1821	+ 132			= ~~21.96~~34
						-21.9706

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Oct. 14. 4

Comparison Stars - measures.

	d		N		d			d		
1/										
25.6	16400		15250		14861			15480		
28.7	8954	56	12685	80	11070	72		9265	66	
	52		90		71			69		
	82		38		70			87		
	28.7433		28.7438		25.6806			25.6217		
2/										
23.8	17220		14015		14950			15730		
13.1	15662	65	5552	58	12989	90		7656	62	
	58		56		94			60		
	07		00		32			25		
	13.1556		13.1553		23.8045			23.8067		
3/ very faint										
18.1	16859		17030		14870			13945		
27.9	7234	52	16644	50	5960	56		12844	45	
	40		42		56			46		
	54		38		68			60		
	27.9619		27.9615		18.1089			18.1101		
4/										
	8410	10	11222		16852			14208		
9.2	02		11187	80	8430	29		12622	31	
32.0	8363		85		27			24		
					58			20		
	31.9956		31.9962		9.1572			9.1584		
5/										
3.1	15850		16929		15317			14970		
20.2	14291	96	8470	73	6759	55		13519	23	
	97		68		58			16		
	40		28		20			88		
	20.1553		20.1542		3.1437			3.1454		

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 920. 1912 Oct. 14. 4

Comparison Stars - measures.

	4			2		
	d		N	d		
25.6	16400		15250	14861		15480
28.7	8954	56	12685	11070	72	9265
	52		90	71		69
	82		38	70		87
	28.7433		28.7438	25.6206		25.6217
3						
23.8	17220		14015	14950		15730
13.1	15662	65	5552	12989	90	7656
	56		56	94		60
	07		00	32		25
	13.1556		13.1553	23.8045		23.8067
3 very faint						
18.1	16859		17030	14870		13945
27.9	7234	52	16644	5960	56	12844
	40		42	56		46
	54		38	68		60
	27.9619		27.9615	18.1089		18.1101
4						
	8410	10	11222	16852		14208
9.2	02		11187	8430	29	12622
32.0	8363		85	27		24
				58		20
	31.9956		31.9962	9.1572		9.1584
5						
3.1	15850		16989	15317		14970
20.2	14291	96	8470	6759	55	13519
	97		68	58		16
	40		28	20		89
	20.1553		20.1642	3.1437		3.1454

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Conditional Equations.

	a	b	$x-\xi$	$y-\eta$
1 XY	25.62	+28.74	+c = −5	+2
2 Xy	23.81	+13.16	+c = +9	+4
3 xY	18.11	+27.96	+c = +5	−23
4 xY	9.16	+32.00	+c = −4	+5
5 xy	3.14	+20.15	+c = −6	+10

Normal Equations.

	82.51	+2329	+c = +3.00	−5.67
	6.15	+260.9	+c = −5.00	+7.50
	17.63	+29.57	+c = −1.33	−5.33
	13.48	+16.66	+c = +1.50	+7.00
	+16.36	−2.79	= +8.00	−13.17
(.75(4))	+4.15	+12.91	= −2.83	−12.33
	+4.15	−0.71	= +2.03	−3.34
		+13.62 b	= −4.86	−9.83
		b	= −0.36	−0.72
		a	= +0.43	−0.93

+3.0	−5.0	−1.3	+1.5	−5.7	+7.5	−5.3	+7.0
−9.7	−2.6	−7.6	−5.8	+20.9	+5.7	+16.4	+12.6
+8.4	+9.4	+10.7	+6.0	+16.8	+18.8	+21.3	+12.0
+1.7	+1.8	+1.8	+1.7	+32.0	+32.0	+32.4	+31.6

c from $(x-\xi)$ c from $(y-\eta)$

Residuals

$x-\xi$			c	o	o − c
+11	−10	+2	= +3	−5	−8
+10	−5	+2	= +7	+9	+2
+8	−10	+2	= 0	+5	+5
+4	−12	+2	= −6	−4	+2
+1	−7	+2	= −4	−6	−2

$y-\eta$					
−24	−21	+32	= −12	+2	+14
−22	−10	+32	= 0	+4	+4
−17	−20	+32	= −5	−23	−18
−9	−23	+32	= 0	+5	+5
−3	−14	+32	= +15	+11	−4

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Conditional equations.

	a	b	x − ξ	y − η
1 XY	25.62	+ 28.74	+ c = − 5	+ 2
2 Xy	23.81	+ 13.16	+ c = + 9	+ 4
3 xY	18.11	+ 27.96	+ c = + 5	− 23
4 xY	9.16	+ 32.00	+ c = − 4	+ 5
5 xy	3.14	+ 20.15	+ c = − 6	+ 10

Normal equations.

82.51	+ 23.29	+ c = + 3.00		− 5.67
6.15	+ 26.09	+ c = − 5.00		+ 7.50
17.63	+ 29.57	+ c = − 1.33		− 5.33
13.48	+ 16.66	+ c = + 1.50		+ 7.00
+ 16.36	− 2.79	= + 8.00		− 13.17
(.754) + 4.15	+ 12.91	= − 2.83		− 12.33
+ 4.15	− 0.71	= + 2.03		− 3.34
	+ 13.626	= − 4.86		− 9.83
	b	= − 0.356		− 0.72
	a	= + 0.43		− 0.93

+ 3.0	− 5.0	− 1.3	+ 1.5		− 5.7	+ 7.5	− 5.3	+ 7.0
− 9.7	− 2.6	− 7.6	− 5.8		+ 20.9	+ 5.7	+ 16.4	+ 12.6
+ 8.4	+ 9.4	+ 10.7	+ 6.0		+ 16.8	+ 18.8	+ 21.3	+ 12.0
+ 1.7	+ 1.8	+ 1.8	+ 1.7		+ 32.0	+ 32.0	+ 32.4	+ 31.6

c from (x − ξ) o from (y − η)

Residuals.

x − ξ			c	o	o − c
+ 11	− 10	+ 2	= + 3	− 5	− 8
+ 10	− 5	+ 2	= + 7	+ 9	+ 2
+ 8	− 10	+ 2	= 0	+ 5	+ 5
+ 4	− 12	+ 2	= − 6	− 4	+ 2
+ 1	− 7	+ 2	= − 4	− 6	− 2

y − η					
− 24	− 21	+ 32	= − 12	+ 2	+ 14
− 22	− 10	+ 32	= 0	+ 4	+ 4
− 17	− 20	+ 32	= − 5	− 23	− 18
− 9	− 23	+ 32	= 0	+ 5	+ 5
− 3	− 14	+ 32	= + 15	+ 11	− 4

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Me920 1912 Oct. 16 6

Points on Venus's Limb measured.

	d	N	remeasure	direct
1/				
16.0	14470	16730	14104	
20.5	97822 72	1136255	9940 35	
	80	5770	.2830	
	90	50	35	
	20.4702	20.4621	20.4686	
2				
16.0	13930	15476		
23.4	92622 62	1013322		
	62	2030		
	48	98		
	23.4676	23.4639		
3 (?)	14932	14486		
17.0	544446	1392844		rough edge
23.9	5858	3638		
	52	10		
	23.9500	23.9449		
4				
15.6				
21.0				

	d	N
	14463	15915
	1025644	1012012
	4848	1626
	90	41
	15.5775	15.5812

5		
15.4		
22.0	min in ☽	
	13530	15900
	6840 26	1259390
	3852	8580
	45	20
	15.5295	15.3319

4	(?) 70391 1	11351	
17.3	2127	1113339	
23.9	6865	5132	very ragged edge
min in ☽	23.9841	.9786	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

ME920 1912 Oct. 16 6

Points on Venus's Limb measured.

4

l	d	N	remeasure	direct
16.0	14470	16730	14104	
20.5	978272	1136255	994035	
	80	5770	2830	
	90	50	35	
	204702	20.4621	204686	

2

160	13930	15476	
234	926262	10133322	
	62	2030	
	48	98	
	E3.4676	234639	

3

	14932	14486	
17.0	544446	1392844	rough edge
23.9	5858	3638	
	52	10	
	E3.9500	239449	

4

	d	N
15.6	14463	15915
21.0	10256744	10120112
	4848	1676
	90	41
	15.5775	15.5812

5

	13530	15900
15.4	6840026	12593390
22.0	5832	8580
	45	20
	15.3295	15.3319

11	703911	11351	
7.3	2127	1113339	
23.9	6865	5132	
			very ragged edge
	23.9841	9786	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Oct 16. 7

Points on moon's limb
measures - continued.

6 ✓

15.7
23.0

		a		z
		16470		13900
		126828		775570
		7078		7264
		90		16
		15.6146		15.6145

7 ✓ Scratch

16.4	15750	15602	15108	16182
20.2	1396062	739990	933026	1198888
	5065	8296	2230	8488
	74	30	20	00
	20.1796	20.1767	16.4212	16.4202

8 ✓ scratch

15.4	15293	16715	14540	16226
21.3	1197276	1007373	886560	1190010
	7270	6875	5250	0602
	24	35	60	54
	21.3531	21.3544	15.4305	15.4333

9 ✓ scratch

	14920		15510	14215
22.4·4	1027484	15505	945655	1027078
15.4·x	8265	1018386	6058	8282
	46	9383	28	45
		35		
	22.4650	22.4666	15.3936	15.3949

10 ✓ scratch

16.4	15000	16650	13910	15682
23.8	735056	1430798	826864	1135858
	5860	0098	7068	5356
	20	66	29	00
	23.7660			
		23.7648	16.4346	16.4333

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Oct 16. 7

Points on moons-limb measures: continued.

6

15.7
23.0

	d		N
	16470		13900
	1261828		775570
	2028		7269
	90		16
	15.6146		15.6145

7 Scratch.

16.4	15750	15602	15108	16182
20.2	1396062	739990	935026	1198886
	5065	8296	2230	8488
	74	30	20	00
	20.1796	20.1767	16.4212	16.4202

8 scratch

15.4	15293	16715	14540	16226
21.3	1197276	1007378	886560	1190010
	7270	6875	5250	0602
	24	35	60	54
	21.3391	21.3349	15.4305	15.4355

9 Scratch

	14920		15510	14215
22.4 · y	1027484	15505	945655	1027078
15.4 · x	8285	1018386	6058	8282
	46	9383	28	43
		35		
	22.4650	22.4666	15.3936	15.3949

10 scratch

16.4	15000	16650	13910	15682
23.8	735056	1430798	826864	1135858
	5860	0098	7068	5356
	20	66	29	00
	23.7660			
		23.7648	16.4346	16.4333

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Oct 25. 8

Times &c.

Exp. to stars	1911 Feb 15	11h	59m	40s	-12h	08m 49
" " moon		12	04	09.8		04 10.0
Clock fast			2	31.7		
H. Sid. T.		12	1	38.2		
" long.		4	44	31.05		
G. Sid. T.		16	46	09.25		
Sid. T. M. noon		21	37	29.62		
Interval		19	8	39.63		
Reduction			− 3	8.02		
G. M. T.		19	5	31.61		

	R. A.	Dec.
Lunar Am. Eph.		
Moon 19h	12h 12m 28.s55	+2° 15′ 27.″5
motion in 1m = 1.s9182		−14.805
" " 5.s527	+ 10.60	− 1′ 21.″8
Tabular place	12h 12m 39.s15	+2° 14′ 05.″5

Moon's parallax 56′ 30.″6
" Semidiam. 15 25.5

1912 Nov. 8.

Approximate center of moon.

x = 16.0 y = 20.4658
x = 16.0 y = 23.4658
mean y = 21.9658
max. y = 23.9814
R = 2.0156

min in x = 15.3307
R = 2.0156
17.3463

Center { X_0 = 17.3463
Y_0 = 21.9658

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

MC920 1912 Oct 25. 8

Times etc.

Exp. To stars	1911 Feb 15	11h	59m	40.5	-12h	08m 40
" " moon		12	04	09.8		04 10.0
clock fast			2	31.7		
H. Sid. T.		12	1	38.1		
" long		4	44	31.05		
G. Sid. T.		16	46	09.15		
Sid. T. M. noon		21	37	29.62		
Interval		19	8	39.53		
Reduction			3	8.18		
G. M. T.		19	5	31.35		

	R. A.		Decl.
Epoch Ann. Eph.			
Moon 19h	12h 12m 28.55	+2°	15' 27.8
Motion in 1m = 9.1 8 2	10.59	-14.86	
" " 5.52	10.59		- 1 21.8
Tabular place	12h 12m 39.14	+2°	~~+14' 06.7~~
			14 05.5

Moon's parallax 56' 30".6
" semidiam. 15 25.6

1912 Nov. 8.

Approximate centre of moon.

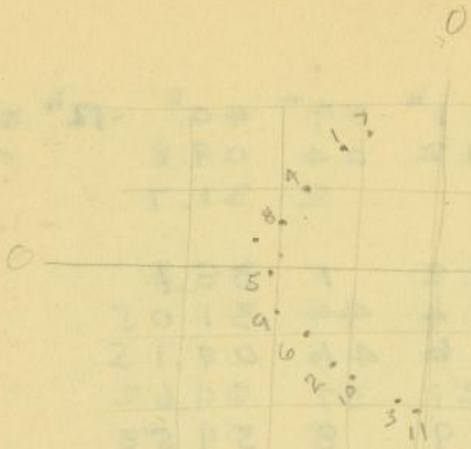
x = 16.0 y = 20.4658
x = 16.0 y = 23.4658
mean y = 21.9658
max y = 23.9814
R = 2.0156

min in x = 15.3307
R = 2.0156
17.3463

Centre { X_0 = 17.3463
Y_0 = 21.9658

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188



Point	Pos ∠	Resid
11	180°.0	+50
3	170.1	−128
10	153.0	+87
2	138.0	−12
6	120.9	+36
9	104.4	−43
5	90.0	−5
8	71.7	+23
4	61.4	−56
1	42.0	+60
7	27.4	−15

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Nov. 9. 9

Moon's Limb - Reduction

Point	x	$x - X_0$	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	16.00000	+ 1.34663	1.8125	4.0634	+ 18
2	16.00000	+ 1.34663	1.8125	4.0634	+ 18
3	17.00000	+ 0.34663	0.1199	4.0482	- 134
4	15.57994	+ 1.76669	3.1219	4.0551	- 65
5	15.33307	+ 2.01356	4.0626	4.0638	+ 22
6	15.61466	+ 1.73317	2.9988	4.0688	+ 72
7	16.42077	+ 0.92256	0.8567	4.0532	- 84
8	15.43199	+ 1.91144	3.6649	4.0645	+ 29
9	15.33942	+ 1.95221	3.8107	4.0608	+ 8
10	16.43400	+ 0.91223	0.8323	4.0719	+ 103
11	17.34663	0.00000	0.00000	4.0643	+ 27
				4.0616	- 2

signs changed because of reversal.

	y	$(y-Y_0)$	Δy	$(y-Y_0)^2$
1	20.46658	+ 1.50000	+ 3	2.25009
2	23.46658	- 1.50000	- 3	2.25009
3	23.94774	- 1.98116	- 4	3.92833
4	21.00000	+ 0.96658	+ 2	0.93332
5	22.00000	- 0.03342	0	0.00012
6	23.00000	- 1.03342	- 2	1.07700
7	20.17822	+ 1.78876	+ 3	3.19665
8	21.33338	+ 0.63320	+ 1	0.39966
9	22.46658	- 0.50000	- 1	0.25001
10	23.76654	- 1.79996	- 3	3.23996
11	23.98814	- 2.01356	- 4	4.06433

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Moon's limb - Reduction.

Point	x	$x - X_0$	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	
1	16.00000	+ 1.34663	1.81125	4.06734	+ 13
2	16.00000	+ 1.34663	1.81125	4.06734	+ 13
3	17.00000	+ 0.34663	0.11999	4.04882	− 134
4	15.57994	+ 1.76669	3.12219	4.05551	− 65
5	15.33307	+ 2.01356	4.06226	4.06388	+ 22
6	15.61466	+ 1.73117	2.99688	4.03873	+ 72
7	16.42007	+ 0.92576	0.85677	4.05332	− 84
8	15.43119	+ 1.91464	3.66449	4.06455	+ 29
9	15.39422	+ 1.95221	3.81077	4.06088	+ 8
10	16.43400	+ 0.91243	0.83223	4.07149	+ 105
11	17.34663	0.00000	0.00000	4.06433	+ 27
				4.06616	− 2

signs changed because of reversal.

	y	$(y-Y_0)$	Δy	$(y-Y_0)^2$
1	20.46588	+ 1.50000	+ 3	2.25009
2	23.46588	− 1.50000	− 3	2.25009
3	23.94744	− 1.98156	− 4	3.92833
4	21.00000	+ 0.96588	+ 2	0.93332
5	22.00000	− 0.03412	0	0.00012
6	23.00000	− 1.03412	− 2	1.07000
7	20.17882	+ 1.78706	+ 3	3.19465
8	21.33388	+ 0.63200	+ 1	0.39960
9	22.46588	− 0.50000	− 1	0.25001
10	23.76544	− 1.79956	− 3	3.23924
11	23.98144	− 2.01556	− 4	4.06433

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj 188

No	[aa]	[at]	[au]	[bt]	[bn]
1	1.82	+ 2.02	+ 24.3	2.25	+ 27.0
2	1.82	- 2.02	+ 24.3	2.25	- 27.0
3	0.12	- 0.69	- 46.9	3.92	+265.3
4	3.13	+ 1.72	- 115.0	0.94	- 63.0
5	4.08	- 0.06	+ 44.4	0.00	- 0.7
6	2.99	- 1.78	+ 124.6	1.06	- 74.2
7	0.56	+ 1.66	- 78.1	3.20	-150.4
8	3.65	+ 1.20	+ 55.4	0.40	+ 18.3
9	3.80	- 0.98	- 15.6	0.25	+ 4.0
10	0.82	- 1.64	+ 93.7	3.24	-185.4
11	0.00	- 0.00	+ 0.0	4.08	- 54.5
	23.09	- 0.57	+111.1	21.59	-240.6

[ac]: 14.27 [bc]: - 3.97 [cn] = - 2.0

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj 188

MC 920.

1912 Nov. 9 } 10
Nov. 26 }

Moon's Limb-Reduction

Conditional Equations.

1	+ 1.35 a	+ 1.50 b	+ c =	+ 18
2	+ 1.35	− 1.50	+ c =	+ 18
3	+ 0.35	− 1.98	+ c =	− 134
4	+ 1.77	+ 0.97	+ c =	− 65
5	+ 2.02	− 0.03	+ c =	+ 22
6	+ 1.73	− 1.03	+ c =	+ 72
7	+ 0.93	+ 1.79	+ c =	− 84
8	+ 1.91	+ 0.63	+ c =	+ 29
9	+ 1.95	− 0.50	+ c =	− 8
10	+ 0.91	− 1.80	+ c =	+ 103
11	+ 0.00	− 2.02	+ c =	+ 27

Normal Equations.

a	b	c	
+ 23.09	− 0.57	+ 14.27	= + 111
− 0.57	+ 21.59	− 3.97	= − 241
+ 14.27	− 3.97	+ 11.00	= − 2
+ 0.57	− 0.01	+ 0.35	= + 3
− 14.27	+ 0.35	− 8.82	= − 69
	+ 21.58	− 3.62	= − 238
	− 3.62	+ 2.18	= − 71
	+ 3.62	− 0.61	= − 40
		+ 1.57 c	= − 111
	− 6.01	+ 3.62	= − 118
	+ 15.57		= − 356
− 18.51	+ 5.15	− 14.27	= + 3
+ 5.15	− 1.43	+ 3.97	= − 1
+ 4.58	+ 4.58		= + 114
+ 4.58	+ 20.16		= − 242
− 1.04	− 4.58		= + 55
+ 3.54 a			= + 169
+ 870 a		+ 5336	=

$\frac{\Delta\delta}{\Delta\nu} = 2.01 - .17 = +0.34$

c = − 71 ± 37

b = − 24 ± 11

a = + 48 ± 24

$\frac{\Delta a}{\Delta\nu} = 201 - 0.61 = -1.73$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 920.

1912 Nov. 9. (10
Nos 26)

Moon's limb - Reduction

Conditional Equations.

1	+ 1.35 a	+ 1.50 b	+ c =	+ 18	
2	+ 1.35	− 1.50	+ c =	+ 18	
3	+ 0.35	− 1.98	+ c =	− 134	
4	+ 1.77	+ 0.97	+ c =	− 65	
5	+ 2.02	− 0.03	+ c =	+ 22	
6	+ 1.73	− 1.03	+ c =	+ 72	
7	+ 0.93	+ 1.79	+ c =	− 84	
8	+ 1.91	+ 0.63	+ c =	+ 29	
9	+ 1.95	− 0.50	+ c =	− 8	
10	+ 0.91	− 1.80	+ c =	+ 103	
11	+ 0.00	− 2.02	+ c =	+ 27	

Normal Equations.

a	b	c	
+ 23.09	− 0.57	+ 14.27 =	+ 111
− 0.57	+ 21.59	− 3.97 =	− 241
+ 14.27	− 3.97	+ 11.60 =	− 2
+ 0.57	− 0.01	+ 0.35 =	+ 3
− 14.27	+ 0.35	− 8.82 =	− 69
	+ 21.58	− 3.62 =	− 238
	− 3.62	+ 2.18 =	− 71
	+ 3.62	− 0.61 =	− 40
		+ 1.57 c =	− 111
	− 6.01	+ 3.62 =	+ 118
	+ 15.57	=	− 356

$\frac{\Delta b}{\Delta n} = 2.01 + 17 = +0.34$

$c = -71 \pm 37$

$b = -24 \pm 11$

− 18.51	+ 5.15	− 14.27 =	+ 3
+ 5.15	− 1.43	+ 3.97 =	− 1
+ 4.58	+ 4.58	=	+ 114
+ 4.58	+ 20.16	=	− 242
− 1.04	− 4.58	=	+ 55
+ 3.54 a		=	+ 169

$a = +48 \pm 24$

$+ 8.70\,a \qquad + 5.33\,c = \qquad \frac{\Delta \Delta}{\Delta n} = 2.01 - 0.61 = -1.23$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920 1912 Nov. 26. 11

Moon's Centre
Residuals

					C	O	O − C
1	+ 65	− 36	− 71	=	− 42	+ 18	+ 60
2	+ 65	+ 36	− 71	=	+ 30	+ 18	− 12
3	+ 17	+ 48	− 71	=	− 6	− 134	− 128
4	+ 85	− 23	− 71	=	− 9	− 65	− 56
5	+ 97	+ 1	− 71	=	+ 27	+ 22	− 5
6	+ 83	+ 25	− 71	=	+ 36	+ 72	+ 36
7	+ 45	− 43	− 71	=	− 69	− 84	− 15
8	+ 92	− 15	− 71	=	+ 6	+ 29	+ 23
9	+ 94	+ 17	− 71	=	+ 35	− 8	− 43
10	+ 44	+ 43	− 71	=	+ 16	+ 103	+ 87
11	00	+ 48	− 71	=	− 23	+ 27	+ 50
							+ 256 − 259

Average = 47
P.E = $47 \times \sqrt{\frac{1}{8}} \times 0.84 = \pm 46$

$X_0 = -17.3463$ $Y_0 = -21.9658$ $R_0^2 = 4.0616$
$+\frac{1}{2}a$ = + 24 $+\frac{1}{2}b$ = − 12 $\pm c$ = − 71
$X = -17.3439 \pm 12$ $Y = -21.9670$ $R^2 = 4.0545$

From preliminary constants (see p. 3)
.. computed ..

	X	Y
	−17.3595	−21.9706
ax =	+ 7	− 16
by =	− 8	− 16
c =	+ 2	+ 32
	X = −17.3594	Y = −21.9706

$\xi = +0.6406$ $\eta = +0.0294$
$\log \xi = 9.80659$
.. $\cos\delta = 9.99983$
.. const 8.50724
$\log(\alpha - A) = 1.29952$

$\log \tan\delta = 8.5914$
.. $\delta^2 = 9.6542$
const .. 7.0534
$\log \eta_1 = 5.2990$

$\alpha - A = + 19.9^s$
$A = 12^h\ 12^m\ 27^s$
$\alpha = 12^h\ 12^m\ 46.9^s$

$\eta = + 0$
$\eta_0 = +0.0294$
$\log \eta_0 = 8.4683$
const = 7.3311
.. $(\delta - D) = 1.13720$
$\delta - D = + 13.7$
$D = +1^\circ\ 37'\ 12.$
$\delta = +1^\circ\ 37'\ 25.7$

17

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

1912 Nov. 26.

MC 9·20

Wood's Centre

Residuals

				C	O	O − C
1	+65	− 36	− 71 =	− 42	+ 18	+ 60
2	+65	+ 36	− 71 =	+ 30	+ 18	− 12
3	+ 17	+ 48	− 71 =	− 6	− 134	− 128
4	+ 85	− 23	− 71 =	− 9	− 65	− 56
5	+ 97	+ 1	− 71 =	+ 27	+ 22	− 5
6	+ 83	+ 25	− 71 =	+ 36	+ 72	+ 36
7	+ 45	− 43	− 71 =	− 69	− 84	− 15
8	+ 92	− 15	− 71 =	+ 6	+ 29	+ 23
9	+ 94	+ 12	− 71 =	+ 35	− 8	− 43
10	+ 44	+ 43	− 71 =	+ 16	+ 103	+ 87
11	00	+ 48	− 71 =	− 23	+ 27	+ 50

+256 − 259

Average = 47

P.E. = $47 \times \sqrt{\frac{11}{8}} \times 0.84 = \pm 46$

$X_0 = 17.3463$ $Y_0 = 21.9658$ $R_0^2 = 40616$

$-\frac{1}{2}\omega = -24$ $-\frac{1}{2}\epsilon = +12$ $\pm C = -71$

$X = 17.3439 \pm 12$ $Y = 21.9670$ $R^2 = 40545$

from previous constants (see p. 3)

$X = 17.3283$ $Y = 21.9634$

$ax = +7$ -16

$by = -8$ -16

$c = +2$ $+32$

$X = 17.3284$ $Y = 21.9634$

-17.3594 -21.9706

$\bar{z} = +0.6716$

$\log \bar{z} = 9.827111$

$\cdot \cos\delta = 9.999983$

$\cdot$ const $= 8.507124$

$\log(\alpha - A) = 1.320044$

$\alpha - A = +20^s.90$

$A = 12^h\ 12^m\ 27^s.$

$\alpha = 12^h\ 12^m\ 46^s.93$

$\eta = +0.0356$

$+0.0294$

$\log \tan\delta = 8.5914$

$\delta^2 = 9.6542$

const $= 1.0534$

$\log \eta_1 = 5.2990$

$\eta = +0$

$\eta_0 = +0.0366$

$\log \eta_0 = 8.563488$

const $= 7.331155$

$\cdot (\delta - D) = 1.233333$

$\delta - D = +17''.1$

$D = +1^\circ\ 37'\ 12''.$

$\delta = +1^\circ\ 37'\ 29''.1$

$+1^\circ\ 37'\ 25''.7$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920. (1911 Feb 15. 12^h Moon.

1912 Dec. 5. 12

Reduction to Apparent Place

α_0 =	12^h	12^m	$47.^s90$		δ_0 =	$+1^\circ$	$37'$	$29.''1$			
G =	17	7	6		H =	20^h	23^m	6^s			
$G+\alpha_0$ =	5	19	54	$= 79^\circ 48'$	$H+\alpha_0$ =	8^h	35^m	54^s	$= 128^\circ 48'$		

$\log \frac{1}{15}$ =	8.8239			$\log \frac{1}{15}$ =	8.8239			$\log i$ =	0.8318	m	
$\therefore g$ =	0.8526			$\therefore h$ =	1.2852			$\therefore \cos\delta_0$ =	9.9998		
$\therefore \sin(G+\alpha_0)$ =	9.9931			$\therefore \sin(H+\alpha_0)$ =	9.8917			$\log(i)$ =	0.8316	m	
Tan δ_0	8.4528			$\therefore \sec\delta_0$ =	0.0002						
$\log_6(g)$ =	9.1224			$\therefore (h)$ =	0.0010						

$\therefore g$ =	0.8526			$\log h$ =	1.2852						
$\therefore \cos(G+\alpha_0)$ =	9.2482			$\therefore \cos(H+\alpha_0)$	9.7970	m					
$\therefore (g')$	0.1008			$\therefore \sin\delta_0$ =	8.4526						
				$\therefore (h')$	9.5348	m					

α_0 =	12^h	12^m	46.93 ✓		δ_0 =	$+1^\circ$	37'	25.''7 ✓			
f =			− 0.25		(g') =		+	1.3			
(g) =			+ 0.01		(h') =		−	0.3			
(h) =			+ 1.00 ✓	+0.76	(i) =		−	6.8	− 5.8	✓	
α =	12	12	47.69 ✓		δ =	$+1^\circ$	37'	19.''9 ✓			

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC920. (1911 Feb 15. 12h) Moon.

1912 Dec. 5. 12

Reduction to apparent place

$\alpha_0 = 12^h\ 12^m\ 47^s.90$ $\quad \delta_0 = +1^\circ\ 37'\ 29''.1$

$G = 17\ 7\ 6$ $\quad H = 20^h\ 23^m\ 6^s$

$G + \alpha_0 = 5\ 19\ 54 = 79^\circ 48'$ $\quad H + \alpha_0 = 8^h\ 35^m\ 54^s = 128^\circ 48'$

$\log \frac{1}{15} = 8.8239$ $\quad \log g = 0.8526$ $\quad \log \sin(G+\alpha_0) = 9.9951$ $\quad \tan \delta_0 \ 8.9528$ $\quad \log \delta(g) = 8.1224$

$g = 0.8526$ $\quad \cos(G+\alpha_0) \ 9.2482$ $\quad (g') \ 0.1008$

$\log \frac{1}{15} = 8.8239$ $\quad \log h = 1.2852$ $\quad \sin(H+\alpha_0) = 9.8917$ $\quad \sin \delta_0 = 8.4526$ $\quad (h) = 0.0010$

$\log h = 1.2852$ $\quad \cos(H+\alpha_0) \ 9.7970_n$ $\quad \sin \delta_0 = 8.4526$ $\quad (h') \ 9.5348_n$

$\log i = 0.8318_n$ $\quad \cos \delta_0 = 9.9998$ $\quad \log(i) = 0831 6_n$

α_0	$12^h\ 12^m$	$47^s.90$	δ_0	$+1^\circ\ 37'$	$29''.1$
f		$-\ 0.25$	(g')	$+$	1.3
(g)		$+\ 0.01$	(h')	$-$	0.3
(h)		$+\ 1.00$	(i)	$-$	6.8
α	$12\ 12$	~~48.66~~ 47.69	δ	$+1^\circ\ 37'$	~~23".3~~ 19.9

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Lunar Parallax.

α' = 12h 12m 47.69s ✓
Θ = 12 01 38.2

$\Theta - \alpha'$ = − 11 09.5 ✓
= − 2° 47′ 22″ ✓

$\frac{1}{2}(\alpha - \alpha')$: − 1′ 01″

$(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha')$: − 2° 46′ 21″

log tan ϕ' = 9.95727 ✓
" cos $(\alpha' - \alpha')$ = 0.00000 ✓
" cos $[(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha')]$: 9.99949 ✓
" tan γ = 9.95778 ✓

γ + 42° 13′ 09.5″ ✓
δ' + 1 37 19.9 ✓
$\delta' - \gamma$ = + 40 35 49.6 ✓

log sin ϕ' = 9.82640 ✓
" sin π = 8.21583 ✓
" sin $(\zeta - \delta')$ = 9.81340 ✓
" sin γ = 9.82733 ✓

" sin $(\delta - \delta')$ = 8.02828 ✓

$\delta - \delta'$ = + 36′ 41.5″ ✓

δ = + 2 14 01.4 ✓

Corr Eph δ = + 2° 14′ 05.5″ ✓

O − C = − 4.1 ✓

Corr for stand radius − 1.2

True (O − C) = − 5.3

δ' = + 1° 37′ 19.9″ ✓

π = 56′ 30.6″ ✓

log $\rho \cos\phi'$ = 9.86913 ✓
" $\rho \sin\phi'$ = 8.21583 ✓
" " $(\Theta - \alpha')$ = 8.68723 ✓
" " cos δ' = 9.99985 ✓

" sin $(\alpha - \alpha')$ = 6.77239 ✓

approx $(\alpha - \alpha')$ = − 2′ 02″ ✓

log cos δ: 9.99967 ✓

" sin $(\alpha - \alpha')$ = 6.77252 ✓

$\alpha - \alpha'$ = − 2′ 02.2″ ✓
= − 8.15 ✓

α = 12 12 39.54 ✓

α = 12h 12m 39.15s ✓

+ 0.39 ✓

+ 0.29

+ 0.68

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Lunar Parallax.

$\alpha' = 12^h\ 12^m\ 47^s.69$
$\Theta = 12\ 01\ 38.2$

$\Theta - \alpha' = -\ 11\ 09^s.5$
$= -\ 2^\circ\ 47'\ 22''$

$\frac{1}{2}(\alpha - \alpha') = -\ 1'\ 01''$

$(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = -\ 2^\circ\ 46'\ 21''$

log tan ϕ'	9.95727
" cos $(\alpha - \alpha')$	0.000000
" cos $[(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha')]$	9.99949
" tan γ	9.95778
γ	$+42^\circ\ 13'\ 09''.5$
δ'	$+\ 1\ 37\ 19.9$
$\delta' - \gamma$	$+40\ 35\ 49.6$

log ρ sin q'	9.82640
" sin π	8.21586
" sin $(q - \delta')$	9.81340
" sin γ	9.82735
" sin $(q - \delta')$	8.02831

$\delta - \delta' = +\ 36'\ 41.5$

$\delta = +2\ 14\ 01.5$

Corr Eph $\delta = +2^\circ\ 14'\ 05''.5$

$O - C = -\ 4.1$

Corr for Stand radius $-\ 1.2$

Trial $(O - C) -\ 5.3$

$\pi = 56'\ 30''.6$

log ρ cos q'	9.86913
" ρ sin π	8.21586
" $(\Theta - \alpha')$	8.68723
" cos δ'	9.99985
" sin $(\alpha - \alpha')$	6.77239
approx $(\alpha - \alpha')$	$-\ 2'\ 02''$
log cos δ	9.99967
" sin $(\alpha - \alpha')$	6.77255
$\alpha - \alpha'$	$-\ 2'\ 02.2$
	$=\ -\ 8^s.15$

$\alpha = 12\ 12\ 3954$

$\alpha = 12^h\ 12^m\ 39^s.15$

$+\ 0.40$

$+\ 0.29$

$+\ 0.68$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921. 1912 Oct 19. 16

Standard coordinates see fol 1-2

	1	2	3
α	12h 08m 31.97s	12h 09m 23.09s	12h 12m 25.05s
A	12 12 54.	12 12 54	12 12 54
x-A	− 4 22.03	− 3 30.91	+ 28.95
sin(x-A)	− 262.01	− 210.90	− 28.95
log "	2.418320	2.324080	1.461650
" cosδ	9.999960	9.999950	9.999950
" ξ0	0.925520	0.830820	9.968840
ξ0	− 8.4240	− 6.7736	− 0.9308
ξ1	− 23	− 21	− 1
ξ	26.4263	24.7757	18.9309
x	26.4864	24.6936	18.9766
x-ξ	− 601	+ 821	− 457

signs of x + y are changed

δ	+0° 44' 05.7"	+2° 45' 20.6"	0° 50' 48.4"
D	1 33 33	1 33 33	1 33 33
δ-D	− 49 27.3	+1 11 47.6	− 42 44.6
tan(δ-D)	− 2967.5	+ 43082	− 2564.7
log "	3.472390	3.634300	3.409040
" η0	0.803540	0.965450	0.740190
tanδ	8.10818	8.6824	8.1634
" ξ2	1.85510	1.66160	9.93760
" η1	7.0126	7.3974	5.1544
η0	− 6.3612	+ 9.2352	− 5.4979
η1	+ 10	+ 25	0
η	28.3602	12.7623	27.4979
y	28.2875	12.7002	27.4938
y-η	+ 727	+ 621	+ 41
Rem y=	28.28744	12.70100	
y-η	+ 728	+ 613	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 921. 1912 Oct 19 16

Standard coordinates see p. 1 · 2

	1	2	3
α	$12^h\ 08^m\ 31^s.97$	$12^h\ 09^m\ 23^s.09$	$12^h\ 12^m\ 25^s.05$
A	12 12 54.	12 12 54	12 12 54
α-A	− 4 8203	− 3 3091	− 28.95
sin(α-A)	− 262.01	− 210.90	− 2.895
log "	2.418320	2.324080	1.461655
cos δ	9.999996	9.999950	9.999995
ξ_0	0.92552	0.83082	9.96884
ξ_0	− 8.4240	− 6.7736	− 0.9308
ξ_1	− 23	− 21	− 1
ξ	26.4263	24.7757	18.9309
x	26.4864	24.6936	18.9766
x-ξ	− 601	+ 821	− 457

signs of x + y are changed

δ	+0° 44′ 05.″7	+2° 45′ 20.″6	0° 50′ 48.″4
D	1 33 33	1 33 33	1 33 33
δ-D	− 49 27.3	+ 1 11 47.6	− 42 44.6
Tan(δ-D)	− 2967.5	+ 43082	− 2564.7
log "	3.471739	3.634300	3.409044
η_0	0.803544	0.965450	0.740194
Tan δ	8.10818	8.6824	8.1634
ξ^2	1.8510	1.6616	0.9376
η_1	7.0126	7.3974	5.1544
η_0	− 6.3612	+ 9.2352	− 5.4979
η_1	+ 10	+ 25	0
η	28.3602	12.7623	27.4979
y	28.2875	12.7002	27.4938
y-η	+ 727	+ 621	+ 41
Rem η^2	26.2874	12.7010	
y-η	+ 728	+ 613	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj 188

MC921

1912 Oct 19. 19

	4	5
α	12 17 04.43	12 20 07.63
A	12 12 54	12 12 54.
α-A	+ 4 10.43	+ 7 13.63
sin(α-A)	+ 250.42	+ 433.55
log "	2.398671	2.637044
" cos δ	9.999997	9.999977
" ξ_0	0.905900	1.144065
ξ_0	+8.0520	+13.9332
ξ_1	+ 30	+ 68
ξ	9.9450	4.0600
x	10.0224	4.0264
x-ξ	- 774	+ 336

δ	+0 20 10.5	+1 52 35.9
D	1 33 33	1 33 33
δ-D	-1 13 22.5	+ 19 02.9
tan(δ-D)	-4403.2	+ 1142.9
log "	3.643772n	3.058011
" η_0	0.974922n	0.388916
" Tan δ	7.7683	8.5154
" ξ^2	18718	2.2881
" η_1	66335	7.8569
η_0	-9.4388	+2.4499
η_1	+ 43	+ 72
η	31.4345	19.5429
y	31.5162	19.6690
y-η	- 817	- 1261
Reiu y =	31.5160	19.6694
y-η =	- 815	- 1265

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921 1912 Oct 19. 19

	4	5
α	12 17 04.43	12 20 07.63
A	12 12 54	12 12 54.
α-A	+ 4 10.43	+ 7 13.63
sin(α-A)	+ 250.42	+ 433.55
log	2.39867	2.63704
log cos δ	9.99999	9.99977
ξ_0	0.90590	1.14405
ξ_0	+80520	+13.9332
ξ_1	+ 30	+ 68
ξ	19.8450	4.0600
x	1.00224	4.0264
x-ξ	+ 774	+ 336

δ	+0 20 10.5	+1 52 35.9
D	1 33 33	1 33 33
δ-D	-1 13 22.5	+ 19 02.9
tan(δ-D)	-4403.2	+ 1142.9
log	3.64377	3.05801
η_0	0.97492	0.38916
log tan δ	7.7683	8.5154
log ξ	1.81818	2.2881
η_1	0.66335	7.8569
η_0	-9.4388	+2.4499
η_1	+ 43	+ 72
η	31.4345	19.5429
η	31.5162	19.6690
η-η	- 817	- 1261
Rem η =	31.5160	19.6694
η-η =	- 815	- 1265

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 921 1912 Oct 17 20

Comparison Stars
measures.

	4 d		4 n		x d		x n	
1/								
26.5	14233		15760		15849		14258	
26.3	11355	60	8640	35	10718	11	9398	96
	60		46		11		94	
	40		70		60		72	
	28.2877		28.2873		26.4858		26.4869	
2	16420		16364		16720		15150	
24.7	9420	16	13376	66	13660	50	8822	20
12.7	24		74		50		18	
	22		76		26		64	
	12.7001		12.7003		24.6981		24.6940	
3/	14310		14010		13375		11625	
18.9	9375	80	8952	50	13135	45	18588	57
27.5	72		55		40		57	
very	20		22					
faint								
	27.4939		27.4936		18.9765		18.9768	
4								
10.0	14960		15875				7500	
31.5	9795	94	11030	32	8250	54	7278	82
	95		30		55		70	
	70		77		8024			
	31.5170		31.5155		10.0229		10.0220	
For remeasure surface E3.								
5								
4.0								
19.7	13354		16190				8640	
	6676	75	12695	65	10232	30	8373	72
	75		89		30		75	
	66		00		9970			
	19.6687		19.6693		4.0261		4.0267	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 921 1912 Oct 17 20

Comparison stars measures.

V	a		N		a		N	
	4				x			
26.5	14233		15760		15849		14258	
28.3	11355	60	8640	35	10718	11	9398	96
	60		46		11		94	
	40		70		60		72	
	28.2877		28.2873		26.4859		26.4869	
2	16420		16364		16720		15150	
24.7	9420	16	13374	65	13660	50	8222	20
12.7	24		74		50		18	
	22		76		26		64	
	12.7001		12.7203		24.6931		24.6940	
3	14310		14010		13375		11625	
18.9	9375	80	8952	50	13135	45	18587	
27.5	72		55		40		57	
very faint	20		22					
	27.4939		27.4936		18.9765		18.9768	
4								
10.0	14960		15875				7500	
31.5	9795	94	11030	32	8250	54	7278	92
	95		30		55		70	
	70		77		8024			
	31.5170		31.5155		10.0229		10.0220	

for remeasures see page 23.

5								
4.0								
19.7	13354		16190				8640	
	6676	75	12895	85	10232	30	8373	72
	75		89		30		75	
	66		00		9970			
	19.6687		19.6693		4.0261		4.0267	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Renseignements 1913 Jan 7.

1 100 82 86
69
9621
20.95-42

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Points on Uranoid Ring.
Measures.

	d				remeasure direct.
1/					
16.0	17650		16833		18927
20.9	8140 33		1675770		9442 44
	45-40		5658		4432
	60		40		
	20.9520		20.9427		20.9487
2/	15694		132.25		
16.0	806353		1085545		
22.7	5055		6640		
	04		35		
	22.7647		22.7625		
3/	11100		837880		
17.0	1095044		6773		
24.0	4040		8225		
	20.0156		20.0149		
4/	15038		16125		
17.0	803444		1314336		
23.7	5058		3540		
	52		39		
	23.7006		23.7009		
5/					15210 16365
16.1					665042 1491530
23.0					3440 1430
					22 80
					16.1421 16.1445
6/					
15.8	min. in x				15482 16115
22.0					1337578 821815
					7585 1220
					92 30
					15.7894 15.7911

12/ x = 17.9 y = 23.9
16889 16011
819898 1464965
0002 65-70
90 10
23.8690 .8651
max. in y

measures Nov. 5

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Points on neroid limb.
measured.

	d	v	remeasure direct.
1			
16.0	17650	16833	18927
20.9	9140 33	16757 70	9442 44
	45 40	56 58	44 32
	60	40	
	20.9520	20.9417	20.9487
2	15694	13225	12 x = 17.9 y = 23.9
16.0	8063 58	10855 45	16889 16011
22.7	50 55	6640	8198 98 14649 65
	04	35	0002 65 70
			90 10
	22.7647	22.7625	23.8690 8651 max. m
3	11100	837880	
17.0	1095044	6773	
24.0	4040	8225	
	20.0156	20.0149	
4	15038	16125	
17.0	8034 44	13143 36	
23.7	50 38	35 40	
	52	39	
	23.7006	23.7009	
5			15210 16365
16.1			665042 14915 30
23.0			34 40 1430
			82 80
			16.1421 16.1445
6			15482 16115
15.8	min. in x		1337578 821815
22.0			7585 1220
			92 30
			15.7894 15.7911

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Prints of moon's limb.
measures continued.

7/		a		n
15.9		16710		909788
21.0		1647270		8690
		7260		8860
		15.9759		15.9770
8/ scratch-				
15.8	14902	16139	15321	15860
21.5	957075	11487793	13440 48	7755551
	8066	9089	5046	55558
	16	41	33	66
	21.5536	21.5350	15.8122	15.8110
9/ scratch				
16.6	16190	14476	16081	16962
20.3	1340316	7250061	11.602 10	1147262
	1308	5150	0403	7867
	05	86	96	72
	20.2785	20.2770	16.5517	16.5497
10/ scratch				
	14970	12440	14620	14970
17.3	6847472	10565772	8100 02	11492972
23.8	4538	6362	0101	0888
	78	50	30	72
	23.8133	23.8124 ✓	17.3474	17.3477
11/ Scratch				
16.6	15610	15707	14224	15312
23.4	11221 20	10086 96	980510	973832
	1226	8886	0708	3030
	20	17	30	22
	23.4394	23.4373	16.5581	16.5584

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Points of moon's limb.
measures continued.

7/		a		n	
15.9		16710		9097	88
21.0		1647270		8690	
		7260		8860	
		15.9759		15.9770	

8. scratch-

15.8	14902		16139		15321		15860
21.5	957075		1148793		1344042		7755 51
	8066		9089		5046		5558
	16		41		33		66
	21.5336		21.5350		15.8122		15.8110

9 scratch

16.6	16190		14976		16081		16962
20.3	1340316		725061		1160210		1147262
	1308		5150		0403		7867
	05		86		96		72
	20.2785		20.2770		16.5517		16.5497

10/ scratch

	14970		12440		14620		14970
17.3	694742		1056572		8100 02		1149292
23.8	4538		6362		0101		0388
	78		50		30		72
	23.8033		23.8124		17.3474		17.3477

11/ Scratch

16.6	15610		15707		14224		15312
23.4	1122120		1008696		980510		973832
	1226		8866		0708		3030
	20		17		30		22
	23.4394		23.4373		16.6581		16.5584

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921 1912 Oct 18. 23

Mean measured coördinates of comp. stars and coords of center of plate.

Star	x	y
1	26.4864 ✓	28.2875 ✓
2	24.6936 ✓	12.7002 ✓
3	18.9766 ✓	27.4938 ✓
4	10.0224 ✓	31.5162 ✓
5	4.0264 ✓	19.6690 ✓
5	84.2054	119.6667
	16.84	23.93
	− 18.00	−.82
	− 1.16	+ 1.93
	.31	.465
	−35.96	897.45 ✓
		+14'57" ✓

From page 3

Mean R.A. = $12^h 13^m 30^s$

$- \quad 36^s$

$A = 12^h 12^m 54$

Mean Decl: $+1° 18' 36''$

$+ \quad 14' 57''$

$D = +1° 33' 33''$ ✓

Remeasure Comp. star (4) 1912 Oct 22.

4/

y		x		1/ y		x	
15140		14153		15808		14501	
9986	04	93086		12924	32	7362	65
88		12		28		58	
56		52		11		91	
31.5162		31.5157		28.2881		.2868	

2/

y		x	
15350		14166	
8339	38	11176	68
28		63	
47		60	
12.7014		.7005	

5/

y		x	
15162		16272	
8469	69	12959	60
69		62	
64		58	
19.6694		.6693	

mean y:

1	28.2874
2	12.7010
4	31.5160
5	19.6694

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC981 1912 Oct 18. 23

Mean measured coördinates of comp. stars and coörds of center of plate.

Star	x	y
1	26.4864	28.2875
2	24.6936	12.7002
3	18.9766	27.4938
4	10.0224	31.5162
5	4.0264	19.6690
5	84.2054	119.6667
	16.84	23.93
	−18.00	−22
	− 1.16	+ 1.93
	31	465
	−35.96	897.45
		+14'57"

From page 3

Mean R.A = $12^h 13^m 30^s$

$- \quad 36^s$

$A = 12^h 12^m 54$

Mean Decl: $+1^\circ 18' 36''$

$+ \quad 14' 57''$

$D = +1^\circ 33' 33''$

Remeasure Comp. star (4) 1912 Oct 22.

4/

d		n	
15140		14153	
9986	84	9308	06
88		12	
56		52	
31.5162		31.5157	

1/

d		n	
15808		14501	
12924	32	7 62	65
28		58	
11		91	
28.2881		.2868	

2/

d		n	
15750		14166	
8339	38	11176	68
28		63	
47		60	
12.7014		.7005	

5/

d		n	
15162		16277	
8469	69	12959	60
69		62	
64		58	
19.6694		.6693	

Mean	y.
1	28.2874
2	12.7010
4	31.5160
5	19.6694

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921. 1912 Oct 26. 24

Times etc.

Exp. to stars	1911 Feb. 15	12h	10m	39s	- 12h	19m	39s	
" " moon		12	15	09.8			10.0	
Clock fast			2	31.7				
		12	12	38.2				
M. Sid. T								
" dong.		4	44	31.05				
G. Sid. T.		16	57	09.25				
Sid. T. M. noon		21	37	29.62				
Interval		19	19	39.63				
Reduction			- 3	09.98				
G. M. T.		19	16	29.65				

	R. A			Decl.		
From Am Eph						
moon 19h	12h	12m	28.55	+2°	15'	27.3"
Motion in 1m 1.9179			- 14.805			
" 16.49			+ 31.63		- 4'	04.2"
Tabular place	12	13	00.18	+2	11	23.1

Moon's Parallax	56'	30".5	
" Semidiam	15	25.4	

Approximate Center of moon

x = 16.0	y = 20.9465	x = 17.0	y = 20.0152
	y = 22.7636	x = 17.	y = 23.7008
	43.7101		437160
	mean y = 21.8550		mean y = 21.8580

mean y = 21.8570

y = max. = 23.8670

R = 2.0100

X = min. = 15.7902

X_0 = 17.8002

Center { X_0 = 17.8002, Y_0 = 21.8570

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Times etc.

Exp. to stars	1911 Feb. 15	12^h	10^m	39^s	-12^h	19^m 39^s
" " moon		12	15	09.4		10.0
Clock fast			2	31.7		
		12	12	38.2		
M. Sid. T.						
" long.		4	44	31.05		
G. Sid. T.		16	57	09.25		
Sid. T. M. noon		21	37	29.62		
Interval		19	19	39.63		
Reduction			3	09.98		
G. M. T.		19	16	29.65		

	R. A.			Decl.		
from Am Eph						
moon 19^h	12^h	12^m	28.55	$+2°$	15'	27."3
motion in 1^m 1.9179			-14.805			
$16^m.49$			+31.62		-4'	04."2
Tabular place	12	13	00.18	+2	11	23.1

Moon's Parallax,	56'	30."3
" semidiam	15	25.4

Approximate Center of Moon

$x = 16.0$	$y = 20.9465$	$x = 17.0$	$y = 20.0152$		
"	$y = 22.7636$	$x = 17.$	$y = 23.7008$		
	43.7101		43.7160		
mean y	= 21.8550	mean y	= 21.8580		
	mean Y =	21.8570			
	Y = max =	23.8670			
	R =	2.0100	Center	$X_0 = 17.8002$	
	X = min =	15.7902		$Y_0 = 21.8570$	
	X_0 =	17.8002			

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 921 1912 Oct. 18,

Comparison stars — reduction.

Preliminary reduction

Star	x − 5	+ 914		+ 6x		− 2141	
1	− 601	+ 2576	= + 1975	+ 159	= + 2134		= − 7
2	+ 821	+ 1155	= + 1976	+ 149	= + 2125		= − 16
4	− 774	+ 2867	= + 2093	+ 60	= + 2153		= + 12
5	+ 336	+ 1790	= + 2126	+ 24	= + 2150		= + 9
mean	17.7926	+ 1989		+ 107			= 17.7971

Star	y − 7	− 90x		+ 64		+ 1512	
1	+ 727	− 2384	= − 1657	+ 170	= − 1487		= + 25
2	+ 621	− 2222	= − 1601	+ 76	= − 1525		= − 13
4	− 817	− 902	= − 1719	+ 189	= − 1530		= − 18
5	− 1261	− 362	= − 1623	+ 118	= − 505		= + 7
mean	21.8568	− 1601		+ 131			= − 21.8526

Conditional Equations

xY	1	26.49 + 28.29 + c	= − 11.50		+ 25
xy	2	24.69 + 12.70 + c	= + 10.50		− 13
xY	4	10.02 + 31.52 + c	= + 2.50		− 18
xy	5	4.03 + 19.67 + c	= − 3.50		+ 7

Final Equations.

25.59 + 20.50 + c	= − 11.50		+ 6.00
7.02 + 25.00 + c	= + 10.50		− 5.50
18.26 + 29.94 + c	= + 2.50		+ 3.50
14.36 + 16.18 + c	= − 3.50		− 3.00
18.57 − 1.10	= − 22.00		+ 11.50
3.90 + 3.72	= + 6.00		+ 6.50
3.90 − 1.07	= − 4.62		+ 2.42
+ 14.796	= + 10.62		+ 4.08
b	= + 0.72		+ 0.28
18.57a	= − 22.00 + 3.67	= − 18.33	+ 11.50 + 1.43 = + 12.93
a	= − 0.99		a = + 0.70

− 11.5	+ 10.5	+ 2.5	− 3.5	+ 6.0	− 5.5	+ 3.5	− 3.0
+ 25.3	+ 6.9	+ 18.1	+ 14.3	− 17.9	− 4.9	− 12.8	− 0.1
− 14.8	− 18.4	− 21.5	− 11.7	− 5.7	− 7.2	− 6.4	− 4.6
− 1.0	− 1.0	− 0.9	− 0.9	− 17.6	− 17.6	− 17.7	− 7.7

c for x − 5 c for y − 7

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Comparison Stars — reduction.

Preliminary reduction.

Star	x − 5				+ 6x			− 2141.
1	− 601	+ 2576	= + 1975	+ 159	= + 2134			= − 7
2	+ 821	+ 1155	= + 1976	+ 149	= + 2125			= − 16
4	− 774	+ 2867	= + 2093	+ 60	= + 2153			= + 12
5	+ 336	+ 1790	= + 2126	+ 24	= + 2150			= + 9
	17926	+ 1989		+ 107	=			= ~~17788~~ 17971

Star	y − 7				− 90x			+ 1512
1	+ 727	− 2384	= − 1657	+ 170	= − 1487			= + 25
2	+ 621	− 2232	= − 1601	+ 76	= − 1525			= − 13
4	− 817	− 1902	= − 1719	+ 189	= − 1530			= − 18
5	− 1261	− 362	= − 1623	+ 118	= − 1505			= + 7
	21856	− 1601		+ 131				~~21861~~ 21826

Conditional Equations

xy	1	26.49	+ 28.29 + c	= − 7	+ 25
xy	2	24.69	+ 12.70 + c	= − 16	− 13
xy	4	10.02	+ 31.52 + c	= + 12	− 18
xy	5	4.03	+ 19.67 + c	= + 9	+ 7

Mean Equations.

25.59	+ 20.50 + c	= − 11.50	+ 6.00	
7.02	+ 25.60 + c	= + 10.50	− 5.50	
18.26	+ 29.90 + c	= + 2.50	+ 3.50	
14.36	+ 16.18 + c	= − 3.50	− 3.00	

(+0.21) 18.57	− 5.10	= − 22.00	+ 11.50
3.90	+ 13.72	= + 6.00	+ 6.50
3.90	− 1.07	= − 4.62	+ 2.42
	+ 14.796	= + 10.62	+ 4.08
	b	= + 0.72	+ 0.28
18.57a		= − 22.00 + 3.67 : − 18.33	+ 11.50 + 1.43 : + 12.93
	a	= − 0.99	a = + 0.70

− 11.5	+ 10.5	+ 2.5	− 3.5	+ 6.0	− 5.5	+ 3.5	− 3.0
+ 25.3	+ 6.9	+ 18.1	+ 14.3	− 17.4	− 4.9	− 12.8	− 10.1
− 14.8	− 18.4	− 21.5	− 11.7	− 5.7	− 7.2	− 8.4	− 4.6
− 1.0	− 1.0	− 0.9	− 0.9	− 17.6	− 17.6	− 17.7	− 17.7

c for x − 5 c for y − 7

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921 1912 Oct 18. 26

Comp. Stars - Reduction.

Resids. in x

				C	O	O-C
1	−26	+20	−1	= −7	−7	0
2	−24	+9	−1	= −16	−16	0
4	−10	+23	−1	= +12	+12	0
5	−4	+14	−1	= +9	+9	0

Resids. in y.

				C	O	O-C
1	+18	+8	−18	= +8	+25	+17
2	+17	+4	−18	= +3	−13	−16
4	+7	+9	−18	= −2	−18	−16
5	+3	+6	−18	= −9	+7	+16

Remeasures give resids y | +16, −17, −17, +15

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921 1912 Oct 18.

Comp. Stars - Reduction.

Resids. in x

				C	O	O − C
1	− 26	+ 20	− 1	− 7	− 7	0
2	− 24	+ 9	− 1	− 16	− 16	0
4	− 10	+ 23	− 1	+ 12	+ 12	0
5	− 4	+ 14	− 1	+ 9	+ 9	0

Resids. in y.

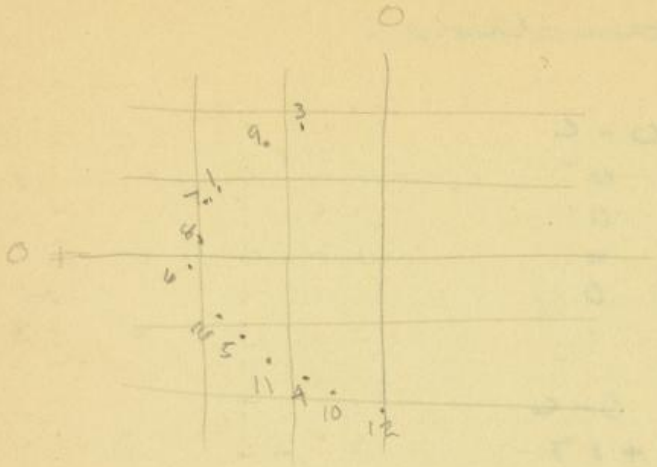
				C	O	O − C
1	+ 18	+ 8	− 18	+ 8	+ 25	+ 17
2	+ 17	+ 4	− 18	+ 3	− 13	− 16
4	+ 7	+ 9	− 18	− 2	− 18	− 16
5	+ 3	+ 6	− 18	− 9	+ 7	+ 16

Remainders give resids. in y

+ 16
− 17
− 17
+ 15

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188



Point	Pos. ∠	Resid.
12	180°.0	+111
10	167.0	−60
4	156.5	−15
11	141.9	−54
5	124.6	−42
2	116.8	+45
6	94.0	−16
8	80.8	−32
7	64.8	+16
1	63.0	+108
9	38.5	+49
3	23.5	−103

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

NC921 1912 Nov 9.

Moon's Limb - Reduction.

Point	x	$x - X_0$	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	16.0000	+ 1.8002 ✓	3.2407 ✓	4.0701	+ 189
2	16.0000	+ 1.8002	3.2407 ✓	4.0630	+ 118
3	17.0000	+ 0.8002 ✓	0.6403 ✓	4.0340	- 172
4	17.0000	+ 0.8002	0.6403	4.0414	- 98
5	16.1437	+ 1.6569	2.7453	4.0522	+ 10
6	15.7902	+ 2.0100	4.0401	4.0605	+ 93
7	15.9764	+ 1.8238	3.3268	4.0611	+ 99
8	15.8116	+ 1.9886	5.9545	4.0587	+ 75
9	16.5507	+ 1.2495 ✓	1.5612	4.0560	+ 48
10	17.3476	+ 0.4526 ✓	0.2048 ✓	4.0315	- 197
11	16.5582	+ 1.2420	1.5426	4.0444	- 68
12	17.8002	0.0000	0.0000	4.0417	- 95
				4.0512	+ 2

Signs of x + y are changed.

	y	$y - Y_0$	Δy	$(y-Y_0)^2$
1	20.9465	+ 0.9105	+ 2	0.8294 ✓
2	22.7636	- 0.9066	- 2	0.8223 ✓
3	20.0152	+ 1.8418 ✓	+ 4	3.3937 ✓
4	23.7008	- 1.8438	- 4	3.4011
5	23.0000	- 1.1430	- 2	1.3069
6	22.0000	- 0.1430	0	0.0204
7	21.0000	+ 0.8570	+ 2	0.7348
8	21.5343	+ 0.3227	+ 1	0.1042
9	20.2778	+ 1.5792	+ 3	2.4948 ✓
10	23.8128	- 1.9558 ✓	- 4	3.8267
11	23.4384	- 1.5814	- 3	2.5018
12	23.8670	- 2.0100	- 4	4.0417

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

NK 921 1912 Nov. 9. 27

Two's Point - Reduction.

Point	x	$x - X_0$	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	16.0000	+ 1.8002	3.2407	4.0701	+ 189
2	16.0000	+ 1.8002	3.2407	4.0630	+ 118
3	17.0000	+ 0.8002	0.6403	4.0340	- 172
4	17.0000	+ 0.8002	0.6403	4.0914	- 98
5	16.1438	+ 1.6569	2.7458	4.0522	+ 10
6	15.7902	+ 2.0100	4.0401	4.0605	+ 93
7	15.9764	+ 1.8238	3.3263	4.0611	+ 99
8	15.8116	+ 1.9886	3.9545	4.0587	+ 75
9	16.5807	+ 1.2195	1.5612	4.0560	+ 48
10	17.3476	+ 0.4526	0.2048	4.0315	- 197
11	16.5582	+ 1.2420	1.5426	4.0444	- 68
12	17.8002	0.0000	0.0000	4.0417	- 95
				4.0512	+ 2

Signs of y and Δy are changed.

	y	$y - Y_0$	Δy	$(y-Y_0)^2$
1	20.9465	+ 0.9105	+ 2	0.8294
2	22.7636	- 0.9066	- 2	0.8223
3	20.0152	+ 1.8418	+ 4	3.3937
4	23.7008	- 1.8438	- 4	3.4011
5	23.0000	- 1.1430	- 2	1.3069
6	22.0000	- 0.1430	0	0.0204
7	21.0000	+ 0.8570	+ 2	0.7348
8	21.5343	+ 0.3227	+ 1	0.1042
9	20.2778	+ 1.5792	+ 3	2.4948
10	23.8128	- 1.9558	- 4	3.8267
11	23.4384	- 1.5814	- 3	2.5018
12	23.8670	+ 2.0100	- 4	4.0417

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj 188

Formation of Normal Equations.

No	aa	ab	ac	bb	bc
1	3.24	+ 1.64	+ 340.2	0.83	+ 172.0
2	3.24	- 1.64	+ 212.4	0.83	- 107.4
3	0.64	+ 1.47	- 138.4	3.39	- 316.5
4	0.64	- 1.47	- 76.4	3.39	+ 180.3
5	2.76	- 1.89	+ 16.6	1.30	- 11.4
6	4.04	- 0.28	+ 186.9	0.02	- 13.0
7	3.31	+ 1.57	+ 180.2	0.74	+ 85.1
8	3.96	+ 0.64	+ 149.2	0.10	+ 24.0
9	1.54	+ 1.97	+ 60.0	2.50	+ 75.8
10	0.26	- 0.88	- 88.6	3.84	+ 386.1
11	1.54	- 1.96	- 84.3	2.50	+ 107.4
12	0.00	- 0.00	- 0.0	4.04	+ 191.0
	25.13	-0.83	+ 755.8	23.48	+ 773.4

[ac] = +15.62 [bc] = -4.07 [cc] = + 2.0

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj: 188

MC 9 21 1912 Nov. 11} 28
Nov 26}

Moon's limb - Reduction.

Conditional Equations.

	a	b	c		
1	+1.80	+0.91	+1	=	+189
2	+1.80	−0.91	+1	=	+118
3	+0.80	+1.84	+1	=	−172
4	+0.80	−1.84	+1	=	−98
5	+1.66	−1.14	+1	=	+10
6	+2.01	−0.14	+1	=	+93
7	+1.82	+0.86	+1	=	+99
8	+1.99	+0.32	+1	=	+75
9	+1.25	+1.58	+1	=	+48
10	+0.45	−1.96	+1	=	−197
11	+1.24	−1.58	+1	=	−68
12	0.00	−2.01	+1	=	−95

Normal Equations.

a	b	c	
+25.13	− 0.83	+15.62	= +756
− 0.83	+23.48	− 4.07	= +773
+15.62	− 4.07	+12.00	= +2
+ 0.83	− 0.03	+ 0.52	= + 25
− 15.62	+ 0.52	− 9.71	= −470
	+23.45	− 3.55	= +798
	− 3.55	+ 2.29	= −468
	+ 3.55	− 0.54	= +121
		+ 1.75	= −347
	− 550	+ 3.55	= −726
	+1795		= +672
−20.33	+ 5.30	−15.62	= − 3
+ 5.30	− 1.38	+ 4.07	= + 1
+ 4.80	+ 4.47		= +753
+ 4.47	+22.10		= +774
− 0.90	− 4.47		= −157
+ 3.90 a			= +596
+711 a		+4396	= —

$\frac{\Delta \delta}{\Delta N}$ = 2.01 · +.15 = +.30

c = − 198 ± 40

b = + + 4 ± 12

a = + 153 ± 26

$\frac{\Delta \alpha}{\Delta N}$ = 2.01 · −.62 = −1.24

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 9 21 1912 Nov. 11 } 25
Nov 26 }

Moon's limb. Reduction.

Conditional Equations.

	a	b	c		
1	+1.80	+0.91	+1	=	+189
2	+1.80	−0.91	+1	=	+118
3	+0.80	+1.84	+1	=	−172
4	+0.80	−1.84	+1	=	−98
5	+1.66	−1.14	+1	=	+10
6	+2.01	−0.14	+1	=	+93
7	+1.82	+0.86	+1	=	+99
8	+1.99	+0.32	+1	=	+75
9	+1.25	+1.58	+1	=	+48
10	+0.45	−1.96	+1	=	−197
11	+1.24	−1.58	+1	=	−68
12	0.00	−2.01	+1	=	−95

Normal Equations.

a	b	c	
+25.13	−0.83	+15.62	= +756
−0.83	+23.48	−4.07	= +773
+15.62	−4.07	+12.00	= +2
+0.83	−0.03	+0.52	= +25
−15.62	+0.52	−9.71	= −470
	+23.45	−3.55	= +798
	−3.55	+2.29	= −468
	+2.55	−0.54	= +121
		+1.75	= −347
	−5.50	+3.55	= −726
	+17.95		= +072

$\frac{\Delta b}{\Delta N} = 201 \cdot +.15 = +30$

$c = -198 \pm 40$

$b = +4 \pm 12$

−20.33	+5.30	−15.62	= −3
+5.30	−1.38	+4.07	= +1
+4.80	+4.47		= +753
+4.47	+22.10		= +774
−0.90	−4.47		= −157
+3.90a			= +596

$a = +153 \pm 26$

+7116 +4396 — $\frac{\Delta a}{\Delta N} = 2.01 - .67 = -1.24$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

1916921

Moon Series.

Residuals

				C	O	O − C
1	+ 275	+ 4	− 198	+ 81	+ 189	+ 108
2	+ 275	− 4	− 198	+ 73	+ 118	+ 45
3	+ 122	+ 7	− 198	− 69	− 172	− 103
4	+ 122	− 7	− 198	− 83	− 98	− 15
5	+ 254	− 4	− 198	+ 52	+ 10	− 42
6	+ 308	− 1	− 198	+ 109	+ 93	− 16
7	+ 278	+ 3	− 198	+ 83	+ 99	+ 16
8	+ 304	+ 1	− 198	+ 107	+ 75	− 32
9	+ 191	+ 6	− 198	− 1	+ 48	+ 49
10	+ 69	− 8	− 198	− 137	− 197	− 60
11	+ 190	− 6	− 198	− 14	− 68	− 54
12	+ 0	− 8	− 198	− 206	− 95	+ 111
					+ 329	− 322

Average (O−C) = 54

P.E. = $54 \times \sqrt{\frac{17}{24}} \times 0.84 = \pm 52$.

$X_0 = -17.8002$ $Y_0 = -21.8570$ $R_0^2 = 4.0512$

$+\frac{1}{2}a = +76$ $+\frac{1}{2}b = +2$ $+c = -198$

$X = -17.7926 \pm 13$ $Y = -21.8568 \pm 6$ $R^2 = 4.0304 \pm 40$

From fraction, corrs. $X = -17.7971$ $Y = -21.8526$

∴ corrected ∴

	X	Y
ax	− 18	+ 12
by	+ 16	+ 6
c	− 1	− 18
	$X = -17.7974$	$Y = -21.8526$

$\xi = +0.2026$

$\log \xi = 9.306647$

$\cos\delta = 9.999837$

$\therefore \cos\delta = 8.507247$

$\log(\alpha - A) = 0.799577$

$\alpha - A = +6.30$

$A = 12^h\ 12^m\ 54^s$

$\alpha = 12^h\ 13^m\ 00.30^s$

see page 34

$\eta = +0.1474$

$\log \tan\delta = 8.8120$

$\therefore \xi^2 = 86133$

$\cos\delta = 7.05334$

$\log \eta = 4.24870$

$\eta_0 = +0.1474$

$\log \eta = 9.168500$

$\therefore \cos\delta = 7.331150$

$\log(\delta - D) = 1.837350$

$(\delta - D) = +68.8$

$D = +1\ 33\ 33$

$\delta = +1^\circ\ 34'\ 41''.8$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

				C	O	O − C
1	+ 275	+ 4	− 198	+ 81	+ 189	+ 108
2	+ 275	− 4	− 198	+ 73	+ 118	+ 45
3	+ 172	+ 7	− 198	− 69	− 172	− 103
4	+ 172	− 7	− 198	− 83	− 98	− 15
5	− 254	− 4	− 198	+ 52	+ 10	− 42
6	+ 308	− 1	− 198	+ 109	+ 93	− 16
7	+ 278	+ 3	− 198	+ 83	+ 99	+ 16
8	+ 304	+ 1	− 198	+ 107	+ 75	− 32
9	− 191	+ 6	− 198	− 1	+ 48	+ 49
10	− 69	− 8	− 198	+ 137	− 197	− 60
11	+ 190	− 6	− 198	− 14	− 68	− 54
12	+ 0	− 8	− 198	− 206	− 95	+ 111

+ 329 − 322

$X_0 = 17.8002$ $Y_0 = 21.8579$ $K_0^2 = 4.0512$

$\Delta x = + 76$ $\Delta y = - 2$ $\Delta c = - 198$

$X = 17.7926 \pm 13$ $Y = 21.8568 \pm 16$ $K^2 = 4.0304 \pm 40$

Some [illegible] corrects. $x = 17.7881$ $y = 21.8610$

Confirmed

$- 18$ $+ 12$

$+ 16$ $+ 6$

$c = - 1$ $- 8$

$X = -17.7974$ $Y = -21.8526$

$\delta = +0.2122$

$\log \delta = 9.3267\,5$

$\cos \delta = 9.9991\,3$

$\log \Delta = 8.3275\,9$

$\log(\alpha - A) = 0.8196\,8$

$\alpha - A = + 6^m\,60^s$

$A = 12^h\,12^m\,54^s$

$\alpha = 12^h\,13^m\,00^s.60$

$12^h\,13^m\,00^s.30$

$\eta = +0.1390$

$\log \tan \delta = 8.5782\,00$

$\delta = 8$ [illegible] 33

$\log \Delta = 7.7053\,34$

$= 4.2489\,7$

$\eta_0 = +0.1390$

$\log \cos \delta = 9.9991\,3$

$\delta = 7^\circ\,33'\,15''$

$\log(\delta - D) = 1.8111\,6$

$(\delta - D) = + 1^\circ\,49'.8$

$D = + 1^\circ\,33'\,53''$

$\delta = + 1^\circ\,54'\,57''.8$

$+ 1^\circ\,34'\,41''.8$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 921 (1911 Feb 15) 1912 Dec 3. 30
Dec. 11.

Reduction to apparent place.

From p. 12 $\alpha_0 = 12^h\ 13^m\ 00^s.30$ $\delta_0 = +1^\circ\ 34'\ 41''.8$
Red in α = + 0.76 Red in δ = − 5.8
$\alpha = 12^h\ 13^m\ 01^s.06$ $\delta = +1^\circ\ 34'\ 36''.0$

Lunar Parallax.

$\alpha' = 12^h\ 13^m\ 01^s.06$ $\delta' = +1^\circ\ 34'\ 36''.0$
$\Theta = 12\ 12\ 38.2$ $\pi = 56'\ 30''.3$

$\Theta - \alpha' = -\ 0^h\ 22^s.86$ $\log \rho \cos\phi' = 9.86913$
$= -\ 5'\ 42''.9$ " $\sin\pi = 8.21580$
" " $(\Theta - \alpha') = 7.22080_n$
$\frac{1}{2}(\alpha - \alpha') = -\ 0\ 02.$ " $\cos\delta' = 9.99983$
" $\sin(\alpha - \alpha') = 5.30592_n$
$(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = -\ 5'\ 41''$
$\log\tan\phi' = 9.95727$ Aberr $(\alpha - \alpha') = -\ 0'\ 04''$
" $\cos\frac{1}{2}(\alpha - \alpha') = 0.000000$
" " $(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha') = 0.000000$
" $\tan\gamma = 9.95727$ $\log\cos\delta = 9.99968$
" $\sin(\alpha - \delta') = 5.30605_n$
$\gamma = 42^\circ\ 11'\ 09''.5$
$\delta' = +1^\circ\ 34'\ 41''.8$ $\alpha - \alpha' = -0'\ 04''.2$
$\gamma - \delta' = 40\ 36\ 27.7$ $= -\ 0^s.28$
$\log\rho\sin\phi' = 9.82640$
" $\sin\pi = 8.21580$
" " $(\phi - \delta') = 9.81350$
" $\sin\phi = 9.82707$
" $\sin(\alpha - \delta') = 8.02865$

$\delta - \delta' = +\ 36'\ 43''.2$

$\delta = +2^\circ\ 11'\ 19''.2$ $\alpha = 12^h\ 13^m\ 00^s.78$

Fam Eph $\delta = +2^\circ\ 11'\ 23''.1$ $\alpha = 12^h\ 13^m\ 00^s.18$

$O - C = -\ 3''.9$ $+\ 0.60$

see p. 34

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

MC 921 (1911 Feb 15)

1912 Dec 3. 30
Dec. 11.

Reduction to apparent place.

(from p. 12 (Red in α = +0.76

$\alpha_0 = 12^h\ 13^m\ 00^s.60$ $\quad \delta_0 = +1^\circ\ 34'\ 37''.8$

Red in δ = $-5''.8$

$\alpha = 12^h\ 13^m\ 01^s.36$ $\quad \delta = +1^\circ\ 34'\ 32''.0$

01.06 34 36.0

Lunar Parallax.

$\alpha' = 12^h\ 13^m\ 01^s.06$ $\quad \delta' = +1^\circ\ 34'\ 36''.0$

$\odot = 12\ 12\ 34.2$ $\quad \pi = 56'\ 30''.5$

$\odot - \alpha' = -\ 0^m\ 32^s.86$ $\quad \log \rho \cos\phi' = 9.86913$

$= -\ 5'\ 42''.9$ $\quad \log \sin\pi = 8.21580$

$\log (\odot - \alpha') = 7.22080_n$

$\log \cos\delta' = 9.99983$

$\frac{1}{2}(\alpha - \alpha') = -\ 0\ 02$ $\quad \log \sin(\alpha - \alpha') = 5.30592_n$

$(\odot - \alpha') - \frac{1}{2}(\alpha - \alpha') = -\ 5'\ 41''$ $\quad$ approx $(\alpha - \alpha') = -\ 0'\ 04''$

$\log \tan\phi' = 9.95727$

$\log \cos\frac{1}{2}(\alpha - \alpha') = 0.000000$

$\log (\odot - \alpha') - \frac{1}{2}(\alpha - \alpha') = 0.000000$

$\log \tan\gamma = 9.95727$

$\log \cos\delta = 9.99968$

$\log \sin(\gamma - \delta') = 5.30605_n$

$\gamma = 42^\circ\ 11'\ 10''.5$

$\delta' = +1^\circ\ 34'\ 41''.8$

$\gamma - \delta' = 40\ 36\ 28.5$

$\alpha - \alpha' = -0'\ 04''.2$

$= -\ 0''.28$

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

$\log \sin\pi = 8.21580$

$\log \sin(\phi - \delta') = 9.81351$

$\log \sin\gamma = 9.82707$

$\log \sin(\gamma - \delta') = 8.02863_n$

$\delta - \delta' = +\ 36'\ 43''.7$

$\delta = +2^\circ\ 11'\ 19''.8$ $\quad \alpha' = 12^h\ 13^m\ 00^s.78$

(corr Ephs $\delta = +2^\circ\ 11'\ 23''.1$ $\quad \alpha = 12^h\ 13^m\ 00^s.18$

$O - C = -\ 3''.9$ $\quad + 0''.60$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC921 1913 Apr. 10. 32

Comp Stars with center of 920

x	26.4864	24.6936	10.0224	4.0264
3	25.5583	23.9080	9.8761	3.1913
x-3	+ .9281	+ .7856	+ .9463	+ .8351
y	28.2875	12.7007	31.5162	19.6690
8	28.8302	13.2325	31.9080	20.0114
y-η	− .5427	− .5323	− .3918	− .3424

x-3	-.904	-7x		-.6550
+.9281	-.2546	= +.6735	-.185	= +.6550 = 0
+.7856	-.1143	= +.6713	-.173	= +.6540 = -10
+.7463	-.2836	= +.6627	-.070	= +.6557 = +7
+.8351	-.1770	= +.6581	-.028	= +.6553 = +3
-17.926	-1.967		-1.75	= -18.6568

y-η	+91x	-54	+4		+3131
-.5427	+.2410	= -.3017	-.141	= -.3158	+.028 = -.3130 = +1
-.5323	+.2247	= -.3076	-.064	= -.3140	+.013 = -.3127 = +4
-.3918	+.0912	= -.3006	-.158	= -.3164	+.032 = -.3132 = -1
-.3924	+.0366	= -.3058	-.098	= -.3156	+.020 = -.3136 = -5
-21.8568	+1.619		-1.09		+.022 = -21.3905

signs of (x-3) and (y-η) should be changed thus making

X = -16.9284
Y = -22.3231

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phee.proj 188

MC 921. 1913 Apr. 10. 32

Comp. Stars with center of 920

$x_{,y}$	26.4864	24.6936	10.0224	4.0264
$\bar{x}$	25.5583	23.9080	9.0761	3.1913
$x-\bar{x}$	+ .9281	+ .7856	+ .9463	+ .8351
y	28.2875	12.7002	31.5162	19.6690
η	28.8302	13.2325	31.9080	20.0114
$y-\eta$	− 5427	− 5323	− 3918	− 3424

$x-\bar{x}$	−904		−7x		−6550	
+9281	−2546	= +6735	−185	= +6550	=	0
+7856	−1143	= +6713	−173	= +6540	=	−10
+9463	−2836	= +6627	−70	= +6557	=	+7
+8351	−1770	= +6581	−28	= +6553	=	+3
−17.1926	−1967		−125		=	−18.6568

$y-\eta$	+91x		−54		+4		+3131	
−5427	+2410	= −3017	−141	= −3158	+28	= −3130	=	+1
−5323	+2247	= −3076	−64	= −3140	+13	= −3127	=	+4
−3918	+912	= −3006	−158	= −3164	+32	= −3132	=	−1
−3924	+366	= −3058	−98	= −3156	+20	= −3136	=	−5
−21.8568	+1619		−109		+22	=	−21.3905	

signs of $(x-\bar{x})$ and $(y-\eta)$ should be changed thus making

$X = -16.9284$
$Y = -22.3231$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

1913 Apr. 10

MC921

Plate Constants

a	b	c	x − 3	y − n
+2649	+2829	+1 =	0	+1
+2469	+1270	+1 =	−10	+4
+1002	+3152	+1 =	+7	−1
+403	+1967	+1 =	+3	−5

Mean Equations

+25.59	+20.50	+1 =	−5.00	+2.50
+7.02	+25.60	+1 =	+5.00	−3.00
+18.26	+29.90	+1 =	+3.50	0.00
+14.36	+16.18	+1 =	−3.50	−0.50

+18.57	−5.10	= −10.00		+5.50
+3.90	+13.72	= +7.00		+0.50
−3.90	+1.07	= +2.10		−1.16
	+14.79	= +9.10		+0.66
		b = +0.615		−0.04
+18.57a	= −10.00	+3.14 = −6.86	+5.50	−0.23 = +5.27
		a = −0.37		+0.28

−5.0	+5.0	+3.5	−3.5	+2.5	−3.0	0.0	−0.5
+9.5	+2.6	+6.7	+5.3	−7.3	−2.0	−5.2	−4.1
−12.6	−15.8	−18.4	−10.0	+0.9	+1.1	+1.3	+0.7
−8.1	−8.2	−8.2	−8.2	−3.9	−3.9	−3.9	−3.9

	C	O	O − C
−10 + 17 − 8 = −1		0	+1
−9 + 8 − 8 = −9		−10	−1
−4 + 19 − 8 = +7		+7	0
−1 + 12 − 8 = +3		+3	0

	C	O	O − C
+8 − 1 − 4 = +3		+1	−2
+7 − 1 − 4 = +2		+4	+2
+3 − 1 − 4 = −2		−1	+1
+1 − 1 − 4 = −4		−5	−1

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc. 188

MC921 1913 Apr. 10 33

Plate Constants.

a	b	c	x − ξ	y − η
+26.49	+28.29	+1 =	0	+1
+24.69	+12.70	+1 =	−10	+4
+10.02	+31.52	+1 =	+7	−1
+4.03	+19.67	+1 =	±3	−5

Mean Equations.

+25.59	+20.50	+1 =	−5.00	+2.50
+7.02	+25.60	+1 =	+5.00	−3.00
+18.26	+29.90	+1 =	+3.50	0.00
+14.36	+16.18	+1 =	−3.50	−0.50
+18.57	−5.10	= −10.00		+5.50
+3.90	+13.72	= +7.00		+0.50
−3.90	+1.07	= +2.10		−1.16
	+14.79	= +9.10		+0.66
		b = +0.615		−0.04
+18.57a =	−10.00	+3.14 = −16.86	+5.50	+0.23 = +5.27
		a = −0.37		+0.28

−5.0	+5.0	+3.5	−3.5	+2.5	−3.0	00	−0.5
+9.5	+2.6	+6.7	+5.3	−7.3	−2.6	−5.7	−4.1
−12.6	−15.6	−18.4	−10.0	+0.9	+1.1	+1.3	+0.7
−8.1	+8.2	−8.2	−8.2	−13.9	−3.9	−3.9	−3.9

	C	O	O − C
−10 + 17 − 8	= −1	0	+1
−9 + 8 − 8	= −9	−10	−1
−4 + 19 − 8	= +7	+7	0
−1 + 12 − 8	= +3	+3	0

	C	O	O − C
+18 − 1 − 4	= +3	+1	−2
+7 − 1 − 4	= +2	+4	+2
+3 − 1 − 4	= −2	−1	+1
+1 − 1 − 4	= −4	−5	−1

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

1913 Apr. 10.

MC 921.

Moons mean position.

Second Prelim. Red. $X = -16.9284$ $Y = -22.3231$

For Earth constants:

-16.9284 -22.3231

$\xi = -0.6570$

$\log \xi = 9.817570_n$

$\log \cos \delta = 9.999883$

const. $= 8.507724$

$\log(\alpha - A)\ 1.310500_n$

$\alpha - A = -20.44$

$A = 12\ 12\ 27$

$\alpha = 12\ 12\ 06.56$

$\eta = +0.6095$

$\log \tan \delta = 8.44157$

$\log \xi^2 = 9.63572$

$\eta' = 5.13301$

$\eta_1 = 0$

$\log \eta_0 = 9.78497_n$

const. $= 7.33115$

$\log(\delta - D) = 2.45382$

$\delta - D = +4\ 44.3$

$D = +1\ 37\ 12$

$\delta = +1\ 41\ 56.3$

$\eta = -0.3231$

$\log \tan \delta = 8.44157$

$\log \xi^2 = 0.06041$

$\eta' = 5.55551$

$\eta_1 = +0$

$\log \eta_0 = 9.50934_n$

const. $= 7.33115$

$\therefore (\delta - D) = 2.17819_n$

$\delta - D = -2\ 30.7$

$D = +1\ 37\ 12$

$\delta_0 = +1\ 34\ 41.3$

Red to app. place -5.8

$\delta' = +1\ 34\ 35.5$

Parallax $+36\ 43.2$

$\delta = +2\ 11\ 18.7$

Tabular $+2\ 11\ 23.1$

$O - C = -4.4$

$\xi = +1.0716$

$\log \xi = 0.030063$

$\log \cos \delta = 9.999883$

const. $= 5.507724$

$\therefore (\alpha - A) = 1.52296$

$\alpha - A = +33.34$

$A = 12\ 12\ 27$

$\alpha_0 = 12\ 13\ 00.34$

Red to app. place $+0.76$

$\alpha' = 12\ 13\ 01.10$

parallax -0.28

$\alpha = 12\ 13\ 00.82$

Tabular $12\ 13\ 00.18$

$O - C = 0.64$

Curve to stand reading

Δ 0.2 −4.6

4 0.0 0.0

+ +

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC 921.

1913 Apr. 10. 34

Moons mean position.

From Prelim. Red. $X = -16.9284$ $Y = -22.3231$

plate constants	− 6	+ 5
	+ 14	− 1
	− 8	− 4
	−16.9284	−22.3231

$\xi = -0.1570$

$\log \xi : 9.817\,57n$

$\log S : 9.99983$

const : 8.50724

$\log(\alpha - A)$ 1.31050n

$\alpha - A$ − 20.44

$A = 12\ 12\ 27$

$\alpha = 12\ 12\ 06.56$

$\eta = +0.6095$

$\log \tan \delta : 8.44155$

$\log S^2 : 9.63352$

$\log \eta' : 5.13301$

$\eta' = 0$

$\log \eta_0 : 9.76849$

const 7.33115

$\log(\delta - D) : 2.45382$

$\delta - D = +\ 4\ 44.3$

$D = +1\ 37\ 12$

$\delta = +1\ 41\ 56.3$

$\xi = +1.0716$

$\log \xi : 0.03003$

$\log \cos \delta : 9.99983$

const : 8.50724

$\log(\alpha - A) : 1.52296$

$\alpha - A = +\ 33.34$

$A = 12\ 12\ 27$

$\alpha_0 = 12\ 13\ 00.34$

Red to app. place : + 0.76

$\alpha' = 12\ 13\ 01.10$

parallax − 0.28

$\alpha = 12\ 13\ 00.82$

Tabular $12\ 13\ 00.18$

$O - C = 0.64$

$\eta = -0.3231$

$\log \tan \delta = 8.44155$

$\log S^2 = 0.06064$

$\log \eta' = 5.55551$

$\eta' = +0$

$\log \eta_0 = 9.50934n$

const : 7.33115

$\log(\delta - D) = 2.17819n$

$\delta - D = -\ 2\ 30.7$

$D = +1\ 37\ 12$

$\delta_0 = +1\ 34\ 41.3$

Red to app. place $-\ 5.8$

$\delta' = +1\ 34\ 35.5$

Parallax + 36 43.2

$\delta = +2\ 11\ 18.7$

Tabular +2 11 23.1

$\delta - C = -\ 4.4$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae..proc..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae..proc..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

1912 Oct 24.

Standard coords of Comp. stars

See pp. 1 + 2.

	1	2
α	$12^h\ 08^m\ 31^s.97$ ✓	$12^h\ 09^m\ 23^s.6$ ✓
A	12 13 06	12 13 06 ✓
$\alpha - A$	− 4 34.03 ✓	− 3 42.91 ✓
Sin$(\alpha - A)$	− 274.01 ✓	− 222.90 ✓
log "	2.439777 m ✓	2.348116 m ✓
" cosδ	9.999966 ✓	9.999950 ✓
" ξ_0	0.944971 m	0.854855 m
ξ_0	−8.8098 ✓	−7.1590 ✓
ξ_1	− 24 ✓	− 27 ✓
ξ	9.1878 ✓	10.8383 ✓
x	9.1204 ✓	10.9458
$x - \xi$	− 674 ✓	+ 1075 ✓

δ	$+0^\circ\ 44'\ 05''.7$ ✓	$+2^\circ\ 45'\ 20''.6$ ✓
D	+1 27 34	+1 27 34
$\delta - D$	− 43 28.3	+1 17 46.6
Tan$(\delta - D)$	− 2608.4	+ 4667.4
log "	3.416377 m	3.669080
" η_0	0.747552 m	1.000023
" tanδ	8.10822	8.68240
" ξ_0^2	1.88999	1.70977
" η_1	7.05515	7.44555
η_0	− 5.5914	+10.00053 ✓
η_1	+ 11 ✓	+ 28
η	16.40975	32.00081
y	16.51808	32.10100
$y - \eta$	+.10833	+ 929

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

1912 Oct 24. 36

Standard circles of Comp. stars Sept. 1 + 2.

	1	2
α	$12^h\ 08^m\ 31^s.97$	$12^h\ 09^m\ 23^s.09$
1	12 13 ~~06~~ 07	12 13 07
$\alpha - A$	− 4 35.03	− 3 43.91
$\sin(\alpha - A)$	− 275.01	− 223.90
$\log \dots$	2.43935 m	2.35005 m
$\cos\delta$	9.99996	9.99950
ξ_0	0.94655 m	0.85679 m
ξ_0	−8.5420	−7.1910
ξ_1	− 24	− 27
ξ	9.1556	10.8063
x	9.1204	10.9458
$x - \xi$	− ~~352~~	~~+1395~~
	− 674	+1075

δ	+0° 44′ 05.″7	+2° 45′ 20.″6
D	+1 27 34	+1 27 34.
$\delta - D$	− 43 28.3	+1 17 46.6
$\sin(\delta - D)$	− 2608.4	+ 4667.4
$\log \dots$	3.41637 m	3.66908
η_0	0.74758 m	1.00023
$\dots \tan\delta$	8.1082	8.6824
ξ_0^2	18931	1.7136
η_1	7.0547	7.4494
η_0	−5.5914	+10.0053
η_1	+ 11	+ 28
η	16.4097	32.0081
γ	16.5180	32.1010
$\eta - \eta$	+ .1083	+ 929

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922

Standard Coords of Comp. Stars.

Star	4	5
α	$12^h\ 17^m\ 04^s.43$ ✓	$12^h\ 20^m\ 07.63$ ✓
A	12 13 06 ✓	12 13 06 ✓
$\alpha - A$	+ 3 58.43 ✓	+ 7 01.63 ✓
$\sin(\alpha - A)$	+ 238.42 ✓	+ 421.56 ✓
log	2.377333 ✓	2.624886 ✓
" $\cos\delta$	9.999997 ✓	9.999977 ✓
" ξ_0	0.884566 ✓	1.131879
ξ_0	+7.6658 ✓	+13.5478 ✓
ξ_1	+ 25 ✓	+ 64
ξ	25.6683 ✓	31.5542 ✓
x	25.5804 ✓	31.6006
$x - \xi$	− 879 ✓	+ 464 ✓

δ	$+0^\circ\ 20'\ 10.''5$ ✓	$+1^\circ\ 52'\ 35.''9$ ✓
D	+1 27 34	+1 27 34
$\delta - D$	−1 7 23 5	+ 25 01.9
$\tan(\delta - D)$	− 4044.0	+ 1501.9
log "	3.606811m	3.176644
" n_0	0.937961m	0.507799
" tan δ	7.7683	8.5154
" ξ_0^2	17691	22637
" η_1	65908	78325
η_0	−8.6688	+3.2195
η_1	+ 4 ✓	+ 68 ✓
η	13.3316	25.2263
y	13.2561	25.0894
$y - \eta$	− 755	−.1369

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Standard Coords of Comp. Stars.

Star	4	5
α	$12^h\ 17^m\ 04^s.43$	$12^h\ 20^m\ 07.63$
A	12 13 96	12 13 07
$\alpha - A$	+ 3 57.43	+ 7 00.63
$\ln(\alpha - A)$	+ 237.42	+ 4 20.56
log.	2.375559	2.623183
$\ln \cos\delta$	9.999999	9.999977
$\ln \xi_0$	0.888275	1.130806
ξ_0	+7.6340	+135156
ξ_1	+ 25	+ 64
ξ	25.6365	31.5220
x	25.5804	31.6006
$x - \xi$	~~- 561~~ - 879	~~+ 786~~ + 464

δ	$+0^\circ\ 20'\ 15''.5$	$+1^\circ\ 52'\ 35''.9$
D	+1 27 34	+1 27 34.
$\delta - D$	−1 7 23.5	+ 25 01.9
$\ln(\delta - D)$	− 4044.0	+ 1501.9
log.	3.606814m	3.176764
$\ln \cos\delta$	0.937796m	0.507799
$\tan\delta$	7.7683	8.5154
ξ_0'	17655	22617
η'	6.5872	7.8305
η_0	−8.6688	+3.2195
η_1	+ 4	+ 68
η	13.3316	24.2263
η	13.2561	25.0894
$1 - \eta$	− 755	−.1369

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922 1912 Oct. 22.

Comparison Stars - Measures.

	y		d		n		d		n	
1/	9.1	14	01	0	15	90	15	62	15	20
	16.5	8	82	25	11	08	6	82	14	00
			24			82		83		00
			08			07		32		00
								30		10
		16.	51	84+	16.	51	9.	12	9.	12
								01		07
2/	10.9	14	21	0	13	75	13	31	13	96
	32.1	13	20	0	47	66	12	76	45	01
			06	12		66		61		95
			12			54		20		58
		32.	10	04	32.	10	10.	94	10.	94
						15		54		62
3/	two faint to measure.									
4/	25.6	16	08	7	14	40	15	48	17	86
	13.3	13	52	0	69	54	11	29	12	04
			24	20		58		88		50
			03			01		92		60
		13.	25	65	13.	25	25.	58	25.	58
						57		00		09
5/		14	49	0	16	03	14	47	15	20
	31.6	13	58	92	69	25	10	47	92	78
	25.1		92			25		75		80
			90			38		80		94
		25.	08	99	25.	08	31.	60	31.	60
						89		00		11

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922 1912 Oct. 22. 39

Comparison Stars - measures.

		d		n		d	n
1/	V						
	9.1	14010		15905		15628	15207
	16.5	8827	25	11081	95	6828	14000 00
		24		82		32	00
		08		07		30	10
		16.5184		16.5177		9.1201	9.1207
2/							
	10.9	14210		13755		13310	13962
	32.1	13200	12	47666	74	12765	45019 2
		06		66		61	95
		12		54		20	58
		32.1004		32.1015		10.9459	10.9462
3/	Too faint to measure.						
4/							
	25.6	16087		14401		15489	17860
	13.3	13520	20	6954	61	11295	12048 54
		24		58		88	50
		03		01		92	60
		13.2565		13.2557		25.5800	25.5809
5/		14490		16035		14475	15255
	31.6	13559	92	6925	30	10477	9278 80
	25.1	92		25		75	80
		90		38		80	94
		25.0899		25.0889		31.6000	31.6011

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922 1912 Oct 22.

Mean measured coords of comp stars and coords of center of plate.

Star	x	y	R.a.	Decl	ph 1-2
1	9.1204	16.5180	12^h 08^m 32^s	$+0^\circ$ 44′ 06″	
2	10.9458	32.1010	09 23	+2 45 21	
4	25.5804	13.2561	17 04	+0 20 10	
5	31.6006	85.0894	20 08	+1 52 36	
4	77.2472	86.9645	4 | 55 7	4 | 5 42 13	
	19.31	21.74	12 13 47	1 25 33	
	+1.31	− 0.26	− 41	+ 2 1	
	31	465	A: 12 13 06	D: 1 27 34	
	131	2790			
	393	930			
	40.61	120.90			

Preliminary Reduction.

Star	x − 3	−1104		−1076		+2588	
1	−674	−1817	= −2491	− 91	= −2582	= + 6	
2	+1075	−3531	= −2456	−109	= −2565	= +23	
4	− 879	−1459	= −2338	−256	= −2594	= − 6	
5	+464	−2760	= −2296	−316	= −2612	= −24	
Moon	18.2850 ✓	−2480 ✓	=	−182 ✓		=	18.2776 ✓

Star	y − m	+1107		−44		−2010	
1	+1083	+1003	= +2086	− 66	= +2020	= +10	
2	+ 929	+1204	= +2133	−128	= +2005	= − 5	
4	− 755	+2814	= +2059	− 53	= +2006	= − 4	
5	−1369	+3476	= +2107	−100	= +2007	= − 3	
Moon	22.5428 ✓	+2011 ✓	=	− 90 ✓		=	22.5339 ✓

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922 1912 Oct 22. 39

Mean measured coords of comp stars and coords of center of plate

Star	x	y	R.A.	Decl. ph 1:2.
1	9.1204	16.5180	12h 08m 32s	+0° 44′ 06″
2	10.9458	32.1070	09 23	+2 45 21
4	25.5804	13.2561	17 04	+0 20 10
5	31.6006	25.0894	20 08	+1 52 36
4	77.2472	86.9645	4 55 7	4 5 42 13
	19.31	21.74	12 13 47	1 25 33
	+131	− 0.26	− 41	+ 2 1
	31	465	A = 12 13 06	D = 1 27 34
	131	2790		
	393	930		
	4053.61	120.90		

Preliminary Reduction.

Star	x − 3	− 1104	− 1076	+ 2588
1	− 674	− 1817 = − 2491	− 91 = − 2582	= + 6
2	+ 1075	− 3531 = − 2456	− 109 = − 2565	= + 23
4	− 879	− 1459 = − 2338	− 256 = − 2594	= − 6
5	+ 464	− 2760 = − 2296	− 316 = − 2612	= − 24
	18.2850	− 7480	− 152	18.2776

Star	y − m	+ 1107	− 44	− 2010
1	+ 1083	+ 1003 = + 2086	− 66 = + 2020	= + 10
2	+ 924	+ 1204 = + 2128	− 123 = + 2005	= − 5
4	− 755	+ 2814 = + 2059	− 53 = + 2006	= − 4
5	− 1869	+ 3476 = + 2107	− 100 = + 2007	= − 3
	22.5428	+ 7011 =	− 90	22.5339

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922. 1912 Oct. 22. . 40

Points on lunaris limb - measures.

	d	n
1		
18.0	15779	16570
20.6	10189982	12112212
	8590	0520
	87	70
	20.5594	20.5542
2		
19.0	14730	15127
20.7	8055545	11800095
	4850	0504
	33	27
	20.6682	20.6674
3	16300	15715
19.0	12070070	9882982
24.4	7265	0214
	92	20
	24.4229	24.4181
4		
20.0	16170	15292
21.5	11260040	10195888
	4548	9590
	75	92
	21.4924	21.4900
5		
20.0	16967	14420
23.5	11002995	10350050
	8497	8060
	61	25
	23.5969	23.5926
6		
19.6		
21.0		

probably on terminator

14670	15820
10440048	10012225
4548	1525
72	32
19.5774	19.5808

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 922. 1912 Oct 22. 40

Points on lunar limb - measures.

	d	N
1		
18.0	15774	16570
20.6	10189-92	12112 12
	8590	0520
	87	70

probably on terminator

20.5594 20.5542

2		
19.0	14730	15127
20.7	805545	1180095
	4850	0504
	33	27

20.6682 20.6674

3	16300	15713
19.0	12070 70	9882 92
24.4	7205	0214
	92	20

24.4229 24.4181

4		
20.0	16170	15292
21.5	1126040	1019588
	4548	9540
	75	92

21.4934 21.4900

5		
20.0	16967	14420
23.5	1106295	1035050
	8497	3060
	61	25

23.5969 23.5926

6	14670	15820
19.6	1044048	1001225
21.0	4548	1525
	72	32

19.5774 19.5808

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

Points on Nuovo's Rim - measures - continued.

	d	N
7		
20.2	16210	14560
22.0	8400 98	1234850
	9085	4845
	10	70
	20.2183	20.2214
8		
20.2	15132	13612
23.0	755566	1120092
	4452	0002
	38	16
	20.2417	20.2415
9		
19.7	15830	15605
24.0	1256045	888500
	5048	0004
	40	10
	19.6718	19.6711
10		
20.3	14810	16206
22.4	774551	1324246
max in N	5368	4343
	18	18
	20.2939	20.2966
11	scratch.	
18.7	15760 14120	15256 15657
20.6	988785 9978 70	1261422 831506
	9184 8070	2028 1110
	58 20	70 70
	20.5872 20.5855	18.7361 18.7356
12		
18.2	15289 14517	measured nov. 5
20.5	995565 977875	rough edge -
	5782 7580	possibly on terminator
min ing	78 01	
	20.5318 .5270	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC922 1912 Oct 22 41

Points on Nemesis limb.
Measures - continued.

	d	N
7		
20.2	16210	14560
22.0	8400 98	1234850
	9065	4845
	10	70
	20.2183	20.2214
8		
20.2	15132	13612
23.0	755566	1120092
	4462	0002
	38	16
	20.2417	20.2415 v
9		
19.7	15830	15605
24.0	1256045	888500
	5048	0004
	40	10
	19.6718	19.6711
10		
20.3	14810	16206
22.4	774551	1324246
maximum	5568	4343
	18	18
	20.2939	20.2966
11 scratch.		
18.7	15760 14120	15256 15657
20.6	988785 9978 70	1261422 831506
	9184 80 70	2028 1110
	58 20	70 70
	20.5872 20.5855	18.7361 18.7356
	15289 14517	measured nov. 5
	995505 978775	rough edge -
	5782 7580	possibly not terminator
	78 61	
	20.5318 5270	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

	star	a	b	x−5	y−7.
x y	1	9.12 + 16.52 + c =		+ 6	+ 10
x Y	2	10.95 + 32.10 + c =		+23	− 5
X y	4	25.58 + 13.26 + c =		− 6	− 4
X Y	5	31.60 + 25.09 + c =		−24	− 3
		10.04 + 24.31 + c =		+14.50	+ 2.50
		28.59 + 19.18 + c =		−15.00	− 3.50
		21.28 + 28.60 + c =		− 0.50	− 4.00
		17.35 + 14.89 + c =		0.00	+ 3.00
(−.212)		−18.55 + 5.13		= +29.50	+ 6.00
		+ 3.93 + 13.71		= − 0.50	− 7.00
		+ 3.93 − 1.09		= − 6.25	− 1.27
		+ 14.80		= + 5.75	− 5.73
			b	= + 0.39	− 0.39
		−18.55 a = + 29.50 − 2.00 = +27.50			+ 6.00 + 2.00 = +8.00
			a	= − 1.48	a = − 0.43

+ 14.5	− 15.0	− 0.5.	0.0		+2.5	− 3.5	−4.0	+3.0
+ 14.8	+ 42.2	+31.4	+25.7		+4.3	+12.3	+9.2	+7.5
− 9.5	− 7.5	−11.2	− 5.8		+9.5	+7.5	+11.2	+5.8
+19.8	+19.8	+19.7	+19.9		+16.3	+16.3	+16.4	+16.8

c from x − 5 | c from y − 7.

Resids in x.

star				c	G	O − C
1	−13	+ 6	+20 =	+13	+ 6	−7
2	−16	+13	+20 =	+17	+23	+6
4	−37	+ 5	+20 =	−12	− 6	+6
5	−46	+10	+20 =	−16	−24	−8

Resids in y.

star				c	O	O − C
1	− 4	− 6	+16 =	+6	+10	+4
2	− 5	−13	+16 =	−2	− 5	−3
4	−11	− 5	+16 =	0	− 4	−4
5	−14	−10	+16 =	−8	− 3	+5

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

	Star	a	b	x − 3	y − 7.
x y	1	9.12 + 16.52 + c =		+ 6	+ 10
x Y	2	10.95 + 32.10 + c =		+ 23	− 5
X y	4	8.58 + 13.26 + c =		− 6	− 4
X Y	5	31.60 + 25.09 + c =		− 24	− 3
		10.04 + 24.31 + c =		+ 14.50	+ 2.50
		28.59 + 19.18 + c =		+ 15.00	− 3.50
		21.28 + 28.60 + c =		− 0.50	− 4.00
		17.35 + 14.89 + c =		0.00	+ 3.00
2	(2)	− 18.55 + 5.13		= + 29.50	+ 6.00
		+ 3.93 + 13.71		= − 0.50	− 7.00
		+ 3.93 − 1.09		= − 6.25	− 1.27
		+ 14.80		= + 5.75	− 5.73
			b	= + 0.39	− 0.39
		− 18.55 a = + 29.50 − 2.00 = + 27.50			+ 6.00 + 2.00 = + 8.00
		a = − 1.48			a = − 0.43

+ 14.5	− 15.0	− 0.5	0.0	+ 2.5	− 3.5	− 4.0	+ 3.0
+ 14.8	+ 42.2	+ 31.4	+ 25.7	+ 4.3	+ 12.3	+ 9.2	+ 7.5
− 9.5	− 7.5	− 11.2	− 5.8	+ 9.5	+ 7.5	+ 11.7	+ 5.8
+ 19.8	+ 19.8	+ 19.7	+ 19.5	+ 16.3	+ 16.3	+ 16.4	+ 16.8
c from x − 3				c from y − 7.			

Resids in x.

Star				c	o	o − c
1	− 13	+ 6	+ 20 =	+ 13	+ 6	− 7
2	− 16	+ 13	+ 20 =	+ 17	+ 23	+ 6
4	− 37	+ 5	+ 20 =	− 12	− 6	+ 6
5	− 46	+ 10	+ 20 =	− 16	− 24	− 8

Resids in y.

Star				c	o	o − c
1	− 4	− 6	+ 16 =	+ 6	+ 10	+ 4
2	− 5	− 13	+ 16 =	− 2	− 5	− 3
4	− 11	− 5	+ 16 =	0	− 4	− 4
5	− 14	− 10	+ 16 =	− 8	− 3	+ 5

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Times etc.

Eqp. to stars	1911 Feb. 15	12h	22m	41s	–	12h	31m	41s
" " moon		12	27	11.9				12.2
clock fast			2	31.7				
		12	24	40.35				
H. Sid. T								
H Long.		4	44	31.05				
G. Sid T		17	09	11.40				
Sid T. M. noon		21	37	29.62				
Interval		19	31	41.78				
Reduction			3	11.95				
G. M. T.		19	28	29.83				

		R. a	Decl.
From Am Eph.			
moon 19h	12h	12m 28.55	+2° 15′ 27.″3
motion in 1m		1.9176	-14.804
" " 28.497		+ 54.65	– 7, 01.9
Tabular place	12	13 23.20	+2° 08′ 25.4

moon's parallax	56′	29.″9
" semidiam.	15	25.3

Approximate Center of moon.

x = 19.	y = 20.6678	x = 20.0	y = 21.4912
x = 18.	y = 24.4205	20.0	y = 23.5948
	45.0883		45.0860
mean y = 22.5442	wt. 2	mean y = 22.5430	wt. 1

Y_0 = 22.5438

y = min = 20.5294

R_0 = 2.0144

x = max = 20.2952

R_0 = 2.0144

X_0 = 18.2808

Adopted Center { X_0 = 18.2808
Y_0 = 22.5438

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj 188

Times etc.

Exp. to stars	1911 Feb. 15	12h	22m	41s	12h 31m	41s
" " moon		12	27	11.9		12.2
clock fast			2	31.7		
		12	24	40.35		
H. Sid. T						
H Long.		4	44	31.05		
G. Sid T		17	09	11.40		
Sid T. M. noon		21	37	29.62		
Interval		19	31	41.78		
Reduction			3	11.95		
G. M. T.		19	28	29.83		

From Am Eph.		R. A.	Decl.
moon 19h	12h	12m 28.55	+2° 15' 27.3
motion in 1m		1.9176	-14.804
" " 28.497		+ 54.65	- 7.019
Tabular place	12	13 23.18	2° 08' 25.4
		23.20	
moon's parallax		56' 29.9	
" semidiam.		15 25.3	

Approximate Center of moon.

19.	y = 20.6678	x = 20.0	y = 21.4912
	- y = 24205	20 0	y = 23.5948
	45.0883		45.0860
	mean y = 22.5442 wt 2		mean y = 22.5430 wt 1

Y_0 = 22.5438

y: min = 20.5294

R_0 = 2.0144

x = mean = 20.2952

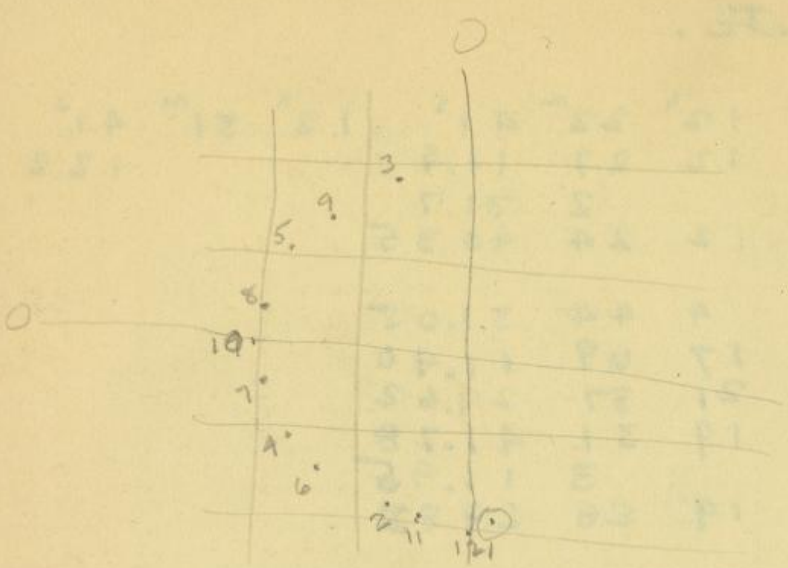
R_0 = 2.0144

X_0 = 18.2808

Adopted Center { X_0 = 18.2808 / Y_0 = 22.5438

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188



Point	Pos. ∠.	Resid
12	180°0	+127
11	167.0	−104
2	159.0	−142
6	139.9	+131
4	121.5	+48
7	105.6	−46
10	90.0	−18
8	76.9	−53
5	58.5	+56
9	43.7	+37
3	21.0	−42

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Moon's Limb. - Reduction

Point	x	$(x - X_0)$	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	18.0000	- 0.2808	0.0788	40286	reject, see note
2	19.0000	+ 0.7192	0.5172	4.0381	- 159
3	19.0000	+ 0.7192	0.5172	4.0407	- 133
4	20.0000	+ 1.7192	2.9556	4.0640	+ 100
5	20.0000	+ 1.7192	2.9556	4.0606	+ 66
6	19.5791	+ 1.2983	1.6856	4.0698	+ 158
7	20.2198	+ 1.9390	3.7597	4.0555	+ 15
8	20.2416	+ 1.9608	3.8447	4.0529	- 11
9	19.6714	+ 1.3906	1.9338	4.0552	+ 12
10	20.2952	+ 2.0144	4.0578	4.0578	+ 38
11	18.7358	+ 0.4550	0.2070	4.0401	- 139
12	18.2808	0.0000	0.0000	4.0594	+ 54
		mean (excluding 1) =		40540	+ 1

	y	$(y - Y_0)$	Δy	$(y-Y_0)^2$
1	20.5568	- 1.9870	- 4	3.9498
2	20.6678	- 1.8760	- 4	3.5209
3	24.4205	+ 1.8767	+ 4	3.5235
4	21.4912	- 1.0526	- 2	1.1084
5	23.5948	+ 1.0510	+ 2	1.1050
6	24.0000	- 1.5438	- 3	2.3842
7	22.0000	- 0.5438	- 1	0.2958
8	23.0000	+ 0.4562	+ 1	0.2082
9	24.0000	+ 1.4562	+ 3	2.1214
10	22.5438	0.0000	0	0.0000
11	20.5864	- 1.9574	- 4	3.8331
12	20.5294	- 2.0144	- 4	4.0594

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

922 1912 Nov. 12. 44

Triouris limb - Reduction

Point	x	$(x - X_0)$	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	18.0000	- 0.2808	0.0788	40286	[illegible]
2	19.0000	+ 0.7192	0.5172	40381	- 159
3	19.0000	+ 0.7192	0.5172	40407	- 133
4	20.0000	+ 1.7192	2.9556	40640	+ 100
5	20.0000	+ 1.7192	2.9556	40606	+ 66
6	19.5791	+ 1.2983	1.6856	40698	+ 158
7	20.2198	+ 1.9390	3.7597	40555	+ 15
8	20.2416	+ 1.9608	3.8447	40529	- 11
9	19.6714	+ 1.3906	1.9338	40552	+ 12
10	20.2952	+ 2.0144	4.0578	40578	+ 38
11	18.7358	+ 0.4550	0.2070	40401	- 139
12	18.2808	0.0000	0.0000	40594	+ 54
		mean (excluding 1) =		40540	+ 1

	y	$(y - Y_0)$	Δy	$(y-Y_0)^2$
1	20.5568	- 1.9870	- 4	3.9498
2	20.6678	- 1.8760	- 4	3.5209
3	24.4205	+ 1.8767	+ 4	3.5235
4	21.4912	- 1.0526	- 2	1.1084
5	23.5948	+ 1.0510	+ 2	1.1050
6	21.0000	- 1.5438	- 3	2.3842
7	22.0000	- 0.5438	- 1	0.2958
8	23.0000	+ 0.4562	+ 1	0.2082
9	24.0000	+ 1.4562	+ 3	2.1214
10	22.5438	0.0000	0	0.0000
11	20.5864	- 1.9574	- 4	3.8331
12	20.5294	- 2.0144	- 4	4.0594

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

No	aa	ab	an	bb	bn
2	0.52	− 1.35	− 114.5	3.53	+ 298.9
3	0.52	+ 1.35	− 95.8	3.53	− 250.0
4	2.96	− 1.81	+ 172.0	1.10	− 105.0
5	2.96	+ 1.81	+ 113.5	1.10	+ 69.3
6	1.69	− 2.00	+ 205.4	2.37	− 243.3
7	3.76	− 1.05	+ 29.1	0.30	− 8.1
8	3.84	+ 0.90	− 21.6	0.21	− 5.1
9	1.93	+ 2.03	+ 16.7	2.13	+ 17.5
10	4.04	0.00	+ 76.4	0.00	0.0
11	0.21	− 0.90	− 63.9	3.84	+ 272.4
12	0.00	0.00	+ 0.0	4.04	− 108.5
	22.45	− 1.02	+ 317.3	22.15	− 61.9

[ac] = +13.94 [bc] = − 4.13 [cn] = + 1.0

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922

1912 Nov. 12.
1912 Dec 11.

Conditional Equations

	a	b	c	O		C	O−C
2	+0.72	−1.88	+1	= −159	+60 +38 −113	= −15	−144
3	+0.72	+1.88	+1	= −135	+60 −38 −113	= −91	−42
4	+1.72	−1.05	+1	= +100	+144 +21 −113	= +52	+48
5	+1.72	+1.05	+1	= +66	+144 −21 −113	= +10	+56
6	+1.30	−1.54	+1	= +158	+109 +31 −113	= +27	+131
7	+1.94	−0.54	+1	= +15	+163 +11 −113	= +61	−46
8	+1.96	+0.46	+1	= −11	+164 −9 −113	= +42	−53
9	+1.39	+1.46	+1	= +12	+117 −29 −113	= −25	+37
10	+2.01	0.00	+1	= +38	+169 +0 −113	= +56	−18
11	+0.46	−1.96	+1	= −139	+39 +39 −113	= −35	−104
12	0.00	−2.01	+1	= +54	0 +40 −113	= −73	+127

−407 +399

Average (O−C) = 73

Normal Equations

a	b	c	
+22.43	−1.02	+13.94	= +317
−1.02	+22.15	−4.13	= −62
+13.94	−4.13	+11.00	= +1
+1.02	−0.05	+0.63	= +14
−13.94	+0.63	−8.64	= −197
	+22.10	−3.50	= −48
	−3.50	+2.36	= −196
	+3.50	−0.55	= −08
	−	+1.81c	= −204
	−5.19	+3.50	= −290
	+16.91b		= −338
−17.65	+5.22	−13.94	= −1
+5.22	−1.55	+4.13	= +0
+4.78	+4.20		= +316
+4.20	+2058		= −62
−0.86	−4.20		= +13
+3.92a			= +329
+4.86a	+2.98c		=

$\frac{\Delta S}{\Delta n}$ = 2.01 · +.16 = +0.32

c = −113

b = −20

a = +84

$\frac{\Delta a}{\Delta z}$ = 2.01 · −.61 = −1.23

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 922

1912 Nov. 12.
1912 Dec 11.

Conditional Equations

	a	b	c				
2	+0.72	−1.88	+1	= −159	+60	+38	−113 = −15
3	+0.72	+1.88	+1	= −133	+60	−38	−113 = −91
4	+1.72	−1.05	+1	= +100	+144	+21	−113 = +52
5	+1.72	+1.05	+1	= +66	+144	−21	−113 = +10
6	+1.30	−1.54	+1	= +158	+109	+31	−113 = +27
7	+1.94	−0.54	+1	= +15	+163	+11	−113 = +61
8	+1.96	+0.46	+1	= −11	+164	−9	−113 = +42
9	+1.39	+1.46	+1	= +12	+117	−29	−113 = +25
10	+2.01	0.00	+1	= +38	+169	0	−113 = +56
11	+0.46	−1.96	+1	= −139	+39	−39	−113 = −35
112	0.00	−2.01	+1	= +54	0	+40	−113 = −73

Normal Equations.

a	b	c	
+22.43	−1.02	+13.94	= +317
−1.02	+22.15	−4.13	= −62
+13.94	−4.13	+11.00	= +1
+1.02	−0.05	+0.63	= +14
−13.94	+0.63	−8.64	= −197
	+22.10	−3.50	= −48
	−3.50	+2.36	= −196
	+3.50	−0.55	= −08
	−	+1.81c	= −204
	−5.19	+3.50	= −290
	+16.91b		= −338

$\frac{\Delta S}{\Delta a}$ = 2.01 · +14 = +0.32

c = −113

b = −20

−17.65	+5.22	−13.94	=	−1
+5.22	−1.55	+4.13	=	+0
+4.78	+4.20		=	+316
+4.20	+2.50		=	−62
−0.86	−4.20		=	+113
+3.92			=	+254
+4869	+2986			

$\frac{\Delta S}{\Delta a}$ = 2.01 · −61 = −123

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC922 ✓ 1913 Jan. 17.

Moon's mean position (1911.0)

X_0 = 18.27808 ✓ Y_0 = 22.54388 ✓

$\frac{1}{2}a$ = +42 ✓ $\frac{1}{2}b$ = −10 ✓

18.28850 ✓ 22.54278 ✓

From prelim Reduction x = 18.2776 ✓ y = 22.5339 ✓

computed corrections ax = − 27 ✓ − 8 ✓

by = + 9 ✓ − 9 ✓

c = + 20 ✓ + 16 ✓

X = 18.27778 ✓ Y = 22.5338 ✓

ξ = +0.2778 ✓ η = +0.5338 ✓

log ξ = 9.44373 ✓

cos δ = 9.99984 ✓

const = 8.50724 ✓

log $(\alpha - A)$ = 0.93665 ✓

$\alpha - A$ = + 8.64 ✓

A = 12h 13m 06s ✓

α_0 = 12h 13m 14.64s ✓

Red + 0.76 ✓

A' = 12h 13m 15.40s ✓

log tan δ 8.57111 ✓

ξ^2 8.8875

const 7.0534

log η_1 4.5120 ✓

η_1 0 ✓

η_0 = +0.5338 ✓

log ⋯ 9.72738 ✓

const: 7.33115 ✓

(S−D): 2.39623

S − D = + 4′ 09.0″ ✓

D = +1° 27′ 34″ ✓

δ_0 = +1 31 43.0 ✓

Red = − 5.8 ✓

δ' = +1 31 37.2 ✓

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MCT22 1913 Jan. 17.

Nyrén's mean position (1911.0)

X_0 = 18.2808 + 42 = 18.2850 Y_0 = 22.5438 − 10 = 22.5428

From fiducial Reading X = 18.2776 Y = 22.5359
corrections: x = − 27 − 8
y = + 9 − 9
c = + 20 + 16
X = 18.2778 Y = 22.5338

S = +0.2778 η = +0.5338

log S = 9.443773
cos δ = 9.999984
const = 8.507124

log(α−A) = 0.936665

α − A = + 8.64
A = 17 13 06

α_0 = 17 13 14.64
+ 0.76
α' = 17 13 15.40

log tan δ 8.5711
δ° 8.8875
const 7.0534
log η_1 4.5120
η_1 0

η_0 = +0.5338
log = 9.727358
const = 7.331115
(δ−D) = 2.396243

δ − D = + 4′ 09″.0
D = + 1° 27′ 34″

δ_0 = +1° 31′ 43″.0
Red = − 5.8
δ' + 1° 31′ 37″.2

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC 922

1913 Jan 17.

Lunar parallax.

$\alpha' = 12^h\ 13^m\ 15^s.40$ ✓
$\Theta = 12\ 24\ 40.35$ ✓

$\Theta - \alpha' = +\ 11\ 24.95$ ✓
$= +\ 2^\circ\ 51'\ 14''.4$ ✓

$\frac{1}{2}(\alpha - \alpha')$ 1 02.5

$(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha')$ $2^\circ\ 50'\ 12''$

log tan ϕ' = 9.95727 ✓
∴ cos $\frac{1}{2}(\alpha - \alpha')$ = 0 0 0 0 0 0 ✓
$(\Theta - \alpha') - \frac{1}{2}(\alpha - \alpha')$ = 9.99947 ✓
tan γ 9.95780 ✓

$\gamma = 42^\circ\ 13'\ 14''.2$ ✓

$\delta' = +1\ 31\ 37.2$ ✓

$\gamma - \phi' = 40\ 41\ 37.0$ ✓

log sin ϕ' = 9.82640 ✓
sin π = 8 2 1 5 7 5 ✓
∴ ∴ $(\gamma - \delta')$ 9.81426 ✓
∴ sin γ = 9.82736 ✓

∴ sin $(\delta - \delta')$ = 8 0 2 9 0 5 ✓

$\delta - \delta' = +\ 36\ 45.4$ ✓

$\delta = +2\ 08\ 22.6$ ✓

Ann Eph $\delta = +2^\circ\ 08'\ 25''.4$ ✓

O − C = − 2.8

Refract'n & Sol. radius − 0.7

Total (O − C) = − 3.5

$\delta' = +1^\circ\ 31'\ 37''.2$ ✓

$\pi = 56'\ 29''.9$ ✓

log $\rho \cos \phi'$ = 9.86913 ✓
sin π = 8.21575 ✓
∴ ∴ $(\Theta - \alpha')$ = 8.69715 ✓
∴ cos δ = 9.99970 ✓

∴ sin $(\alpha - \alpha')$ = 6.78233 ✓

$(\alpha - \alpha') = +2'\ 05''.0$ ✓
$= +\ 8^s.33$ ✓

$\alpha = 12^h\ 13^m\ 23^s.73$ ✓

$\alpha = 12^h\ 13^m\ 23^s.20$ ✓

+ 0.53

+ 0.18

+ 0.71

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC 922

1913 Jan 17

lunar parallax.

α' =	17h	13m	15.s90
$\odot$ =	17	29	40.35
$\odot - \alpha$:	+	11	24.95
:	2°	51'	14".4
$\frac{1}{2}(\lambda - \lambda')$		1	07.5
$(\lambda) - \frac{1}{2}(\lambda - \lambda')$	2°	50'	12"

log tan φ' =	9.957727
cos $\frac{1}{2}(\lambda - \lambda')$ =	0.000000
$(\odot - \alpha) - \frac{1}{2}(\lambda - \lambda')$ =	999947
tan γ	9.957780

γ = 42° 13' 14.2

δ' = + 1 31 37.2

$\gamma - \delta'$ = 40 41 37.0

log sec φ'	9.826640
sin π	8.215785
: $(\gamma - \delta')$	9.814426
sin γ :	9.827736
sin $(\delta - \delta')$:	8.029090

$\delta - \delta'$ = + 36 45.4

δ = 08 22.7

Diff from δ = + 2° 08' 25.5"

O - C = − 2.8

Prat Hansd. nadir − 0.7

Final (O - C) − 3.5

δ' = + 1° 31' 37.2

π = 56' 29".9

log $\rho \cos \varphi'$ =	9.869135
sin π	8.215785
: $(\odot - \alpha)$:	8.697115
cos δ =	9.999970
: sin $(\alpha - \alpha')$:	6.782383

$(\alpha - \alpha')$: 12' 05".0

: + 8.s33

α = 12h 13m 23.s73

α = 12h 13m 23.s20

+ 0.s53

+ 0.18

+ 0.71

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC 932. 1912 Oct 22. 56

Comparison Stars.

Star	1	No.	Mag	2	No	Mag.	3	No	Mag.
C		1968	7.1		1973	7.8		1986	7.7
	x = 31.2	y = 16.9		x = 28.1	y = 25.6		x = 12.2	y = 24.5	
R.a. C	14h	24m	45s.44	14h	26m	26s.57	14h	34m	36s.70
L			45.46			26.62			36.74
E			45.40			26.61			36.76
Mean	14	24	45.43	14	26	26.60	14	34	36.73
Prec.		+	36.10		+	36.31		+	36.40
1911	14	25	21.53	14	27	02.91	14	35	13.13
A	14	32	26	14	32	26	14	32	26
α-A	-	7	04.47	-	5	23.09	+	2	47.13
Sin(α-A)	-		424.40	-		323.06	+		167.13
log "		2.627788n			2.509288n			2.222306	
" cosδ		998524			9.998291			998324	
" ξ_0		1.120264n			0.999943n			0.713544	
ξ_0		-13.1906			-9.9868			+5.1706	
η_0		-	60		-	28		+	4
I		31.1966			27.9896			12.8290	
L		31.2131			28.0734			12.9058	
L-I		-	165		-	838		-	768

signs of x + y are changed

Decl.									
C	-14°	48'	17".2	-15°	55'	09".0	-15°	46'	11".0
L			16.9			08.6			11.0
E			17.0			09.6			11.3
Mean	-14	48	17.0	-15	55	09.1	-15	46	11.1
Prec		- 2	57.8		-	2 56.8		-	2 52.0
1911	-14	57	14.8	-15	58	05.9	-15	49	03.1
D	-15	30	=0.0	-15	30	00.	-15	30	00.
δ-D	+	38	452	-	28	059	-	19	03.1
tan(δ-D)	+	2325.3		-	1685.9		-	1143.1	
log "		3.366488			3.226833n			3.058094n	
" η_0		0.697633			0.557988n			0.389244n	
tanδ		9.42366n			9.45666n			9.45224n	
$-\xi^2$		22405			19989			14.271	
" η_0		8.71754n			8.50894n			7.93274n	
η_0		+49846			-36139			-2.4509	
η_1		-	522		-	323		-	86
η		170676			256462			244590	
q		16.9356			25.5330			24.4616	
q-η		+	1320		+	1132		-	26

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932. 1912 Oct 22. 56

Comparison Stars.

	Star 1	No.	Mag	2	No	Mag.	3.	No	Mag.
	C	1968	7.1		1973	7.8		1986	7.7
		x = 31.2	y = 16.9		x = 28.1	y = 25.6		x = 12.2	y = 24.5
R.A.	C	14h 24m	45s.44		14h 26m	26s.57		14h 34m	36s.70
	L		45.46			26.62			36.74
	E		45.40			26.61			36.76
	Mean	14 24	45.43		14 26	26.60		14 34	36.73
	Prec.	+	36.10		+	36.31		+	36.40
	1911	14 25	21.53		14 27	02.91		14 35	13.13
	A	14 32	26		14 32	26		14 32	26
	x-A	- 7	04.47		- 5	25.09		+ 2	47.13
	Sin(x-A)	-	424.40		-	323.06		+	167.13
	log "	2.627178m			2.509285m			2.222306	
	cos δ	9.998524			9.998291			9.998324	
	" S_0	1.182026m			0.999943m			0.713554	
	S_0	- 13.1906			- 9.9868			+ 5.1706	
	S_1	- 60			- 28			+ 4	
	S	31.1946			27.1896			12.8240	
	L	31.2131			26.0734			12.9058	
	x-S	- 165			- 838			- 768	
	Decl.								
	C	-14° 48' 17".2			-15° 55' 09".0			-15° 46' 11".0	
	L	16.9			08.6			11.0	
	E	17.0			09.6			11.3	
	Mean	-14 48 17.0			-15 55 09.1			-15 46 11.1	
	Prec	- 2 57.8			- 2 56.8			- 2 52.0	
	1911	-14 57 14.8			-15 58 05.9			-15 49 03.1	
	D	-15 30 0.0			-15 30 00.			-15 30 00.	
	δ-D	+ 38 45.2			- 28 05.9			- 19 03.1	
	sin(δ-D)	+ 2325.3			- 1685.9			- 1143.1	
	log "	3.366488			3.226853m			3.058094m	
	η_0	0.697683			0.557498m			0.389244m	
	cos δ	9.942366			9.945662			9.945222	
	S^2	2240.5			1998.9			1427.1	
	" η_0	8.7175m			8.5089m			7.9327m	
	η_0	+ 49846			- 36139			- 24509	
	η_1	- 522			- 323			- 86	
	η	178676			256462			244590	
	η	16.9356			25.5330			24.4616	
	$\eta - \eta$	+ 1320			+ 1132			- 21	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932. 1912 Oct. 22.

Standard Coordinates – Comparison Stars.

Star	A	No	Mag	5.	No	Mag.
C		1988	8.2	a.g.	5431	9.2
	x = 11.4	y = 17.6		Washington	x = 10.1	y = 11.1
R.A.				a.g.		
C	14h 35m	24s04			14h 36m	00.38
L		24.07				
E		24.06				
Mean	14 35	24.06				
Prec	+	36.26			+	36.12
1911	14 36	00.32			14 36	36.50
A	14 32	26.			14 32	26
δ-A =	+ 3	34.32			+ 4	10.50
Sin		214.31				250.49
log "		2.331 04				2.39879
" cos δ		998507				9.98675
" ξ0		0.82335				0.89278
ξ0		+6.6581				+7.8123
ξ1		+ 10				+ 35
ξ		11.3409				10.1842
x		11.3656				10.1600
x-ξ		- 247				+ 242
Decl.						
C	-14° 53′	24.4″				-14° 02′ 04.0″
L		24.4				
E		25.6				
Mean	-14 53	24.8				
Prec	- 2	51.5			- 2	51.2
1911	-14 56	16.3			-14 04	55.2
D	-15 30	00.			-15 30	00
δ-D	+ 33	43.7			+ 1 25	04.8
Tan	+	2023.8			+	5105.6
log "		3.30617				3.70805
" η0		0.63732				1.03920
" tan δ		9.42622 m				9.3994 m
" ξ²		16567				17856
" η1		8.13623 m				8.2284 m
η0		+4.33383				+10.9446
η1		- 137				- 169
η		17.67754				11.07293
4		17.69754				11.1048
4-η		- 200				- 325

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932. 1912 Oct. 22. 57

Standard Coördinates - Comparison Stars

Star 4	No	Mag	5.	No	Mag.
C	1988	8.2	a.g.	5431	9.2 g.
	x = 11.4 y = 17.6		Washington	x = 10.1	y = 11.1
R.a.	$14^h\ 35^m\ 24^s.04$		a.g.	$14^h\ 36^m\ 00.38$	
C	24.07				
L	24.06				
E					
Mean	14 35 24.06				
Prec	+ 36.26			+ 36.12	
1911	14 36 00.32			14 36 36.50	
A	14 32 26.			14 32 26	
x-A:	+ 3 34.32			+ 4 10.50	
Sin	214.31			25049	
log	2.331047			2.398799	
log cos δ	9.998507			9.998675	
log ξ₀	0.823355			0.892778	
ξ₀	+6.6581			+7.8123	
ξ₁	+ 10			+ 35	
ξ	11.3409			10.1842	
a	11.3656			10.1600	
x-ξ	- 247			+ 242	
Decl.					
C	-14° 53' 24.4"			-14° 02' 04.0"	
L	24.4				
E	25.6				
Mean	-14 53 24.8				
Prec	- 2 51.5			- 2 51.2	
1911	-14 56 16.3			-14 04 55.2	
D	-15 30 00			-15 30 00	
y-D	+ 33 43.7			+ 1 25 04.8	
Sin	+ 2023.8			+ 5105.6	
log	3.306117			3.708005	
log η₀	0.637732			1.039920	
log ξ²	9.42624n			9.39944n	
ξ²	16567			17856	
η₁	8.1363n			8.2284n	
η₀	+4.3383			+10.9446	
η₁	- 137			- 169	
η	17.6754			11.0723	
y	17.6954			11.1048	
y-η	- 200			- 325	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC932. 1912 Oct 23.

Comparison stars – measures.

1

	d		N	
31.2	15718		14660	
16.9	6356	55	14018	20
	58		20	
	10		70	
	16.9355		16.9358	

4

	d		N	
	14888		15488	
	7011	14	13352	52
	15		50	
	90		00	
	31.2123		31.2139	

2

28.1	16995		14010	
25.5	11654	60	9358	42
	56		40	
	90		20	
	25.5335		25.5325	

	16073		15548	
	7785	86	13038	40
	87		38	
	60		85	
	28.0733		28.0735	

3

12.2	16063		15940	
24.5	10785	85	11227	80
	85		30	
	73		48	
	24.5283		24.5283	

	16578		15980	
	10240	44	12334	29
	45		28	
	90		94	
	92.1828		12.1839	

4

1.4	14275		14575	
17.6	7322	26	11525	30
	24		30	
	85		80	
	17.6958		17.6951	

	15376		15650	
	6982	88	14050	58
	88		52	
	88		60	
	11.3657		11.3655	

5

10.1	15590		15506	
11.1	14536	38	6554	55
x	38		50	
	94		10	
	11.1053		11.1043	

	14140		13965	
	13191	84	4910	18
	90		20	
	27		73	
	10.1602		10.1599	

3/

	13907		16400	
12.9	9292	02	11017	20
	94		11	
24.5	12		95	
	24.4613		.4618	

	129060		.9056	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Comparison stars - measures.

	d		n		d		n	
1		4						
31.2								
16.9	15718		14660		14888		15488	
	6356	55	14018	20	7011	14	18352	52
	58		20		15		50	
	10		70		90		00	
	16.9355		16.9358		31.2123		31.2139	
2								
28.1	16995		14010		16100		17278	
25.5	11654	60	9358	42	6845	38	16542	44
	56		40		42		48	
	90		20		10		96	
	25.5335		25.5325		28.0733		28.0735	
3								
12.2	16063		15940		15548		14877	
24.5	10785	85	11223	30	7385	86	13038	40
	85		30		87		38	
	73		48		60		85	
	24.5288		24.5283		12.1828		12.1839	
4								
11.9	14275		14575		16578		15980	
17.6	7322	26	11525	30	10240	44	12334	29
	24		30		45		28	
	85		80		90		94	
	17.6958		17.6951		11.3657		11.3655	
5								
10.1	15590		15506		15376		15650	
11.1	14536	38	6554	55	6982	88	14050	58
	38		50		88		52	
	94		10		88		60	
	11.1053		11.1043		10.1602		10.1599	
3	13907		16400		14140		13965	
12.9	92902	2	11017	20	13191	84	49102	18
	94		11		90		20	
24.5	12		95		27		13	
	24.4613		4618		13.9060		.9056	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC932 1912 Oct 24.

Mean measured coords of Comp. Stars + center of plate.

Star	x	y	R.A.	Decl.
1	31.2131	16.9356	14h 25m 22s	-14 51 15
2	28.0784	25.5330	27 03	-15 58 06
3	12.9058	24.4616	35 13	-15 49 03
4	11.3656	17.6954	36 00	-14 56 16
5	10.1600	11.1048	36 37	-14 04 55
	5 | 93.72	95.73 | 5	160 15	5 | 39 35
	18.74	19.15	14h 32 03	-15 07 55
	31	-2.85	+ 23	- 22 05
	+ 7.4	465	14 32 26	-15 30 00
	222	1325.25		
	+ 22.94	- 22' 05"		

Preliminary Reduction.

Star	x - 5	+ 754	- 1.5°x	- 1053
1	-165	+12.70 = +1105	-47 = +1058	= +5
2	-838	+1915 = +1077	-42 = +1035	= -18
3	-768	+1835 = +1067	-19 = +1048	= -5
4	-247	+1327 = +1080	-17 = +1063	= +10
5	+242	+ 833 = +1075	-15 = +1060	= +7
Moon	-19.0052	+1615	-29	= +18.95 19
	-19.0102	+1615	-29	-18.9569

Star	y - η	- 76.5x	- 74	- 79	+ 1190
1	+1320	-2388 = -1068	-119 = -1187		= +3
2	+1132	-2147 = -1015	-179 = -1194		= -4
3	- 26	- 987 = -1013	-171 = -1184		= +6
4	- 200	- 869 = -1069	-124 = -1193		= -3
5	- 325	- 777 = -1102	- 78 = -1180		= +10
Moon	-21.5298	-1454	-151 =		= -21.5713
	-21.5278	-1454	-151		-21.5693

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

MC 932 1912 Oct 24.

We are measured coords of Comp. Stars + center of plate.

Star	x	y	R.A.	Decl.
1	312731	16.9356	14h 25m 22s	-14 51 15
2	280734	25.5330	27 03	-15 58 06
3	12.9058	24.4616	35 13	-15 49 03
4	11,3656	17.6954	36 00	-14 56 16
5	16.1602	11.1048	36 37	-14 04 55
5	9312	9573	5 160 15	5 39 35
	18.24	1 15	14h 32 03	-15 07 55
	31	-2.85	+ 23	- 22 05
	+ 7.4	465	14 32 26	-15 30 00
	222	13259.28		
	+ 22,94	- 22' 05"		

Preliminary Reduction.

Star	x - 5 + 754		- 1.5x	-1053
1	-165 + 12.70 = +1105		-47 = +1058	= +5
2	-838 + 1915 = +1077		-42 = +1035	= -18
3	-768 + 1835 = +1067		-19 = +1048	= -5
4	-247 + 1327 = +1080		-17 = +1063	= +10
5	+242 + 833 = +1075		-15 = +1060	= +7
	-19.0052 + 1615		-29	= +1058
				-16.9519

Star	y - 7	- 76.5x	- 71	-791	+ 1190
1	+1320	-2388 = -1068	-119 = -1187		= +3
2	+1132	-2147 = -1015	-179 = -1194		= -4
3	- 26	- 987 = -1013	-171 = -1184		= +6
4	- 200	- 869 = -1069	-124 = -1193		= -3
5	- 325	- 777 = -1102	- 78 = -1180		= +10
	21.5298	- 1454	- 151		= +1483
					-21.5713

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932 1912 Oct 23. 60

Points on moon's limb measures.

4

y (9)	d	D
18.0	14272	15395
19.8	5440 30	14195 88
	2438	8592
	80	95
	19.8846	19.8795

2 (3)

18.0	17212	15177
23.2	15430 15	6950 64
	1822	5852
	12	80
	23.1791	23.1777

3 (2)

	16151	15008
19.0	11550 44	9570 85
23.4	4658	8080
max in 8.	51	18
	23.4601	23.4566

4 (8)

17.8	15172	15478
20.0	15430 18	7205 22
	1528	2011
	78	78
	17.8250	17.8264

5 (7)

17.2	14102	15565
21.0	5600 62	1404 038
	0508	4038
	10	73
	17.1495	17.1527

6 (5)

17.2	16006	14675
22.0	7350 50	13330 30
	5050	2535
	20	90
	17.1352	17.1347

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC 932 1912 Oct 23. 60

Points on Moon's limb — measures.

	a	d
1		
18.0	14272	15395
19.8	5440 30	14195 88
	2438	85 92
	80	95
	19.8846	19.8795
2		
18.0	17212	15177
23.2	15430 15	695064
	1822	5852
	12	80
	23.1791	23.1777
3	16151	15008
19.0	1155044	957095
23.9	4658	9080
max u	51	18
y		
	23.4601	23.4566
4		
17.8		15172 15478
20.0		1543018 720522
		1528 2011
		78 78
		17.8250 17.8264
5		
17.2		14102 15565
21.0		560062 1404038
		0508 4058
		10 73
		17.1495 17.1527
6		
17.2		16006 14675
22.0		7350 50 1333030
		5050 2555
		20 90
		17.1352 17.1547

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj 188

MC932. 1912 Oct 23

Points on Lewis's limb

Measures continued.

	d	ν
7/	14932	15790
17.8 (4)	12461 50	9240 32
23.0	6556	4048
	32	92
	17.7526	17.7552
8./ 6	15961	14620
17.1	670401	1585464
21.5	0808	5768
x = min	72	30
	17.0734	17.0760

9/ (1)	14210	15220	13890	14709
19.2	966472	9730 28	554243	1306060
23.5	5675	2024	4845	6565
	18	30	92	23
	25.4547	25.4501	19.1654	19.1651

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC932. 1912 Oct 23

Points on tendon limb
Measures continued.

	d	n
7		
17.8	14932	15790
23.0	12461 50	8240 32
	6556	4048
	32	92
	17.7526	17.7552
8.		
17.1	15961	14620
21.5	670401	1385464
d=min	0808	5768
	72	30
	17.0734	17.0760
9		
19.2	14210 15220 13890	14709
23.5	966472 973028 554243	1306060
	5675 2024 4845	6555
	18 30 92	23
	23.4547 23.4501	19.1654 19.1651

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC932 1912 Oct 26. 62

Times etc.

Sup. to stars	1911 Feb. 18	14^h	05^m	35^s - 14^h 14^m 35^s
" " moon		14	10	00.5 00.7
clock fast			2	32.4
H. Sid T		14	07	28.2
H Long.		4	44	31.05
G. Sid T		18	51	59.25
Sid T. M. noon		21	49	19.29
Interval		21	02	39.96
Reduction			3	26.86
G. M. T.		20	59	13.10

From Am. Eph.	R. A.	Decl.
moon 21^h	14^h 31^m 38.34	-14 40 45.7
motion in 1^m = 1.90356		11.945
" " -0.78	- 1.49	+ 9.3
Tabular place	14 31 36.85	-14 40 36.4

moon's parallax 54' 42.0
" " semidiam 14 55.9

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

MC932 1912 Oct 26. 62

Times etc.

Exp. to stars	1911 Feb. 18	14^h	05^m	35^s	-	14^h	14^m	35^s
" " moon		14	10	00.5				00.7
clock fast			2	32.4				
H. Sid T		14	07	28.2				
H Long.		4	44	31.05				
G. Sid T		18	51	59.25				
Sid. T. M. noon		21	49	19.29				
Interval		21	02	39.96				
Reduction			3	26.86				
G. M. T.		20	59	13.10				

		R. A.			Decl.		
From Am. Eph.							
moon 21^h		14^h	31^m	38.34	-14	40	45.7
motion in 1^m	1.90 58				11.946		
" " -0.78			-	1.49	+		9.3
Tabular place		14	31	36.85	-14	40	36.4

moon's parallax	54'	42.7"
" " semidiam	14	56.2

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Comparison stars - Plate constants.

Conditional Equations.

	a	b	c		
1	31.21	+ 16.94	+ 1 =	+ 5	+ 3
2	28.07	+ 25.53	+ 1 =	- 18	- 4
3	12.91	+ 24.46	+ 1 =	- 5	+ 6
4	11.37	+ 17.70	+ 1 =	+ 10	- 3
5	10.16	+ 11.10	+ 1 =	+ 7	+ 10

Mean Equations.

29.64	+ 21.24	+ 1 =	- 6.50	- 0.50
11.13	+ 17.75	+ 1 =	+ 4.00	+ 4.33
20.49	+ 25.00	+ 1 =	- 11.50	+ 1.00
17.58	+ 15.25	+ 1 =	+ 7.33	+ 3.33

+.57 + 18.51	+ 3.49	=	- 10.50	- 4.83
+ 2.91	+ 9.75	=	- 18.83	- 2.93
+ 2.91	+ 0.55	=	- 1.65	- 0.76
	+ 9.20 b	=	- 17.18	- 1.57
	b	=	- 1.87	- 0.17

18.51 a = - 10.50 + 6.53 = - 3.97 — $-4.83 + 0.59 = -4.24$

a = - 0.72 — a = - 0.23

- 6.5	+ 4.0	- 11.5	+ 7.3	- 0.5	+ 4.3	+ 1.0	+ 3.3
+ 6.5	+ 2.4	+ 4.7	+ 3.9	+ 6.8	+ 2.6	+ 4.9	+ 4.0
+ 39.6	+ 33.2	+ 46.7	+ 28.5	+ 3.6	+ 3.0	+ 4.0	+ 2.6
+ 39.6	+ 39.6	+ 39.9	+ 39.7	+ 9.9	+ 9.9	+ 9.9	+ 9.9

a from (x - E) — a from (y - η)

	Residual in x.			E	O	O - C
1	- 7	- 32	+ 40	= + 1	+ 5	+ 4
2	- 6	- 48	+ 40	= - 14	- 18	- 4
3	- 3	- 46	+ 40	= - 9	- 5	+ 4
4	- 3	- 33	+ 40	= + 4	+ 10	+ 6
5	- 2	- 21	+ 40	= + 17	+ 7	- 10

				C	O	O - C
1	- 7	- 3	+ 10	= 0	+ 3	+ 3
2	- 6	- 4	+ 10	= 0	- 4	- 4
3	- 3	- 4	+ 10	= + 3	+ 6	+ 3
4	- 3	- 3	+ 10	= + 4	- 3	- 7
5	- 2	- 2	+ 10	= + 6	+ 10	+ 4

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932 1912 Nov. 14.

Comparison stars - Plate constants.

Conditional Equations.

	a	b	c		
1	31.21	+ 16.94	+ 1 =	+ 5	+ 3
2	28.07	+ 25.53	+ 1 =	- 18	- 4
3	12.91	+ 24.46	+ 1 =	- 5	+ 6
4	11.37	+ 17.70	+ 1 =	+ 10	- 3
5	10.16	+ 11.10	+ 1 =	+ 7	+ 10

Mean Equations

29.64	+ 21.24	+ 1 =	- 6.50	- 0.50
11.13	+ 17.75	+ 1 =	+ 4.00	+ 4.33
20.49	+ 25.00	+ 1 =	- 11.50	+ 1.00
17.58	+ 15.25	+ 1 =	+ 7.33	+ 3.33

+157 + 18.51	+ 349	=	- 10.50		- 4.83
+ 2.91	+ 97.5	=	- 18.83		- 2.33
+ 2.91	+ 0.55	=	- 1.65		- 0.76
	+ 9.20 b	=	- 17.18		- 1.57
	b	=	- 1.87		- 0.17
18.51 c	= - 10.50	+ 6.53	= - 3.97		- 4.83 + 0.59 = - 4.24
	a	=	- 0.22		a = - 0.23

- 6.5	+ 4.0	- 11.5	+ 7.3	- 0.5	+ 4.3	+ 1.0	+ 3.3	
+ 6.5	+ 24	+ 4.7	+ 3.9	+ 6.8	+ 2.6	+ 4.9	+ 4.0	
+ 39.6	+ 33.2	+ 46.7	+ 28.5	+ 3.6	+ 3.0	+ 4.0	+ 2.6	
+ 39.6	+ 39.6	+ 39.9	+ 39.7	+ 9.9	+ 9.9	+ 9.9	+ 9.6	

a from (x - 3) a from (y - 4)

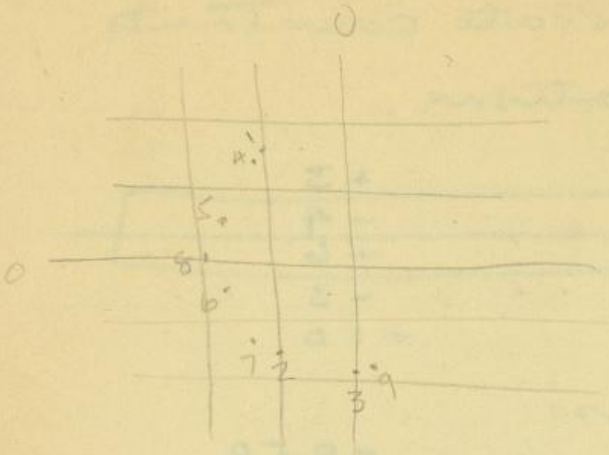
Residuals in x.

				ε	O	O - C
1	- 7	- 32	+ 40	= + 1	+ 5	+ 4
2	- 6	- 48	+ 40	= - 14	- 18	- 4
3	- 3	- 46	+ 40	= - 9	- 5	+ 4
4	- 3	- 33	+ 40	= + 4	+ 10	+ 6
5	- 2	- 21	+ 40	= + 17	+ 7	- 10

				C	O	O - C
1	- 7	- 3	+ 10	= 0	+ 3	+ 3
2	- 6	- 4	+ 10	= 0	- 4	- 4
3	- 3	- 4	+ 10	= + 3	+ 6	+ 3
4	- 3	- 3	+ 10	= + 4	- 3	- 7
5	- 2	- 2	+ 10	= + 6	+ 10	+ 4

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188



Point	Pos. ∠	Resid
9	189.8	−4
3	180.0	−27
2	148.8	+50
7	139.7	+33
6	104.0	−44
8	90.0	−5
5	74.0	−92
4	37.5	+69
1	31.2	+16

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC932 1912 Nov. 14. 64

Moonlimb - Reduction.

Point	x	x − X₀		Δx	(x − X₀)²	(x − X₀)² + (y − Y₀)²	O − C
1	18.0000	+1.0028	−	2	1.0052	3.7257	+38
2	16.0000	+1.0028	+	2	1.0060	3.7265	+46
3	19.0000	+0.0028	+	2	0.0000	3.7234	+15
4	17.8257	+1.1771	−	2	1.3851	3.7300	+81
5	17.1511	+1.8517	−	1	3.4284	3.7099	−120
6	17.1340	+1.8688	+	1	3.4928	3.7138	− 81
7	17.7539	+1.2489	+	2	1.5602	3.7237	+ 18
8	17.0746	+1.9282		0	3.7179	3.7179	−40
9	19.1652	−0.1624	+	2	0.0263	3.7265	+46
						3.7219	+ 3

signs of x + y are changed.

	y	y − Y₀	Δy	(y − Y₀)²
1	19.8820	+1.6482	+ 12	2.7205
2	23.1784	−1.6482	− 12	2.7205
3	23.4584	−1.9282	− 14	3.7234
4	20.0000	+1.5302	+ 11	2.3449
5	21.0000	+0.5302	+ 4	0.2815
6	22.0000	−0.4698	− 3	0.2210
7	23.0000	−1.4698	− 11	2.1635
8	21.5302	0.0000	0	0.0000
9	23.4524	−1.9222	− 14	3.7002

Approximate Center of moon.

x = 18.0 y = 19.8820
18. 23.1784
43.0604
mean y = 21.5302
y = max = 23.4584
R_0 = 1.9282

x = min = 17.0746
R_0 = 1.9282
X_0 = 19.0028

Center X_0 = 19.0028
Y_0 = 21.5302

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Moon's limb - Reduction.

Point	x	$x - X_0$		Δx	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	o-c
1	18.0000	+1.0028	−	2	1.0052	3.7257	+38
2	16.0000	+1.0028	+	2	1.0060	3.7265	+46
3	19.0000	+0.0028	+	2	0.0000	3.7234	+15
4	17.8257	+1.1771	−	2	1.3851	3.7300	+81
5	17.1511	+1.8517	−	1	3.4284	3.7099	−120
6	17.1340	+1.8688	+	1	3.4928	3.7138	− 81
7	17.7539	+1.2489	+	2	1.5602	3.7237	+18
8	17.0746	+1.9282		0	3.7179	3.7179	−40
9	19.1652	−0.1624	+	2	0.0263	3.7265	+46

3.7219 ± 3

† signs of x + y are changed.

	$y - Y_0$	Δy	$(y-Y_0)^2$
1	19.8820	+1.6482	+ 12	2.7205
2	23.1784	−1.6482	− 12	2.7205
3	23.4584	−1.9282	− 14	3.7234
4	20.0000	+1.5302	+ 11	2.3449
5	21.0000	+0.5302	+ 4	0.2815
6	22.0000	−0.4698	− 3	0.2210
7	23.0000	−1.4698	− 11	2.1635
8	21.5302	0.0000	0	0.0000
9	23.4524	−1.9222	− 14	3.7002

Approximate centre of moon.

$x = 18.0$ | $y = 19.8820$
18. | 23.1784
43.0604
mean y = 21.5302
y = may = 23.4584
R_0 = 1.9282

$x = min = 17.0746$
$R_0 = 1.9282$
$X_0 = 19.0028$

centre $X_0 = 19.0028$
$Y_0 = 21.5302$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

	aa	ab	an	bb	bn
1	1.00	+ 1.65	+ 38.0	.	+ 62.7
2	1.00	- 1.65	+ 46.0	.	- 75.9
3	0.00	- 0.00	+ 0.0	.	- 29.0
4	.	+ 1.81	+ 95.6	.	+ 123.9
5	.	+ 0.98	- 222.0	.	- 63.6
6	.	- 0.88	- 151.5	.	+ 38.1
7	.	- 1.84	+ 22.5	.	- 26.5
8	.	0.00	- 87.2	0.00	0.0
9	.	- 0.31	+ 7.4	.	- 88.3
	16.63	- 0.24	- 241.2	+17.86	- 58.6

[ac] = + 9.92 [bc] = - 3.73 [cn] = + 3

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC932 1912MNRAS..27 65

Moon's Runs Reduction

Conditional Equations.

	a	b	c		O					C	O − C
1	+ 1.00	+ 1.65	+ 1	=	+ 38	− 48	+ 13	+ 57	·	+ 22	+ 16
2	+ 1.00	− 1.65	+ 1	=	+ 46	− 48	− 13	+ 57	=	− 4	+ 50
3	0.00	− 1.93	+ 1	=	+ 15	0	− 15	+ 57	=	+ 42	− 27
4	+ 1.18	+ 1.53	+ 1	=	+ 81	− 57	+ 12	+ 57	=	+ 12	+ 69
5	+ 1.85	+ 0.53	+ 1	=	− 120	− 89	+ 4	+ 57	=	− 28	− 92
6	+ 1.87	− 0.47	+ 1	=	− 81	− 90	− 4	+ 57	=	− 37	− 44
7	+ 1.25	− 1.47	+ 1	=	+ 18	− 60	− 12	+ 57	=	− 15	+ 33
8	+ 1.93	0.00	+ 1	=	− 40	− 92	0	+ 57	=	− 35	− 5
9	− 0.16	− 1.92	+ 1	=	+ 46	+ 8	− 15	+ 57	=	+ 50	− 4
										+ 168 − 172	

Average (O−C) = 38

P.E. = $38 \times \sqrt{\frac{9}{6}} \times 0.84 = \pm 39$

Normal Equations.

a	b	c	
+ 16.63	− 0.24	+ 9.92	= − 241
− 0.24	+ 17.86	− 3.73	= − 59
+ 9.92	− 3.73	+ 9.00	= + 3
+ 0.24	− 0.03	+ 0.14	= − 3
− 9.92	+ 0.14	− 5.92	= + 144
	+ 17.83	− 3.59	= − 62
	− 3.59	+ 3.08	= + 147
	+ 3.59	− 0.72	= − 12
		+ 2.36	= + 135
	− 4.18	+ 3.59	= + 171
	+ 13.65		= + 109
− 10.92	+ 4.11	− 9.92	= − 3
+ 4.11	− 1.54	+ 3.73	= + 1
+ 5.72	+ 3.87		= − 244
+ 3.87	+ 16.32		= − 58
− 0.92	− 3.87		= + 13
+ 4.80			= − 231
+ 1238 a		+ 734 c	= —

$\frac{\Delta \delta}{\Delta n} = 1.93 \cdot + 2.0 = + 0.39$

c = + 57 ± 25″

b = + 8 ± 11

a = − 48 ± 18

$\frac{\Delta \alpha}{\Delta n} = 1.98 \cdot - .59 = - 1.15$″

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC932-

Moon's Limb Reduction

Conditional Equations.

	a	b	c		O
1	+1.00	+1.65	+1	=	+38
2	+1.00	−1.65	+1	=	+46
3	0.00	−1.93	+1	=	+15
4	+1.18	+1.53	+1	=	+81
5	+1.85	+0.53	+1	=	−120
6	+1.87	−0.97	+1	=	−81
7	+1.25	−1.47	+1	=	+18
8	+1.93	0.00	+1	=	−40
9	−0.16	−1.92	+1	=	+46

Normal Equations

a	b	c	
+16.63	−0.29	+9.92	= −241
−0.24	+17.86	−3.73	= −59
+9.92	−3.73	+9.00	= +3
+0.24	−0.03	+0.14	= −3
−9.92	+0.14	−5.97	= +144
	+17.83	−3.59	= −62
	−3.59	+3.08	= +147
	+3.59	−0.72	= −12
		+2.36	+185

$\frac{\Delta s}{\Delta n} = 1.93 \cdot +.20 = +0.39$

c = +52 ± 21"

−10.92	+4.11	−9.92	= −3
+4.11	−1.54	+3.73	= +1
+5.72	+3.87		= −24
+3.87	+14.32		= −58
−0.92	−3.87		= +13
+4.80			= −251

+1238a	+734c	=	−1

$\frac{\Delta s}{\Delta n}$ 1.93 · −59 = −1.15"

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

INC 932. 1912 Nov. 27.

Moon's center.

X_0 =	−19.0028	Y_0 =	−21.5302
$+\frac{1}{2}a$ =	+ 29	$+\frac{1}{2}b$ =	+ 4
X =	19.0052 ± 9	Y =	21.5298 ± 5

R_0^2 =	3.7219		
$+\frac{1}{2}c$ =	+ 57		
R^2 =	3.7276 ± 25		

From further reduction $X = -18.9519$ ✓ $Y = -21.5713$ ✓

" computed constants ax = − 4 ✓ − 4 ✓

by = − 40 ✓ − 4 ✓

c = + 40 ✓ + 10 ✓

$X = -18.9523$ ✓ $Y = -21.5711$ ✓

Mean position for 1911.0:

$\xi = -0.9523$ ✓ $\eta = +0.4289$

$\log \xi$ =	9.97877 m ✓	$\log \tan \delta$	9.47781 m
" $\cos \delta$ =	9.98403 ✓	" ξ^2	9.9575
const =	8.50724	const	7.0534
		$\log \eta_1$ =	6.4890 m
$\log(\alpha - A)$ =	1.48750 ✓ m	n_1 =	− 3
		η_0 =	+0.4292
$\alpha - A$ =	− 30.73 ✓	$\log \eta_0$ =	9.63266 ✓
A =	14h 32m 26s ✓	const =	7.33115 ✓
α =	14h 31 55.27 ✓	$\log(\delta - D)$ =	2.30151
Rein	14 31 55.11	$\delta - D$ =	+ 200".2 ✓
Mean	14 31 55.19	D =	−15° 30 00
		δ =	−15 26 39.8 ✓
		Rein	−15 26 39.8
		Mean	−15 26 39.5 ✓

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

WC 932. 1912 Nov 27.

	X_0 = 19.0028	Y_0 = 21.5302	R_0^2 = 3.7219
$-\frac{1}{2}a$	+ 24	$-\frac{1}{2}b$ = − 4	$+c$ = − 47
	X = 19.0052 ± 9	Y = 21.5298 ± 5	R^2 = 3.7276 ± 55

Twice graphical reduction X = 19.0585 Y = 21.4893

computed constants. ax = − 4 − 4

by = − 40 − 4

c = + 40 + 10

X = ~~19.0561~~ Y = ~~21.4893~~

− 18.9523 − 21.5711

Mean position for 1911.0

$\overline{\delta}$ = − 1.0581 η = + 0.5105

log sin δ = 0.024538 log tan δ 9.417811

cos δ = 9.984055 sec² 0.0491

cosec = 8.509724 cosec 7.0534

$\log \xi_0$ = 6.5776n

$\log \sin(\delta - A)$ = 1.533248 m_1 = − 4

m_0 = + 0.5101

$\log \eta_0$ = 9.707066

cosec = 7.531155

$\log(\delta - D)$ = 2.376511

δ − D = + 238.0

D = − 15 30 00

δ = ~~− 15 26 02.0~~

− 15 − 26 59.8

A − A = − 34.140

A = 14 32 26.3

α = ~~14 31 51.86~~

14 31 55.27

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932 (1911 Feb 18. 14.h) 1912 Dec. 3.

Reduction to apparent place.

$\alpha_0 = 14^h\ 31^m\ 51^s.86$ $\quad \delta = -15^\circ\ 26'\ 02''.0$

$G = 17\ \ 9\ \ 6.$ $\quad H = 20^h\ 10'\ 12''$

$G + \alpha_0 = 31^h\ 40^m\ 58^s$ $\quad H + \alpha_0 = 34^h\ 42^m\ 04^s$

$= 115^\circ\ 14'$ $\quad = 160^\circ\ 31'$

$\log \frac{1}{15} =$	8.8239	$\log \frac{1}{15} =$	8.8239	$\log i =$	0.8464
$\therefore g =$	0.8521	$\therefore h =$	1.2833	$\cos\delta =$	9.9840
$\sin(G+\alpha) =$	9.9564	$\sin(H+\alpha_0) =$	9.5231	$\log(i) =$	0.8304
$\tan\delta_0 =$	9.4410	$\sec\delta_0 =$	0.0160		
$\log(g) =$	9.0734	$\log(h) =$	9.6463		

$\log g =$	0.8521	$\log h =$	1.2833
$\therefore \cos(G+\alpha) =$	9.6297	$\cos(H+\alpha) =$	9.9744
$\therefore (\zeta_g)' =$	0.4818	$\sin\delta_0 =$	9.4251
		$\log(h') =$	0.6828

$\alpha_0 =$	$14^h\ 31^m\ 55^s.27$	$\delta_0 =$	$-15^\circ\ 26'\ 39''.8$
$f =$	$-\ 0.24$	$(\zeta') =$	$+\ 3.0$
$(\zeta_g) =$	$-\ 0.12$	$(\zeta_h') =$	$+\ 4.8$
$(\zeta_h) =$	$+\ 0.44$	$(i) =$	$-\ 6.8$
$\alpha =$	$14^h\ 31^m\ 55^s.35$	$\delta =$	$-15^\circ\ 26'\ 44''.8$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

MC 932 (1911 Tau 18.19^h) 1912 Dec. 3. 67

Reduction to apparent place.

α_0 = 14^h 31^m 51^s.86 δ_0 = −15° 26′ 02″.0

G = 17 9 26. H = 20^h 10′ 12″

G + α_0 = 31^h 40^m 58^s H + α_0 = 34^h 42^m 04^s
= 115° 14′ 30″ 160° 31′

$\log \frac{1}{15}$ = 8.8239$_n$ $\log \frac{1}{71}$ = 8.8239$_n$ $\log i$ = 0.8464
$\log \delta$ = 0.8521$_n$ $\log h$ = 1.2833$_n$ $\cos i$ = 9.9840
$\sin(G+\alpha_0)$ = 9.9564$_n$ $\sin(H+\alpha_0)$ = 9.5231$_n$ $\log(i)$ = 0.8304$_n$
$\tan \delta_0$ = 9.4410$_m$ $\sec \delta_0$ = 0.0160$_n$
$\log(g)$ = 9.0734$_m$ $\log(h)$ = 9.6463

$\log \delta$ = 0.8521$_n$ $\log h$ = 1.2833$_n$
$\cos(G+\alpha_0)$ = 9.6297$_m$ $\cos(H+\alpha_0)$ = 9.9744$_m$
$(\zeta_0)'$ = 0.4818$_m$ $\sin \delta_0$ = 9.4251$_m$
$\log(h')$ = 0.6828$_n$

α_0 = 14^h 31^m 51^s.86 δ_0 = −15° 26′ 02″.0
k = − 0.24 (η') = − 3.0
(ζ_0) = − 0.12 (ξ') = + 4.8
(ξ) = + 0.44 $i)$ = − 6.8
α = ~~14^h 31^m 51.94~~ δ = ~~−15° 26′ 01″.0~~

14 31 5-5.35- −15 26 44.8

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Lunar Parallax.

α' = 14h 31m 55.35s ✓
$\odot$ = 14 07 28.2 ✓

$\odot - \alpha'$ = − 24 27.15 ✓
= − 6° 06′ 47″ ✓

$\frac{1}{2}(\alpha - \alpha')$ = − 2 14

$(\odot - \alpha') + \frac{1}{2}(\alpha - \alpha')$ = − 6° 04′ 33″ ✓

log tan φ′ = 9.95727
∴ cos ½(α − α′) = 0.00000
∴ cos[(⊙ − α′) + ½(α − α′)] 9.99755 ✓
∴ tan f = 9.95972

f = + 42° 20′ 48.0″ ✓
δ′ = − 15° 26′ 47.8″

f − δ′ = + 57 47 32.8

log sin φ′ = 9.82640
∴ sin π = 8.20179 ✓
∴ sin(f − δ′) = 9.92743 ✓
∴ sin f = 9.82841 ✓

∴ sin(f − δ′ = 8.12782 ✓

δ − δ′ = + 46′ 04.1″ ✓

δ = − 14 40 40.7 α = 14 31 37.53 ✓

Am Ephm. δ = − 14° 40′ 36.4″ ✓ α = 14h 31m 36.85s ✓

O − C − 4.3″ ✓ + 0.68 ✓

δ′ = − 15° 26′ 47.8″

π = 54′ 42.″0

log ρ cos φ′ = 9.86913 ✓
∴ sin π = 8.20179 ✓
∴ ∴ (⊙ − α′) = 9.02729 ✓
∴ cos δ′ = 9.98403 ✓

∴ sin(α − α′) = 7.11418 ✓

Approx. (α − α′) = − 4′ 28.″

log cos δ = 9.98559 ✓

∴ sin(α − α′) = 7.11251 ✓

α − α′ = − 4′ 27.3″
= − 17.82 ✓

Rem δ = − 14 40 39.7 73 α = 14 31 37.37
mean − 14 40 40.2 14 31 37.45

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Lunar Parallax.

α' = 14h 31m 55s.35
θ = 14 07 28.2

$\theta - \alpha'$ = − 24 27.15
= − 6° 06′ 47″

$\frac{1}{2}(\alpha - \alpha')$ = − 2 14

$\alpha' + \frac{1}{2}(\alpha - \alpha')$ = − 6′ 04′ 33″

log cos ϕ' = 9.95727
∴ cos $\frac{1}{2}(\alpha - \alpha')$ = 0.00000
∴ cos[$(\theta - \alpha' + \frac{1}{2}(\alpha - \alpha')$] = 9.99755
∴ tan ζ = 9.95972

ζ = +42° 20′ 48.0″
δ' = −15° 26′ 44.8″
$\zeta - \delta'$ = +57 47 32.8

log sin ϕ' = 9.82640
∴ sin π = 8.20179
∴ cos($\zeta - \delta'$) = 9.92743
∴ sin ζ = 9.82841
∴ sin($\delta - \delta'$) = 8.12721

$\delta - \delta'$ = + 46′ 04.7″

δ = −14 40 40.1″

Am Ephem. δ = −14° 40′ 36.4″

O − C = − 3.7″

δ' = −15° 26′ 49.8″

π = 54′ 42.7″

log ρ cos ϕ' = 9.86913
∴ sin π = 8.20179
∴ ∴ ($\theta - \alpha'$) = 9.02729
∴ cos δ' = 9.98403
∴ sin($\alpha - \alpha'$) = 7.11418

approx. ($\alpha - \alpha'$) = − 4′ 28.″

log cos δ = 9.98559
∴ sin($\alpha - \delta'$) = 7.11262

$\alpha - \alpha'$ = − 4′ 27.3
= − 17.82

α = 14h 31m 37.53
α = 14h 31m 36.85

O − C = + 0.68

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

NGC 932 1913 Apr 2 Apr 4 69

Moon - Reneasures.

4

	a	N
1	scratch	1
16.8	17160	15780
20.5	11698 10	11222 31
	12	29
	50	71
	20.5448	.5451
2		
19.1	15616	14805
20.6	10231 30	10169 76
min	36	70
	14	00
8	20.5383	.5369
3		
18.0	18539	18879
20.8	10340 40	17076 75
	30	79
	39	76
	20.8202	8199
4		
18.3		
21.0		
5		
18.8		
22.0		
6		
18.9		
22.5		
mark:		
70		
7		
16.8		
23.0		

x

	x	N
	17116	18816
	15461 61	10457 57
	58	60
	22	21
	16.8343	.8361
	19021	18483
	11460 60	16005 11
	54	12
	11	71
	18.2445	.2471
	16776	17819
	15437 49	9120 12
	5049	22
	76	10
	18.8670	.8693
	15726	17849
	14975 74	8574 76
	72	71
	19	49
	18.9249	.9273
	14686	16902
	13180 84	8400 03
	80	00
	76	00
	18.8496	.8499

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proc.188

NMC 932 1913 Apr. 2 Hr. 4 69

Moon - Remeasures.

	a	N	d	x
1 scratch	1		17116	18816
16.8	17160	15780	1546161	1045859
20.5	1169810	11222-31	58	60
	12	29	22	21
	50	71		
	20.5448	.5451	16.8343	.8361
2				
19	15616	14805		
20.6	1023130	10169-76		
min	36	70		
"	19	00		
4	20.5383	.5369		
3				
18.0	18539	18879		
20.8	1034040	1707675-		
	30	79		
	39	76		
	20.8202	8199		
4			19021	18483
18.3			1146060	16005-11
21.0			54	12
			11	71
			18.2445	.2471
5				
18.8			16776	17819
22.0			1543749	9120-12
			5049	22
			76	10
			18.8670	.8693
6				
18.9			15726	17849
22.5-			1497574	8579-76
mark			72	7
"			19	49
			18.9249	.9273
7				
18.8			14686	16902
23.0			1318084	8400-03
			80	00
			76	00
			18.8496	.8499

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932 1913 April 4. 70

Moon - Remeasures.

	d	n	d	n
18.2			15071	16011
24.0			681521	1425740
			3030	5440
			68	10
			18.17555	.1764

9/			
18.0	18548	15508	
24.2	1726975	668480	
	80	87	
	40	00	
	24.17272	.1183	

poor front remeasure: d: 24.17278 n: 24.17203

10 - Scratch				
17.8	17580	18490	17590	18179
24.2	1528280	1078961	1561001	1014549
	76	84	07	40
	73	81	80	70
	24.23000	.2300		
			17.80118	.8027

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj:188

MC 932 1913 April 4. 70

Moon - Remeasures.

	d	n	d	n
18.2			15071	16011
24.0			68 15 21	14 25 5 40
			30 30	5 4 40
			68	10
			18.1755	.1764

9

18.0	18548	15508
24.2	17269 75	6684 80
	80	87
	40	00
	24.1272	.1183

poor point
remeasurement
d: 24.1278 n: 24.1203

10 - Scratch

17.8	17580	18490	18590	18179
24.2	15282 80	10784 81	15610 01	10145
	76	84	07	40 49
	73	81	80	70
	24.2300	.2300		
			17.8018	.8027

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 937 1913 Apr. 4

Droste's Center Measures

	x	$x - X_0$	Δx	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	16.8352	−0.1568	+3	0.0245	3.7421	−13
2	16.9920	0.0000	+3	0.0000	3.7462	+28
3	18.0000	+1.0080	+2	1.0165	3.7486	+52
4	18.2458	+1.2538	+2	1.5725	3.7416	−18
5	18.8682	+1.8762	+1	3.5205	3.7433	−1
6	18.9261	+1.9341	0	3.7408	3.7408	−26
7	18.8498	+1.8578	−1	3.4511	3.7306	−128
8	18.1760	+1.1840	−2	1.4014	3.7404	−30
9	18.0000	+1.0080	−2	1.0157	3.7478	+44
10	17.8022	+0.8102	−2	0.6561	3.7523	+89
				Mean	3.7434	−3

	y	$y - Y_0$	Δy	$(y-Y_0)^2$
1	20.5456	−1.9267	−14	3.7116
2	20.5376	−1.9341	−14	3.7462
3	20.8200	−1.6517	−12	2.7321
4	21.0000	−1.4717	−11	2.1691
5	22.0000	−0.4717	−3	0.2228
6	22.4717	0.0000	0	0.0000
7	23.0000	+0.5283	+4	0.2795
8	24.0000	+1.5283	+11	2.3390
9	24.1234	+1.6517	+12	2.7321
10	24.2300	+1.7583	+13	3.0962

Approximate Center

$x = 18.0$ $y = 20.8200$

24.1234

44.9434

Mean $y = 22.4717$

$y - \text{min} = 20.5376$

$R = 1.9341$

$x - \text{max} = 18.9261$

$X_0 = 16.9920$

Center $\begin{cases} X_0 = 16.9920 \\ Y_0 = 22.4717 \end{cases}$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

MC 932 1913 Apr. 4.

Moon's Center Remeasures

	x	$x - X_0$	Δx	$(x-X_0)^2$	$(x-X_0)^2+(y-Y_0)^2$	O - C
1	16.8352	−0.1568	+3	0.0245	3.7421	−13
2	16.9920	0.0000	+3	0.0000	3.7462	+28
3	18.0000	+1.0080	+2	1.0165	3.7486	+52
4	18.2458	+1.2538	+2	1.5725	3.7416	−18
5	18.8682	+1.8762	+1	3.5205	3.7433	− 1
6	18.9261	+1.9341	0	3.7408	3.7408	−26
7	18.8498	+1.8578	−1	3.4511	3.7306	−128
8	18.1760	+1.1840	−2	1.4014	3.7404	−30
9	18.0000	+1.0080	−2	1.0157	3.7478	+44
10	17.8022	+0.8102	−2	0.6561	3.7523	+89
				mean	3.7434	−3

	y	$y - Y_0$	Δy	$(y-Y_0)^2$
1	20.5456	−1.9267	−14	3.7176
2	20.5376	−1.9341	−14	3.7462
3	20.8200	−1.6517	−12	2.7321
4	21.0000	−1.4717	−11	2.1691
5	22.0000	−0.4717	−3	0.2228
6	22.4717	0.0000	0	0.0000
7	23.0000	+0.5283	+4	0.2795
8	24.0000	+1.5283	+11	2.3390
9	24.1234	+1.6517	+12	2.7321
10	24.2300	+1.7583	+13	3.0962

Approximate Center.

$x = 18.0$ $y = 20.8200$

24.1234

44.9434

mean $y =$ 22.4717

y min $= 20.5376$

$R = 1.9341$

x max $= 18.9261$

$X_0 = 16.9920$

Center $\begin{cases} X_0 = 16.9920 \\ Y_0 = 22.4717 \end{cases}$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

No	ab	ac	bc
1	+ 0,31	+ 2,1	+ 25,1
2	= 0,00	+ 0,0	− 54,0
3	= 1,67	+ 52,5	− 85,8
4	= 1,84	− 22,5	+ 26,9
5	− 0,88	− 1,9	+ 0,5
6	+ 0,00	− 48,3	− 0,0
7	+ 0,99	− 2380	− 68,0
8	+ 1,81	− 35,4	− 45,9
9	+ 1,67	+ 44,5	+ 72,5
10	+ 1,43	+ 72,0	+ 156,8
11	+ 1,82	− 175,0	+ 29,6

[aa] = +16.40 [bb] = +21.03

[ac] = +10.77 [bc] = −1.98

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911Phae..pro..188

Moon's Center – Reversed

Conditional Equations.

	a	b	c	O		c	O − C
1	−0.16	−1.93	+1	= −13	+ 7	−19 + 49 = +37	−50
2	0.00	−1.93	+1	= +28	− 0	−19 + 49 = +30	−2
3	+1.01	−1.65	+1	= +52	−44	−16 + 49 = −11	+63
4	+1.25	−1.47	+1	= −18	−55	−14 + 49 = −20	+2
5	+1.88	−0.47	+1	= −1	−82	− 5 + 49 = −38	+37
6	+1.93	+0.00	+1	= −26	−85	+ 0 + 49 = −36	+10
7	+1.86	+0.53	+1	= −128	−82	+ 5 + 49 = −28	−100
8	+1.18	+1.53	+1	= −30	−52	+15 + 49 = +12	−42
9	+1.01	+1.65	+1	= +44	−44	+16 + 49 = +21	+23
10	+0.81	+1.76	+1	= +89	−36	+17 + 49 = +30	+59
						+194	−194

Average (O − C) = 39

Normal Equations.

a	b	c	
+16.40	+ 1.82	+10.77	= −175
+ 1.82	+21.03	− 1.98	= +28
+10.77	− 1.98	+10.00	= −3
− 1.82	− 0.20	− 1.20	= + 19
−10.77	− 1.20	− 7.06	= +115
	+20.83	− 3.18	= + 47
	− 3.18	+ 2.94	= +112
	+ 3.18	− 0.49	= + 7
		+ 2.45	= +119
	− 3.44	+ 3.18	= +121
	+17.39		= +168
+ 9.90	− 1.82	+ 9.20	= − 3
+114.50	− 21.03	+106.20	= − 32
+26.30		+ 19.97	= −178
+116.32		+104.22	= − 4
− 22.26		− 19.97	= + 1
+ 4.04			= −177

c = +49

b = +90

a = −44

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Moon's Center = Rencontres

Conditional Equations.

	a	b	c	O	c	O − C
1	−0.16	−1.93	+ 1	= −13	+ 7 − 19 + 49 = +37	− 50
2	0.00	−1.95	+ 1	= +28	− 0 − 19 + 49 = +30	− 2
3	+1.01	−1.65	+ 1	= +52	− 44 − 16 + 49 = − 11	+ 63
4	+1.25	−1.47	+ 1	= −18	− 55 − 14 + 49 = −20	+ 2
5	+1.88	−0.47	+ 1	= − 1	− 82 − 5 + 49 = −38	+ 37
6	+1.93	+0.00	+ 1	= −26	− 85 + 0 + 49 = −36	+ 10
7	+1.86	+0.53	+ 1	= −128	− 82 + 5 + 49 = −28	− 100
8	+1.18	+1.53	+ 1	= −30	− 52 + 15 + 49 = +12	− 42
9	+1.01	+1.65	+ 1	= +44	− 44 + 16 + 49 = +21	+ 23
10	+0.81	+1.76	+ 1	= +89	− 36 + 17 + 49 = +30	+ 59
						+194 −194

Average (O − C) = 39

Normal Equations.

a	b	c	
+16.40	+ 1.82	+10.77	= −175
+ 1.82	+21.03	− 1.98	= + 28
+10.77	− 1.98	+10.00	= − 5
− 1.82	− 0.20	− 1.20	= + 19
−10.77	− 1.20	− 7.06	= +115
	+20.83	− 3.18	= + 47
	− 3.18	+ 2.94	= +112
	+ 3.18	− 0.49	= + 7
		+ 2.45	= +119
	− 3.44	+ 3.18	= +121
	+17.39		= +168

c = +49

b = +10

+ 9.90	− 1.82	+ 9.20	= − 3
+114.50	−21.03	+106.20	= − 32
+26.30		+19.97	= −178
+116.32		+104.22	= − 4
−22.26		−19.97	= + 1
+ 4.04			= −177

a = −44

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Moon's Mean Position (1911.0)

$X_0 = 16.9920$ $Y_0 = 22.4717$

$\frac{1}{2}a = -22$ $\frac{1}{2}b = +5$

$X = 16.9898$ $Y = 22.4722$

From Preliminary Reduction $X = 17.0431$ $Y = 22.4307$

Plate Constants $ax = -4$ -4

$by = -40$ -4

$c = +40$ $+10$

17.0427 22.4309

$\xi = -0.9573$

$\log \xi = 9.98105_n$

$\therefore \log \delta = 9.98403^s$

$\therefore \delta = 8.50729$

$(K-A)\ 1.48978_n$

$(K-A) = -30.89$

$A = 14\ 32\ 26$

$\alpha = 14\ 31\ 55.11$

Red $= +0.08$

$\alpha_0 = 14\ 31\ 55.19$

Red for parallax $= -17.82$

$\alpha = 14\ 31\ 37.37^s$

Tabular place $= 14\ 31\ 36.85$

$O-C = +0.52$

Corr to standard radius $= +0.06$

Final $(O-C) = +0.58$

$\eta = +0.4309$

$\log \tan \delta = 9.44113_n$

$\therefore \delta^2 = 9.9621$

$\therefore \eta_1 = 6.4568$

$\therefore \eta_1 = -3$

$\eta_0 = +0.4312$

$\log \eta_0 = 963468$

$\therefore \delta = 7.33115^s$

$\therefore (\delta - D) = 2.30353$

$\delta - D = +201.2$

$= +3\ 21.2$

$D = -15^\circ\ 30'\ 00.$

$\delta_0 = -15^\circ\ 26'\ 38.8$

Red $= -5.0$

$\delta_0' = -15^\circ\ 26'\ 43.8$

Red for par. $= +46.041$

$\delta = -14^\circ\ 40'\ 39.7''$

Tabular place $= -14^\circ\ 40'\ 36.4''$

$O-C = -3.3$

Corr to standard radius $= -0.4$

Final $(O-C) = -3.7$

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Moon's Mean Position (1911.0)

X_0 =	16.9920	Y_0 =	22.4717
$\frac{1}{2}a$ =	− 22	$\frac{1}{2}b$ =	+ 5
X =	16.9898	Y =	22.4722

From Prelim. Reduction: X = 17.0431, Y = 22.4307
Plate Constants: ax = − 4, by = − 4
c = + 40, + 10
17.0427, 22.4309

ζ = +0.9573
log ζ = 9.98105 n
∴ cos δ = 9.98403
anal = 8.50724

∴ (α − A) 1489.78 n

(α − A) = − 30.89

A = 14 32 26.

α_0 = 14 31 55.11

Red = + 0.08

α'_0 = 14 31 55.19

Red for parallax = − 17.82

α = 14 31 37.37 w

Tabular Place = 14 31 36.85

O − C = + 0.52

Correction for Standard region = + 0.06

Final (O − C) = + 0.58

η = +0.4309

log tan δ = 9.4413 n
∴ ζ² = 9.9621
∴ η_1 = 6.4568
∴ η_1 = − 3

η_0 = +0.4312

log η_0 = 9.63468
∴ anal = 7.33115

∴ (δ − D) = 2.30353

δ − D = + 201.2
= + 3 21.2

D = −15° 30 00.

δ_0 = −15 26 38.8

Red = − 5.0

δ'_0 − 15 26 43.8

Red for par. = + 46 04.1

δ = −14 40 39.7 s

Tabular place = −14 40 36.4

O − C = − 3.3

Correction for Standard region = − 0.4

Final (O − C) = − 3.7

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Combining 1st + 2d measures.
with wt 2 attached to 2d measure.

mean position		
to α_0 =	14 31 55.16	α_0 = −15 26 39.1
app. place	+ 08	− 5.0
par	−17.82	+46 04.1
α =	14 31 37.42	−14 40 40.0
Tabular	14 31 36.85	−14 40 36.4
O−C =	+.57	− 3.6

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

Combining 1st + 2d measures.
with wt ½ attached to 2d measure

mean position		
is α_0 = 14 31 55.16	δ_0 = −15 26 39.1	
Aberration	+ 0.8	− 5.0
Par	−17.82	+46 04.1
α = 14 31 37.42	−14 40 40.0	
Tabular 14 31 36.85	−14 40 36.4	
O−C = +.57	− 3.6	

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj.188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1911phae.proj..188

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System