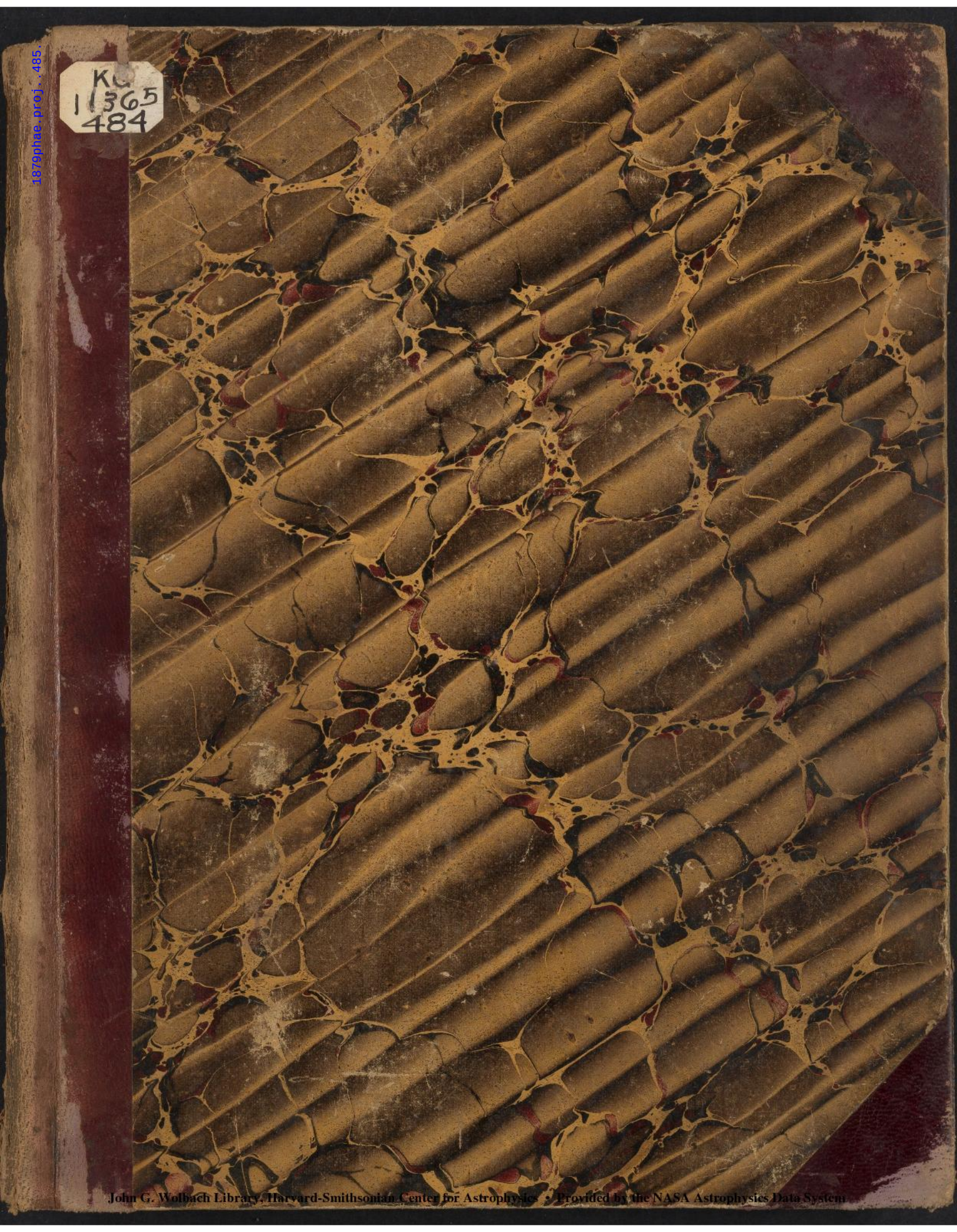
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KU
11365
484



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KG 11365.484

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50-4 Systematic Errors Gould Lyston, 64-68.
58 Klein Astr. Nach. 71
88 Jupiter's Satellites. Assumed dimensions.
130 Sitz unchecked in Abh I Vol XI.
140-1 Rhotenolite D.
177-83 Compar. advantages angles & distances Sat. Trans.

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Prospective Work.

I. Observations. a. E. Equal.
b. Photometer

II. Publications

III. Instrument a.
2

IV. Building. 1 Computing Room.
2 Dome.
3 Prime Vertical Room
4 Library.

V.

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I, 1, E. Equatorial.

Capacity. 150 nights of eight hours. = 1200 hours.
extra " 200 " " ten "

I. Pole Stars Standards.

II. Double Stars, Rhet. M.

Dembowski & Hall, Standards	10
Binary stars	5
Triple "	5
Séries	10
Doubles A > B+4, A > 5.0	3

III. Variable Stars. Rhet. K.

Argelander. inf.	5
" bel inf.	3

IV. Zone

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2. Meridian Instrument.

Capacity 3 hours 100 nights = 300 hours.
60 stars per hour = 18000 stars.

1. All N.P. stars south of 30° S.
including all D.M. stars brighter than 6.0 mg.
2. All Nord. Cl. (?) stars south of 55° N. (50 cells)
3. Angular distances comp. for Br. Circle
4. Bright attendant, visible N.

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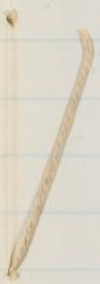
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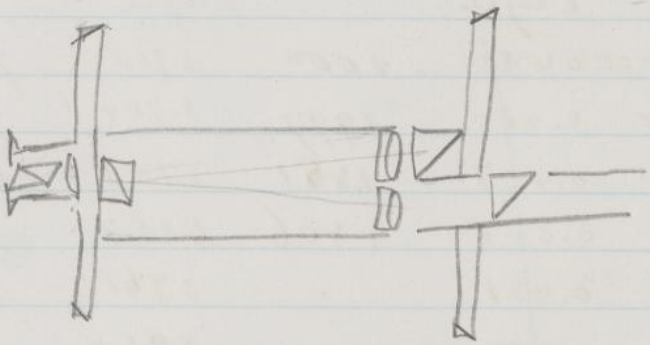
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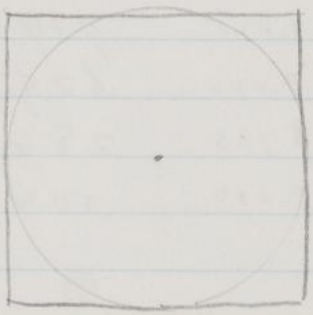
Mars and Saturn.

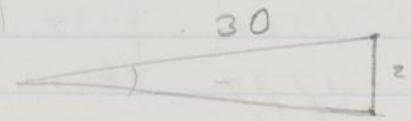
	2 log tan.		2 log tan			
12°69	0.456	2000	8.705	705	1295	3.24
12.67	0.450	1.999	8.704	.703	1296	3.24
13.41	0.477	1.881	8.755	636	1245	3.11
15.57	0.555	1.806	8.857	.663	1143	2.86
13.57	0.481	"	8.761	.567	1239	3.10
16.70	0.600	"	8.954	.760	1046	2.61
16.86	0.606	1.733	8.963	.696	1037	2.59
19.01	0.689	1.644	9.075	.719	925	2.31
18.39	0.665	1.581	9.044	.625	956	2.39
13.61	0.484	1.521	8.768	.289	1232	3.08
17.79	0.642	1.490	9.014	.504	986	2.46

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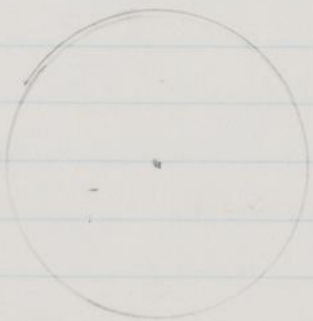
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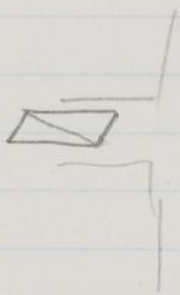






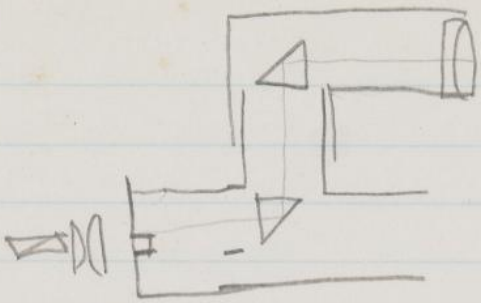
$1^{0} = .5$ in.





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683 | 38
38 | 18
303
304

200

172 | 268 | 6 | +2
447 | +8

65 | −14 | +3 | 15
−8 | −4
−12 | −37
+13 | −10
+3 | −32
+16 | +4
66 | +29
+19
+32
180 | 11
164

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28
20
54
21

8

J		V	
+	−	+	−
+20		+28	
+54			
21			-8
25			27
31			20
11			~~2~~
1	~~42~~		27
22			4
	-4		18
	-8		9
41			12
38		15	
	-3		18
	-8		30
	-2		12
190			
~~189~~	-25	15	185
			5
	-67		-79

Retaining
$\Sigma +$

Rejecting
$\Sigma + = 205$
$\Sigma - = 210$

25 | 415
.166 25
165
150
150

.166
2|332
47
285

M. D = .166
P.E. = .028

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194				
195				
195				
198				
200				
201				
202	916	2.290	107	.267
202	687	1.717	122	.305
203				
203				
203				
203				
203				
203				
205	.073			.182
205				042
205	.850	2125	31	.077
205				
204	770	1925		
204	653	1632	166	42
205				
204				
209				
209				
209				
209				
209				
209				
213				
213				

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1879phae.proj..485.

		J +	J −	V +	V −
	41				28
9			20		
43			54		
56	66			79	
		67			
10	5		21	8	
14	14		25	27	
19	7		30	20	
0	14		11	27	
10	9		1	4	
11	5		22	18	
31 / 15	22	4	42	~~2~~	9
19 / 27	25	8	38		12
	29				16
14					
19	5	3		18	
13	17 / 1	8		30	
		2		12	
		25	190	164	37
		67	74	79	25
202	153	92	264	243	65
108	107	92 / 172 / 16 / 12	107	178 / 14 / 14 / 38 / 25 / 100 / 98	127
310	260				
570		.107 × 4 = 428		1	.127 × 4 = 508
.19		.012 × 43 = .055			.012 × 57 = .961

Retaining

$\Sigma +$ 335

$\Sigma -$ 329

Σ 664 a Dec. = .221

Rejecting

$\Sigma +$ 189

$\Sigma -$ 227

25 | 416 a Dec. .1664

13

.75 | 30

750 | 4448

448 17

3020

3136

11

189	227
28	22
217	205

107

127

234

6646 5705

4164 3555

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1879phae.proj..485.

570 / 164
5512
3880 .86

355 / 4.6
3328 85
2220

.86

M	S	S − M. +	−
609	.573		1
.666	.719		
.610	.736		
.731	.731		
791	.690		
700	.625		
707	.721		
751	.610		
16518	.548		
.6956	.756		
	.583		
	.693		
	.598		
	.744		
	.825		
	.848		
	.822		
8	11922 L 17		
	11922 701		

289 .504
335 .607
588

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Satellites

Mars. about 6 miles 14 mag.

Mimas .65
Teth 1.53
Dio 1.35
Encl .84
Tet 3.03
Hyp. .61
Rhea 1.47

Titt. 2.80 .62 | 84 840 2
588
320 .074

Uran 12 mag. 9.00

8.25
1.75
35

11.50 4.4
Tit 3.05 2.2
Ob. 160 | 305 16 | 276
16
11 | 8.30 191 145 192 116
2.76 144 112
10 40

75004 | 16 75000 .60
64 470 160.
110
112

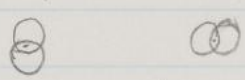
8.87
1.13
.3 mag

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Dein			6	14
Phibea			7	
Mne.			280	12
Eumk.			400	11.5
Lut.			630	
Dir			630	10.5
Rhea			900	10
Tit			1400	9
Hyp.			190	13
Sat			280	13
			940	9.5
Tit	.0191	32	610	9
Rhea	.0172		550	"
Phil.	.074	34	2500	6 mag.

1 mm = 30" plate Rhea Repsn. 6 mm = 18"



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d	δ	s1	l
	4.68	5.02	6.19
	4.20	4.95	6.63
	4.41	5.11	6.44

p .37
4 .31
.28
.25

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Magnitudes estim'd by Mr. A. S.

		Star.		R. A.
Dec	3.	51 Cephei?		51
"	"			52
"	"	960 Ursæ		53
Feb	7	80°.54 6.2		
	19	2 Ursæ Min.	90	56
	24	" "		58
	26	" "		60
	27	" "		62
Mar	16	51 Cephei	94	
	19	"		
	16	" (Mitch.)	98	
	19	" "		
		2 Ursæ.		
		Mark 20, 26 30, 31, Cam 2		102
		"	Mitch	106
		2 faint stars	110	112-7
		51. without Mitch.		
4		2 Ursæ- Mitch. 4		
5		51 " " without		
5		" " " with		
5		2 Ursæ " without		
5		" " " with		
		57		
		"		
		1		
		"		

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5½ – 9.7 45
5.5, 6.0, 6.5, 7.0,
7.5, 8.0, 8.5 9.0
9.5 9
Lt. 1
53

~~Objs.~~

Mag.	1	1	1
Mea. Light	2	5	6
Number	4	5	6
Mean dec.	4	5	6

XIII

- Sect. U.A.R.
- Morton. C.S.
- " Zone.
- Pole Stars.

J.M. Dubbs
" Nebulae
Lab. Mars. '77
" " '79

Morton. Angl. Cat. St.
" Nebulae
" Light Sec I, K

β Persei

– Jupiter's Satellites

Micrometer
– Unequal Dabbs.
– Dean. Planets

Morton
Pole Stars.
Angl. Ursa Insa.
Angl. Variable Cat.
Asteroids
Variable Schaufele

Rosalba Mars.
" Asteroid.

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Volumes Annals.

XI. Photom. Obsn. E. Equ. 1878

XII. Meridl. Circl 72-3 Obsn.

XII " " 74-5 Gen. Cat.

XIII Photom. Zone. C.S., Stellar. Parallax

XIV Meridl Circl 76-7

XV " " C.S. 1878

XVI Zone.

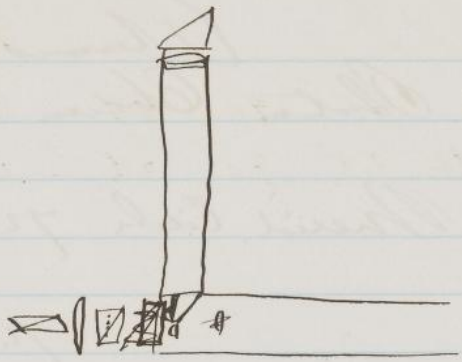
XVII "

XVIII Meteorology.

XIX

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δ 18

Name α δ s−1 2

R.A.

R.A. = degrees and minutes

Dec.

N.P.D. = minutes

by N.P.D.

by Dec. R.A.

by cor R.A.

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				η_{xy}
51 Pisc.	5.0	9.0	27	3.6
4 Andr.	4.5	9.0	36	4.2

82	182
87	231
80	148
100	195
73	152
103	237
65	167
45	102
55	116
690	1530
	138
	150
22	138
	220

$$\varepsilon = .845 \frac{\Sigma_\varepsilon}{\sqrt{n(n-1)}}$$

$$A = \frac{\Sigma_\varepsilon}{n} A. .845 \sqrt{\frac{n}{n-1}} = \varepsilon$$

$$k_n = \frac{\varepsilon}{\sqrt{2}} = \frac{.845}{\sqrt{n-1}} A$$

14

176 | 690 | 4

172

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Names.	☿ Mer. Mid.	♂	51	♄	88°.4.	88°.9
R. A.	1h 6m 38s	18° 19 7	6 31 7	20 8 30	0 45 31	1 51 8
R. A. in 0°-0'	16° 38'	274° 59'	187° 47'	302° 7'.5	11° 24'	27° 47'
Declination	88° 32'.2	86° 36'.0	87° 15'.1	88° 52'.5	88° 14'.6	88° 29'.2
N. P. D. in 0°-0'	1° 27'.8	3° 24'.0	2° 44'.9	1° 7'.5	1° 45'.4	1° 30'.8
Log. N. P. D.	1.94349	2.30963	2.21722	1.82930	+2.02284	1.95809
Log. Sin. R. A.	9.45674	-8.93885	-9.13171	-9.72572	9.29591	9.66851
Log. y	1.40023	1.24848	1.34893	1.55502	1.31875	1.62660
y	25.1	17.7	22.3	35.9	20.8	42.3
Log. Cos. R. A.	9.98144	9.99836	9.99598	9.92791	9.99135	9.94680
Log r.	1.92493	2.30799	2.21320	1.75721	+2.01419	1.90489
r	84.1	203.2	163.4	57.2	103.3	80.3
x^2	7078.81	41290.24	26699.56	3271.84	10661.89	6448.09
y^2	630.01	313.29	497.29	1288.81	432.64	1789.29
$R^2 = x^2 + y^2$	7708.82	41603.53	27196.85	4560.65	11094.53	8237.38
R = n.P.D	87.8 = 87.8	204.0 = 204	164.9 = 164.9	67.5 = 67.5	105.4 = 105.4	90.8 = 90.8
x	-25.1	+203.2	-163.4	+57.2	-20.8	-42.3
y	-84.1	-17.7	+22.3	-35.9	-103.3	-80.3
	8.6	1.4	7.8	9.2		
y	-75.5	-7.5	+30.1	-26.7		
	-.2	+1.3	-1.0	+.3	-.1	-.2
	+8.6	10.1	7.8	9.1	8.7	8.6
y'	-75.5	-7.6	+30.1	-26.8	-94.5	-71.7
y + 2 inc	.5		.2	.2	.6	.5
x'	-24.6	203.1	-163.6	57.0	-20.2	-41.8
	-24.6	+203.3	-163.2	+57.4		

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Name.	89°.3.	89°.35.	89°.37.	89°.1.	89°.26.	
R. A.	1 49 36	20 13 29	22 6 40	0 11 5	15 44 3	
R. A. in degrees	27° 24'	303° 22'	231° 40'	2° 46'	236° 1'	
Declination	89° 29.2	89° 45.9	89° 48.0	89° 36.2	89° 55.1	
N. P. D. in 0°-0'	0° 30.8	0° 14.1 ×	0° 12.0	0° 23.8	0° 04.9	
log. N. P. D.	1.48855	1.1 49 22 1.6 44 44	1.07918	1.37655	0.69020	1.07918
log. Sin. R. A.	9.66295	-9.74036	-9.89455 ?	8.68367	-9.91866	9.67633
log. y	1.15150	0.8 89 58 +.38480	0.97373	0.06025	0.60886	0.75551
y	14.2	7.7 ~~24.3~~	9.4	1.15	4.0	5.70
log. Cos R.A.	9.94832	9.92177	9.79256	9.99949	-9.74737	9.94458
log y.	1.43687	1.0 70 99 ~~+.56621~~	0.87174	1.37607	0.4 37 57 ~~9.66603~~	~~0.87179~~ 1.02376
y	27.3	11.8 ~~36.8~~	7.4	23.8	2.74	10,56
	745.29	139.24	54.76	566.44	7.51	
	201.64	59.29	88.36	1.32	16.0	
	946.93	198.53	143.12	567.76	23.51	
	30.8 = 30.8	14.1 = 1.41	12.0 = 12.0	23.8 = 23.8	4.85 = 4.9	
	-14.2	+11.8	+7.4	-1.15	+4.0	+10.6 ~~7.4~~
	-27.3	-7.7	-9.4	-23.8	+2.74	-5.7
						88
	-.1	+.1	0	0	0	
	8.7	8.9	8.8	8.8	8.8	+3.1
	-18.6 .1	+2.2	-0.6	15.0	11.5	~~5.2~~
	-14.0	+11.8	+7.4	-1.15	+4.0	+10.6

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m =	2	3	4	5	6	7	8	9
Log m	0.3010	0.4771	0.6021	0.6990	0.7781	0.8451	0.9031	0.9542
log(m-1)	0.0000	0.3010	0.4771	0.6021	0.6990	0.7781	0.8451	0.9031
Log m - log(m-1)	0.3010	0.1761	0.1250	0.0969	0.0791	0.0670	0.0580	0.0511
$\frac{1}{2}$ (")	0.1505	0.0881	0.0625	0.0484	0.0395	0.0335	0.0290	0.0256
log .845	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269
Log .845 $\frac{1}{2}$log( )	0.0774	0.0150	$\bar{1}$.9894	$\bar{1}$.9753	$\bar{1}$.9664	$\bar{1}$.9604	$\bar{1}$.9559	$\bar{1}$.9525
P.E. obs =	1.196	1.036	0.976	0.945	0.926	0.913	0.903	0.896

Log m + log(m-1)	0.3010	0.7781	1.0792	1.3011	1.4771	1.6232	1.7482	1.8573
$\frac{1}{2}$(")	0.1505	0.3891	0.5396	0.6506	0.7385	0.8116	0.8741	0.9286
Log .845	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269
Log .845 + $\frac{1}{2}$ log( )	0.0774	0.3160	0.4665	0.5775	0.6654	0.7385	0.8010	0.8555
	1.198	2.070	2.929	3.780	4.628	5.476	6.324	7.170

Log .845	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269	$\bar{1}$.9269
$\frac{1}{2}$ log (m-1)	0.0000	0.1505	0.2385	0.3011	0.3495	0.3890	0.4225	0.4516
log $\frac{.845}{\sqrt{m-1}}$	$\bar{1}$.9269	$\bar{1}$.7764	$\bar{1}$.6884	$\bar{1}$.6258	$\bar{1}$.5774	$\bar{1}$.5379	$\bar{1}$.5044	$\bar{1}$.4753
antilog.	.845	.598	.488	.422	.378	.345	.319	.299

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10	11	12	13	14	15	16	17
1.0000	1.0414	1.0792	1.1139	1.1461	1.1761	1.2041	1.2304
0.9542	1.0000	1.0414	1.0792	1.1139	1.1461	1.1761	1.2041
0.0458	0.0414	0.0378	0.0347	0.0322	0.0300	0.0280	0.0263
0.0229	0.0207	0.0189	0.0174	0.0161	0.0150	0.0140	0.0132
$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
$\bar{1}.9498$	$\bar{1}.9476$	$\bar{1}.9458$	$\bar{1}.9443$	$\bar{1}.9430$	$\bar{1}.9419$	$\bar{1}.9409$	$\bar{1}.9401$
0.891	0.886	0.883	0.880	0.877	0.875	0.873	0.871
1.9542	2.0414	2.1206	2.1931	2.2600	2.3222	2.3802	2.4345
0.9771	1.0207	1.0603	1.0965	1.1300	1.1611	1.1901	1.2172
$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
0.9040	0.9476	0.9872	1.0234	1.0569	1.0880	1.1170	1.1441
8.017	8.863	9.710	10.554	11.40			
$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
0.4771	0.5000	0.5207	0.5396	0.5569	0.5731	0.5880	0.6020
$\bar{1}.4498$	$\bar{1}.4269$	$\bar{1}.4062$	$\bar{1}.3873$	$\bar{1}.3700$	$\bar{1}.3538$	$\bar{1}.3389$	$\bar{1}.3249$
.282	.267	.255	.244	.234	.226	.218	.211

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	18	19	20	25	30	35	40	45
	1.2553	1.2788	1.3010	1.3979	1.4771	1.5441	1.6021	1.6532
	1.2304	1.2553	1.2788	1.3802	1.4624	1.5315	1.5911	1.6435
	0.0249	0.0235	0.0222	0.0177	0.0147	0.0126	0.0110	0.0097
	0.0125	0.0118	0.0111	0.0088	0.0074	0.0063	0.0055	0.0048
	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
	$\bar{1}.9394$	$\bar{1}.9387$	$\bar{1}.9380$	$\bar{1}.9357$	$\bar{1}.9343$	$\bar{1}.9332$	$\bar{1}.9324$	$\bar{1}.9317$
	0.870	0.868	0.867	0.862	0.860	0.857	0.856	0.854

Log n + log$(n-1)$	2.4857	2.5341	2.5798
	1.2428	1.2670	1.2899
	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
	1.1697	1.1939	1.2168

$n = \frac{20}{18}$.

		(18)	(19)					
$\bar{1}.9269$	log. .845	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
0.6394	$\frac{1}{2}$log$(n-1)$.	0.6152	0.6276	0.6901	0.7462	0.7657	0.7956	0.8217
$\bar{1}.2875$	log. $\frac{.845}{\sqrt{n-1}}$	$\bar{1}.3117$	$\bar{1}.2993$	$\bar{0}.2368$	$\bar{0}.1887$	$\bar{1}.1612$	$\bar{1}.1313$	$\bar{1}.1052$
.194	antilog.	.205	.199	.173	.152	.145	.135	.127

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50	60	70	80	90	100
1.6990	1.7782	1.8451	1.9031	1.9542	2.0000
1.6902	1.7709	1.8388	1.8976	1.9494	1.9956
0.0088	0.0073	0.0063	0.0055	0.0048	0.0044
0.0044	0.0036	0.0032	0.0028	0.0024	0.0022
$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
$\bar{1}.9313$	$\bar{1}.9305$	$\bar{1}.9301$	$\bar{1}.9297$	$\bar{1}.9293$	$\bar{1}.9291$
0.854	0.852	0.851	0.851	0.850	0.849

$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$	$\bar{1}.9269$
0.8451	0.8855	0.9194	0.9488	0.9747	0.9978
$\bar{1}.0818$	$\bar{1}.0414$	$\bar{1}.0075$	$\bar{2}.9781$	$\bar{2}.9522$	$\bar{2}.9291$
.121	.110	.102	.095	.090	.085

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Problem of Pole Stars

$$y_r = (1407 + x) C t + y_0$$

$$x_c = \frac{y'}{2(1407+x)} =$$

$$y_{80} = y_{55} + 8.8 + \frac{x}{160} \qquad x_{80} = x_{55} + \left(\frac{y_{55}}{53}\right)^2 - \left(\frac{y_{80}}{53}\right)^2$$

y is evidently at- IX, XV.

x " " " " "

x "

$$\frac{y_{55}^2 - y_{80}^2}{53^2} \qquad \frac{(y_{53} + y_{80})}{53^2} 8.8$$

8.8

53
53
159
265
2809 | 88
264 320
169

$$x_{80} = x_{55} + \frac{y_{55} + y_{80}}{320}$$

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195
~~117~~
1365
234
1599

234

1507
72
16
1595

Last Number. 1599
00 72
Class 16
Time 1507
Shortcut 1511

195
114
117
194
975
1595

1511
~~1507~~
72
16
1595

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	α Hrs. Min	δ	51	λ	88°.4	88°.9
x'	−24.6	203.3	−163.2	+57.4	−94.8	−41.8
y'	−75.5	−7.6	30.1	−26.8	−20.2	−71.7
$\frac{x'}{y'}$	.326	26.75	5.42	2.14	4.68	.583
$\tan^{-1}\frac{x'}{y'}$	18°.1	87°.9	79°.5	65°.0	77°.9	30°.2
	1 12.4	84	42m.	4h 20.0s	5h 11.6	2h 0.8s
	1 14.9	10.5	44.4	19 42.6		
x'^2	605.16	41330.89	26634.24	3294.76	8930.25	1747.24
y'^2	5700.25	57.76	906.01	718.24	408.04	5140.89
$x'^2+y'^2$	6305.41	41388.65	27540.25	4013.00	9338.29	6888.13
$\sqrt{x'^2+y'^2}$	79.4	203.4	166.0	63.4	96.6	83.0
	88° 40.6	86° 36.6	87 14.0	88° 56.6	88° 23.4	88° 37.0
	88 40.6	86 36.5	87 13.7	88° 56.6		

R.A.

α	1	14.9	88	40.6 −
δ	18	10.5	86	36.5
51	6	42.4	87	13.7
λ	19	42.6	88	56.6
88°.4	~~5~~ 4	~~11.6~~ 48.4	88	23.4
88.9	2	0.8	88	37.0 −
89.3	2	28.0	89	36.7 −
35	17	42.0		48.0
37	18	18.4		52.6
1	0	17.6		45.0 −
26	13	16.8		47.8 −
89.37	1	27.8	89	54

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1879phae.proj...485.

89°.3.	89°.35.	89°.37.	89°.1.	89°.26.	
-14.0	+11.8	+7.4	-1.15	4.0	+10.6
-18.6	+2.2	-0.6	15.0	11.5	-5.7
.753	5.37	12.3	.0767	.348	1.86
37°.0	79°.5	85°.4	4°.4	19°.2	61.°7
2h 28.0	5h 18.0s	5h 41.6s	17.6s	1h 16.8s	
196.00	139.24	54.76	1.32	16.00	112.36
345.96	4.84	00.36	225.00	132.25	32.49
541.96	144.08	55.12	226.32	148.25	144.85
23.3	12.0	7.42	15.0	12.2	12.0
89° 36.7	89° 48.0	89° 52.6	89° 45.0	89° 47.8	89° 48.0

Nov 26

	h	m		
89°.1	0	17.6	89°	45.0
α	1	14.9	88	40.6
89 26 l	1	16.8	89	47.8
88 9	2	08	88	37.0
89 3	2	28.0	89	36.7
88 4	5	11.6	88	23.4
89 35 l	5	42.0	89	48.0
8 l	6	10.5	86	36.5
89 37 l	6	18.4	89	52.6
51 Cepk	6	44.4	87	13.7
2 l	7	42.6	88	56.6

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−5	+.002	+.01
	+18.	+.32
	+19	+.03
	+13	+.03
	+43	−.05
	+50	+.35
	+31	+.68
	+57	+.48
	+74	+.41
	−98	+.03

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1879phae.proj..485.

Progress of Catalogue for Initial. Pht.

Jan 25. Southern Stars began and a work age by Phipps and ended to 10h 54.0 C.S. Cat. ended to 2h.

27 S. Stars to 13h 28.3s.

Apr. 20. Catalogue completed and checked by B.P.P. from 0 to 12 by H. and A. D.M. Mags and Dec. inserted 12 to 18h by M.A. to 70° and from 0 to 12h to ° by B.P.P.

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1879phae.proj..485.

1 Systematic Errors in R.A.

	0	2	4	6	8	10	12	14	16
85–80°	+608	+268				+409			+34
70	+153	+250	-5					+71	
60	+17	+250	+110	+97	+97	+40		+4	+34
50	+3	+36			+102 +170	+1	-58	+2	+51
40	+103	+50	+29	+73		+57	+1	+39	-17
30	+107	+65	+41		+88	+87	+64	-2	-9
20	+6	+46		-20		+45	+13		+37
10	+45	-9	+13	-2		+16	+14	+17	+19
0	-20	+47	-11	-6		+45	+14	+1	+25
-10	+14	+20	-23		+2			+9	+7

	0–6	6–12	12–18	18–24
85	+292	+46		
75	+133	-2		
65	+126	+78		
55	+13	+34		
45	+61	+100		
35	+71	+58		
25	+8	+24		
15	+16	+11		
5	+5	+10		
-5	+4	+1		

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18	20	22
~~-.887.~~		
+135	+86	
+45	+13	
+93		+62
	+44	+82
+35	+33	+36
+6	+8	+40
+7	+54	+32
+38	+34	+25
+14	+18	+40

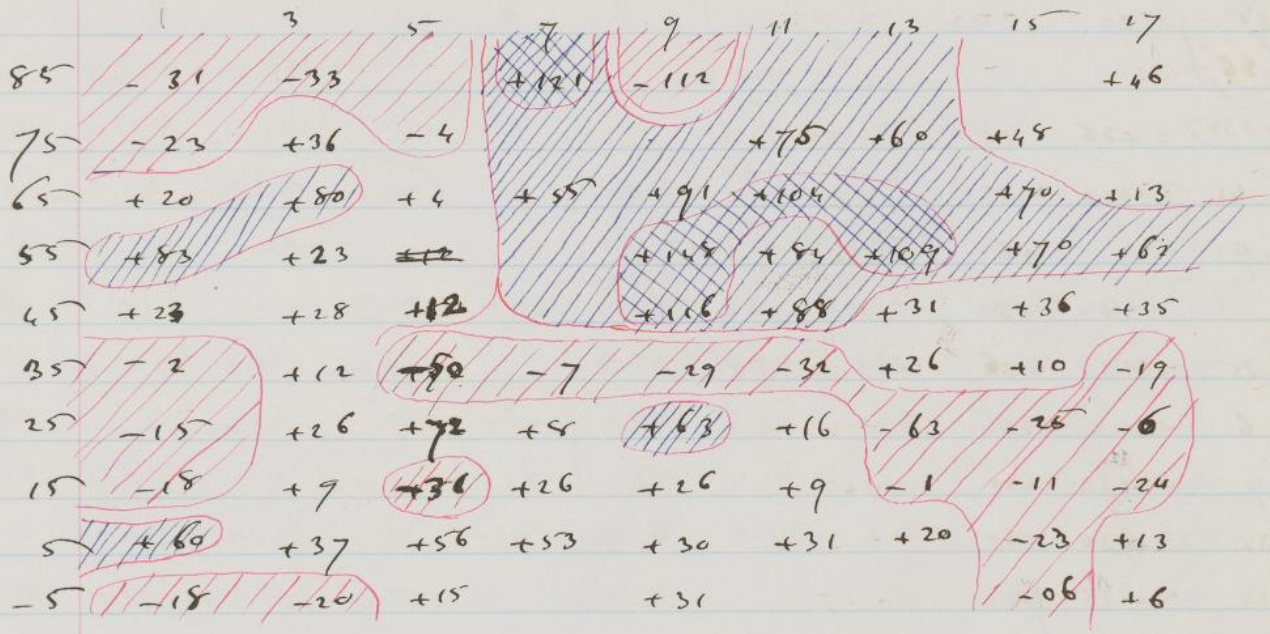
12 - 19

+438	+69	+34	-.867
+133	-7	+24	+110
+126	+78	+19	+29
+19	+57	-2	+77
+61	+100	+8	+63
+71	+87	+18	+35
+8	+24	+10	+18
+16	+11	+17	+31
+5	+10	+13	+32
+4	+2	+8	+24

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Declinations



	3	9	15	21
-5	-32	+4	+46	+16
5	+3	+75	+54	+53
15	+35	+83	+37	+72
25	+53	+116	+80	+50
35	+21	+78	+34	+19
45	-13	-12	+6	-16
55	+24	+5	-31	-29
65	-13	+20	-12	-16
75	+51	+38	+3	-5
85	-8	+31	0	-14

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19	21	23
+16		
+ 5	+121	+32
+87	+ 33	+95
+31		+64
	+23	+15
+2	+12	−47
+9	−57	−15
+3	+12	−62
+21	−16	+ 9
−10	+ 5	+27

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Systematic Errors in RA

G		No.	Σ+		Σ		Δ
-10	0	41	.643	.549	+.094	.002	
0	10	48	~~1.611~~ 1.703	~~.256~~ .345	~~.858~~	.018	
10	20	45	1.111	.244	.867	.019	
20		47	1.159	.541	.618	.013	
30		43	~~1.867~~ 2.063	~~.000~~ .196	1.867	.043	
40		40	2.318	.333	1.985	.050	
50		31	1.329	.364	.965	.031	
60		20	1.194	.062	1.132	.057	
70		14	1.443	.413	1.030	.074	
80		7	1.319	.313	1.006	.168	

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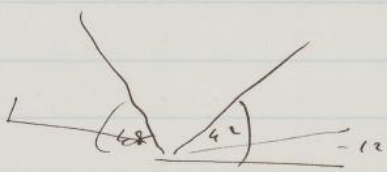
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Reduction by Absorp. of Air

0	.000		
10		.9934	6
20	.003	9730	27
30	.007	9375	62
40	.017	8843	116
50	.045	.8081	192
60	.097	.6990	301
70	.191	.5341	.466
80	.388	.2397	.760
85	.684	.0403	1.060



Lc	Alt.	S. Dec.	
55	7°	-40°	4.5
65	17	30	5.0
75	27	20	
85	37	10	

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Sat.

Heav. 6

Long. 6

No. 3.5

Ly R². 6.

2	4.5	5
4	6.5	6
7	9.5	9
3.5	6	6
3.5	6	6
4.5	7	6
2	4.5	5
26.5		
17.5		
44.0		

Eclipse Just

4.5	6	4.5
5.5	6	7.5
9.	10	5.5
6.	6	4.5
5.	5	3.5
4.5	5	7 Helg
4.5	5	6.
7.	7	7. Heav.
7.	7	45.5
6	6	8 Long.
7	7	6 %
6	6	7 Error
6	6	66.5
4.5	5	

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Plan of Placing of Rhodes H

Blk	Lot	Date	No
31	59	Jan 18	
	85-9		
	122	Feb 3	
44	104	June 7	
"	156	" 28	
	182		
45	122	July 28	

Change plan

Lots Zeus 157
Zeus Rhodes C

June 7.

1879phae.proj..485.

Zero 30° A field through B

Effect of motion in plane a zero

Data insufficient but satisfied

Zero 45° A field through B

" " " " "

Drift of Zeros.

" " " " "

Hence we may conclude that after the changes of Art. 2 a zero of 120–160 denotes that the image of B is not intercepted in plane passing through A

E. C. S. March 21. 1879

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+1.6

B.A.C. Obs. 5h 48 — 6 39

75° — 105° +15° -15°

		RA.	Dec.	
1893	5h	49.8	+9° 29′	7
1901		51.2	−14° 12′	4
1907		52.1	+12° 48′	6
1908		52.2	+ 1° 49′	~~6~~
13		52.7	+ 0° 32′	~~5.6~~
19		53.5	− 9° ~~24~~′	6½
20		53.6	−9° 34′	5½
28		55.7	+9° 39′	5
36		56.4	+10° 36	5½
44		58.6	+5° 26′	6½
45		58.6	+4° 10′	6
~~55.2~~				
56	6h	00.0	+10° 14′	6½
58		1.0	+14° 47	4½
59		1.0	+14° 56′	4½
61		1.4	+11° 10′	7
74		3.0	−11° 8′	6
90	6	5.1	+14 14	5 ~~7~~
94		6.1	− 6° 31′	5
20 12		8.9	+12° 36′	6
15		9.1	− 6° 14′	4½
17		9.6	−12° 19′	5½
22		10.4	+10° 00′	6
30		12.1	−10° 40′	6½
40		14.1	− 7° 46′	6
57		17.0	+ 3° 50′	6
59		17.4	+ 4° 40′	5½
60		17.4	+4° 40′	8

6 40

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No.	R.A.	Dec.	Mag.
2070	6^h 18.9	+11° 17′	neb.
86	21.1	+ 0 23′	6
87	21.2	− 4° 16′	6½
88	21.2	− 0° 12′	6
94	22.2	− 4° 41′	6
99	22.7	− 0° 29′	7
2105	23.2	− 6° 57′	6½
18	25.6	+ 5° 8′	7
23	26.0	+ 4° 57′	6
26	26.4	+ 7° 26′	5
29	26.7	+ 14° 16′	6½
44	28.3	+ 7° 41′	6
85	34.3	+ 10° 2′	6
89	35.0	+ 0° 38′	6
99	37.1	+ 13° 22′	5½
2206	38.5	+ 13° 03′	4
08	39.1	+ 12° 50′	6½
11	40.0	+ 8° 44′	6
16	40.8	+ 8° 11′	5
22	41.7	+ 2° 34′	5
30	43.6	+ 13° 34′	6
55	47.8	+ 13° 21′	5½

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Groll. Systems I, II

Systematic Errors depend on Dec.

Original dev. in R.A.

	No.	Σ+	Σ−	Σ	Σ/n	Δ	Δ/n
	22	345	234			+111	
−10 − 5	~~19~~	~~298~~	~~315~~			~~−17~~	+5
5	19	298	315			−17	
0	22	544	100			+444	+20
+5	26	669	245			+424	+16
10	22	585	79			+506	+23
15	23	526	165			+361	+16
20	21	515	294			+221	+11
25	26	644	247			+397	+15
30	23	1062	65			+997	+43
35	20	1001	131			+870	+44
40	21	1277	46			+1231	+59
45	~~19~~	~~1042~~	~~287~~			+755 ~~+494~~	+29
50	13	596	139			+457	+35
~~55~~	18	733	225			+508	+28
60	11	336	62			+274	+25
65	9	858	0			+858	+95
70	10	1029	171			+858	+86
75	4	414	242			+172	+43
80	2	443	0			+443	+222
85	4	876	313			+563	+141
	335	14803	3354				

335 | 11449 | 34,18

1005

1399

1340

590

335

255

.034

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Systematic Deviation in Groll. I, II in declin.

Dec.

No.

	No	Σ+	Σ−	Δ	$\frac{\Delta}{n}$	+	−
−10 − 5	22	427	431	−04	−00	8	16
5	19	377	283	+94	+05	9	13
0	24	685	191	+494	+24	11 5	5
+5	26	736	184	+552	+21	15 4	7
+10	22	678	287	+91	+04	14	8
+15	23	242	453	−211	−09	11	12
+20	21	440	283	+157	+07	13	8
+25	26	556	589	−33	−01	11	15
+30	23	295	522	−227	−10	10 3	10
+35	20	370	466	−96	−05	13	7
+40	21	555	321	+234	+11	12	8 1
+45	19	1246	90	+1156	+61	9 9	1
+50	13	844	52	+792	+61	9 3	1
+55	18	1398	71	+1327	+74	10 6	2
+60	11	535	115	+420	+38	5 3	3
+65	9	559	26	+533	+59	5 3	1
+70	10	453	33	+420	+42	4 3	3
+75	4	168		+168	+42	1 3	
+80	2		66	−66	−33	1	1
+85	4	201	64	+137	+34	2	2
	335	10465	4527				

4527
335 | 5938 | 17.702
335
2580
2345
2350
2345
500
.177

14992 | 335
1340 .447
1592
1340
2520
2345
175

13049
1005
2999 .39
3015
160 .389

.447 = mean error
.389 = reduced

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120
84

30

549
183
444
104
*
177
126
126

1943

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+ 10
+ 8
− 5
− 12
+ 7
− 3
+ 1

Σ + 26
Σ − 20
Σ 46 6.6
Δ +6 +1

a = num + $\gtrless$ m
b = " + < "
c = " −
$a+b+c=n$
d = mean cor.
$\Sigma' = (\Sigma+) - ad + (\Sigma-) + cd + bd$
$\Sigma = (\Sigma+) + (\Sigma-)$

$$Cor. = \frac{a-(b+c)}{n}$$

∴ When the mean of sets of Observations is corrected by d the sum of the deviations will be changed by

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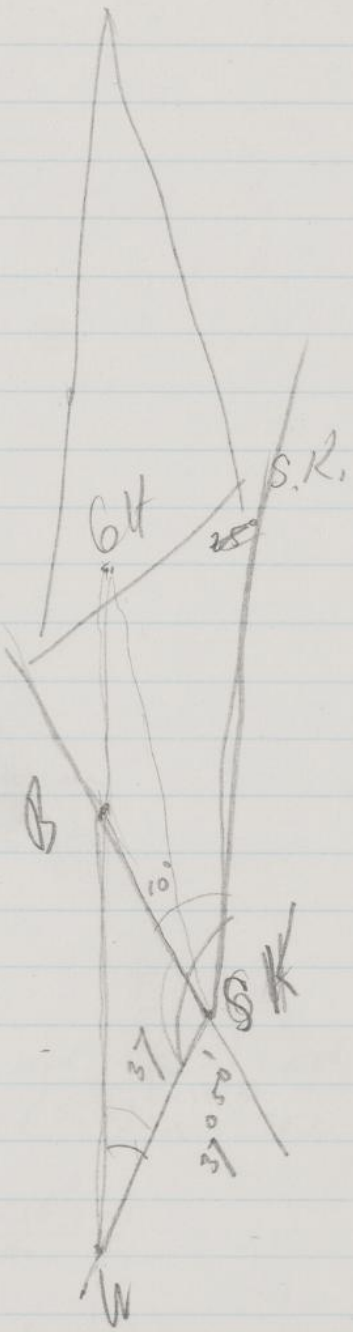
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Comparison D.M. and C.S. mag.

	Dm	C.S.			C.S. for	Dm Real
4.0	4.0					
4.1	.1					
4.2	.2	4.3	I			
4.3	.3					
4.35	.4					
4.4	.5	4.5	I			
4.5	6					
4.6	7	4.6				
4.7	8					
4.7	9	~~5.0~~	II			
4.9	5.0	4.9	II		4.9	5.0
5.05	1				5.0	5.1
5.1	2	5.1	III		5.1	5.2
5.2	3	5.3	II			
5.3	4					
5.4	5	5.4	III			
5.45	6	5.4	I			
5.5	7	5.4	I			
5.6	8	5.6	IIII	Dec. 1153 5.5 I	5.6	5.8
5.7	9	5.7	I		5.7	5.9
5.8	6.0	5.7	IIIII		5.9	6.0
2.0	2.0	1.9	I			
3.5	3.3	3.5	I			

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$y =$	.05	.10	.15	.20	.25	.30
x	.99875	.99500	.98867	.97981	.96822	.95398
α	2° 52′	5° 44′	8° 38′	11° 32′	14° 29′	17° 27′
2α	5° 44′	11° 28′	17° 16′	23° 04′	28° 58′	34° 54′
Nat Sin 2α	.09990	.19880	.29682	.39180	.48430	.57215
$\frac{\alpha}{\text{min}}$	172′	344′	518′	692′	869′	1047′
$\frac{\alpha}{10800}$	.0160 .4840	.0319	.0480 .4520	.0641	.0805 .4195	.0970
$.159 \times \text{Sin } 2\alpha$	.0159	.0316	.04742	.0623	.0769	.0709
$A = \frac{\alpha}{180°} - .159 \sin 2\alpha$	.0001 .4671	.0003	.0008 .4048	.0018	.0036 -.3426	.0061 60

$y =$	.65	.70	.75	.80	.85	.90
x	.75994	.71407	.66153	.59995	.52671	.43602
α	40° 32½′	44° 26′	48° 35′	53° 8′	58° 13′	64° 9′
2α	81° 05′	88° 52′	97° 10′	106° 16′	116° 26′	128° 18′
Nat Sin 2α	.98791	.99980	.99219	.95997	.89545	.61978
α	2432′	2686′	2915′	3188′	3493′	3849′
$\frac{\alpha}{10800}$	.2252 .2748	.2469	.2700 .2300	.2952	.3235 .1765	.3564
$.159 \times \text{Sin } 2\alpha$	.1570	.159	.1577	.1525	.1423	.0985
$A = \frac{\alpha}{180°} - .159 \sin 2\alpha$	.0682 .1178	.0879 ~~.0879~~	.1123 .0723	.1427 ~~.1426~~	.18128 .0342	.2579 2316

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.35	.40	.45	.50	.55	.60
.93677	.91648	.89298	.86603	.83517	.80003
20° 29′	23° 35′	26° 45′	30° 00′	33° 22′	36° 52′
40′ 58′	47° 10′	53° 30′	60° 00′	66° 44′	73° 44′
.65562	.73333	.80386	.86603	.91868	.95997
12 29′	14 15′	16 05′	18 00	20 02	22 12
149	~~670~~				
.1138	.1311	.1487	.1667	.1854	.2049
.3462		.3513		.3146	
.1043	.1165	.1278	.1376	.1460	.1525
.0095	.0146	.0209	.0291	.0394	.0524
.2419	~~444~~	.2235	~~290~~	.1686	522

.95	1.00
.31233	.00000
71°48′	90°
143 36′	180°
.59342	.00000
4308′	
.3989	.5000
.1011	
.0942	.0000
.3047	.5000
.0069	

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3.000	1.25	.07
2.76	1.15	.31
2.52	1.05	.53
2.28	.95	.79
2.04	.85	1.03

$$P = 3.07 + 1.337 \tan\delta \sin\alpha$$

$$\sin\alpha = \frac{P - 3.07}{1.337} \csc\delta$$

1.25 2.25

3.07 / 1337

2674 230

3960

1.25	.06
1.11	.24

.230

2.30

.18

2400 / 1337 = 1.795

1337

10630

9359

12710

12033

6770

7668 / 1337 = 5.2

320

2300

2.24

3280

2674

5060

5

1879phae.proj..485.

Computation of Precession in R.A.

	D		45°		40° 1.14			35° 1.428		
	3.07	.0								
12	3.00	.052	3.0	12.0	062	3.6	14.4	.074	4.2	16.8
11	2.76	.23	13.3	53.2	.274	15.7	62.8	.33	19.2	76.8
10		.41	24.2	96.8	.49	29.4	117.6	.59	36.2	144.8
9		59	36.2	144.8	.70	44.4	177.6	.84	57.1	228.4
8		77	50.4	201.6	.92	66.9	267.6			
7		95	71.8	287.6						
6		113								
5		131								
4		149								
3		167								
2										
1										
0										
13										
14	3.24	.128	7.4	29.6	15	8.6	34.4	18	10.3	41.2
15	3.48	.31	18.1	76.4	37	21.7	86.8	44	26.1	104.4
16	3.72	.49	29.3	117.2	58	35.4	131.6	70	44.4	177.6
17	3.96	.67	42.1	168.4	80	53.1	212.4	96	73.7	294.8
18	4.20	85	58.2	232.8						
19	4.44	103								
20	4.68	121								

	13	14	15	16	17
45°	0 39	~~1 16~~	~~1 56~~	2 49	3 50
45°		30 16	1 57	2 48	3 53
40°		~~14~~	~~1 58~~	~~2 58~~	~~4 28~~
35					

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$3.072 - 1.337 \sin x \tan \delta$

$$\frac{3.072 - P}{1.337} = \tan \delta$$

$P = 3.00$

		tan δ	
1.25	.072	.052	3.0
1.15	.312	.23	13.0
1.05	.552	.41	22.5
	.792	.59	30.5
	1.032	77	37.6
	1.272	95	43.5
	1.512	113	48.5
		131	52.6
		149	56.1
1.35		13.	7.4
1.45		31	17.2
1.55		49	26.1
1.65		67	33.8
1.75		85	40.4
1.85		103	45.7
1.95		121	50.4

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	45	0	30	1	16	1	57	2	48	3	53	
0	40		34	1	27	2	12	3	32			
	35		41	1	44	2	58	4	55			

	45	0	12	0	53	1	37	2	25	3	32	4 48
XII	40		14	1	3	1	58	2	58	4	28	
	35		17	1	17	2	25	3	48			

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Altitudes of Jupiter. 1879

	Mean Ln.	Dec.	0° HA.	5°	10°
Mar. 1	23h 9m	-14.0	5h 7	4 38	4 8
Apl.	21 34	11.7	13	46	18
May.	20 0	9.7	24	55	27
June	18 11	8.3	30	5 2	34
July.	16 18	7.9	33	4	35
Aug.	14 10	8.6	27	0	32
Sept.	11 55	10.1	23		45
Oct.	9 44	11.3	15		40
Nov.	7 37	11.7	13		38
Dec.	5 46	10.9	19		42
Jan	4 1	9.2	23		50

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☿ Rises	Sets	♀ Rises	Sets	
18 2				
16 21		17 45		16 21 – 17 45
14 36		16 55		14 36 16 55
12 41		16 27		12 41 16 27
10 45	21 57	16 27		10 45 16 27
8 43	19 37	16 50		8 43 16 50
	17 18		6 35	6 35 17 18
	14 59		5 42	5 42 14 59
	12 50		4 54	4 54 12 50
	11 5		4 28	4 28 11 5
	9 24		4 37	4 37 9 24

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Copy MS. 1879

1
2 S°
3 Instrl. C.S. Cat. of Dh. mag.
4 completed began Zone stars arranged accord to mag.
5 Wed
6 Th. Cat. Meridl Obs. 12 0 – 12 28 60
7 S 12 28 – 13 31 (140)
8 13 31 – 15 0.? (210)
9 S
10 15 0? – 16 30 (230)
11 16 30 – 17.0, – 10–11? (70, 120)
12 9–10 11–12 , 8 – 8 – 20 (60,
13 Th.
14 8 20 – 9, 0 – 0 53
15 0 53 – 3 – 13 (17, 151, 145, 40) 353
16 S
17 3h13m – 5.0
18 5.0 – 7.0
19 ———
20 Th.
21 17.0 — 19 0 ?
22 19 0 – 20 6
23 S
24 20 6 –
25
26
27
28
29 S

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Stars Culminating

Dec.	Alt.	Lat.	S. Dec.
55°	5°	52°	-43°
60	10	57	-38°
70	20	67	-28°
80	30	77	-18°
90	40	87	-8°

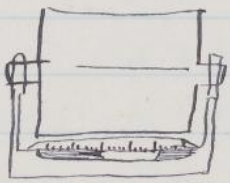
	4.0	4.1 - 4.5	4.6 - 4.9	5.0	5.1 - 5.9	6.0
75° - 90°	3	2	1	8	10	13
60 - 75°	20	8	13	17		
55 - 60	13					

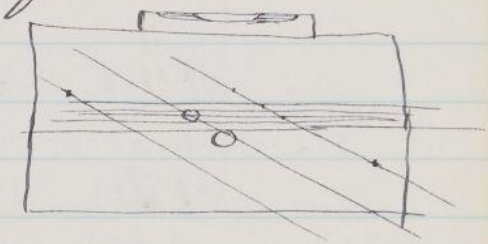
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Parallax of Mars.

The transits are being made. Shall eliminate ~~parallax~~ in practice





Mar. 15, 1879.

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Criteria for rejection of doubtful observations

8	−2	−4
9	−1	−3
11	+1	−1
13	+3	+1
22		+10
89	−1	−3
66	18	22
14	a.D. 1,33	3,7
72		
12		
6	1	5
12	22	10

Reject ~~if the~~ any observation if its deviation is (n) times the average deviation

Let R_n = sum of all readings
R_{n-1} = " " " last doubtful readings
R = doubtful

Then $R_{n-1} = R_n + \frac{R + R_n}{n-1} = \frac{n R_n - R}{n-1}$

If $R_1, R_2, R_3 \ldots R_m$ are doubtful

$$R_{(n-m)} = \frac{n R_n - (R_1 + R_2 \ldots R_m)}{n-m}$$

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Average Deviation when the mean is changed

	12	10	9	11	8	13	14
8	-4	-2	-1	-3	0	-5	-6
9	-3	-1	0	-2	1	-4	-5
9	-3	-1	0	-2	1	-4	-5
11	-1	+1	+2	0	3	-2	-3
13	+1	+3	+4	+2	5	0	-1
22	+10	+12	+13	+11	14	+9	+8
	22	20	20	20	22	24	28
12	3,7	3.3					

7	28
8	22
9	20
10	20
11	20
12	22
13	24
14	28

The av. dev. will be a min when the number of plus and minus residuals is equal. Zeros may be counted as either + or −.

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Jupiter's Satellites.

Assumed Diams. &c.

	⊙ – Diam.	Mean Dist.		Diam."
I	1.081	111.82	Jupiter's	1994.0 ✓
II	.910	177.81	"	1655.6 ✓
III	1.537	283.63	"	1117.8 ✓
IV	1.282	498.85	"	530.0 ✓
		⊙		369.8 ✓

Mean Dist Jupr = 5.2028 Bessel. log = 16 0.0 New Astr.
" Sun Diam ⊙ = 16' 1".82 " = 16' 2".0 N. Almanac

Any. " " per Just.
" " Sat I " "
II " "
III " "
IV " "

Time of Ingress = (time trav. diam. sat. + time trav. diam sun) sec. any. incidence sat. Meridian

	Time Diam Sat.				Sat Time	Obs. Time		
I	58.8	23v.3	10.9	11.2	70.0	96	120	2789
II	62.5	2v0.1	21.9	22.5	90.0	92	120	3387
III	133.5	v34.0	44.2	45.2	178.7	180	260	7107
IV	148.0	v92.0	103.3	105.6	153.6	135	300	10050

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Method of Reduction.

Compute table giving variation of light for each satellite at mean distance of Jupiter from Sun.

$$\frac{178.74}{714.8}$$

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Constant of D. E. &c.

I $I = \frac{AH}{R \sin r}$

$\frac{AH}{P}$, $\sin r$, $\log I$, I, $\log$ Light, Const.

II $\frac{abs}{\sin r}$

$\log abs$, $\sin r$, $\log I$, I $\log$ Light Const.

III $\frac{A \not{E} f}{I}$ $\sin r$ $\log I$

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Table II

1.33	9.4
	3010
	1505
0.1265	.9731
0.1505	.1505
9.9760	0.8226
9.6106	9.6609
	.9248
	~~.1617~~
3654	.4835

log F

.3654

.4835

.7474

.5879

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$134 = a + b\,1.0$		$1340 = a + b\,100$	
$146 = a + b\,1.1$		160.6	$a\,1.1\ b\,1.21$
132	1.1	146.2	1.21
65	4.1	266.5	16.81
47	6.8	319.6	46.24
25	8.3	207.5	68.89
31	8.5	263.5	72.25
$580 = 7a + 30.9b$		$1487.9 = 30.9a\ 206.61b$	

$30.9a + 206.61b$

$146 + 146 = 1606$ $\quad 133 + 132 = 146$ $\quad 65 + 41 = 260$ $\quad 47 + 6b = 376 + 28b2 = 319.6$ $\quad 83 + 25 = 166 + 415$ $\quad 85 + 31 + 85 + 255 = 263+$

$580 = 7a + 30.9b$ $\quad a = 82.8 - 4.41b$

$1487.9 = 30.9a\ 206.61b$ $\quad a = 48.2 - 6.69b$

$34.6 = -22.8b$

$b = -1.44$

a

$b = -14.4$

$82.8 + 63.5 = 146.3$ $\quad 963 + 48.2 = 144.5$

$b = -14.4$

$145 - 14.4(60 - b)$ $\quad (b - 60°)$

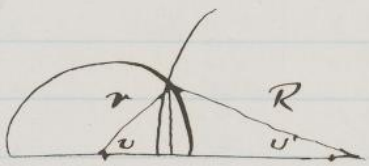
27

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Area of Segments

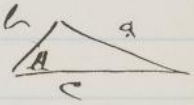


$\frac{v}{2\pi}$ $v r^2 - \frac{1}{2} r^2 \sin v \cos v$

$+ v'$

$\pi r^2 \left(v - \frac{1}{2} \sin v \cos v \right) = r^2 \left(v - \frac{1}{2} \sin 2v \right)$

$\sin A = \dfrac{2\sqrt{s(s-a)(s-b)(s-c)}}{bc}$



$a = R$ $\quad s = \frac{1}{2}(a+b+c)$

$b = 1$

$c = x$ $\quad s - a = \frac{1}{2}(b+c-a)$

$$\frac{(b+c+a)(b+c-a)(b+a-c)(a+c-b)}{4bc}$$

$\sqrt{1^2 - y^2} + \sqrt{R^2 - y^2} = a$

$x + \sqrt{R^2 - 1 + x^2} = a$

$R^2 - 1 + x^2 = (a-x)^2$

$R^2 - 1 = a^2 - 2ax$

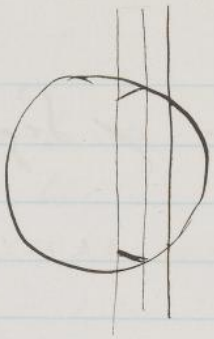
$x = \dfrac{a^2 + 1 - R^2}{2a} = \dfrac{a}{2} + \dfrac{1 - R^2}{2a}$

$R^2 = 1^2 + a^2 - 2a\cos\theta$ $\qquad \dfrac{a}{2} + \dfrac{R^2 - 1}{2a}$

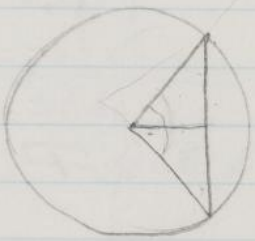
1
1.5
2.
3.
5

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Area of Segment



$\left(\frac{2\alpha}{360^\circ}\right) - \frac{1}{2}\sin 2\alpha$

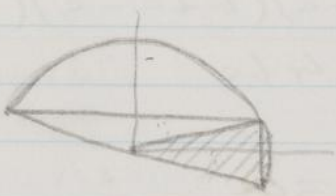
$\frac{2\alpha}{360^\circ} - \frac{1}{2\pi}\sin 2\alpha = \text{Reg. Area}$

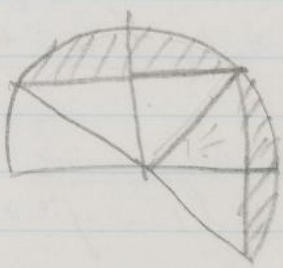
π ?

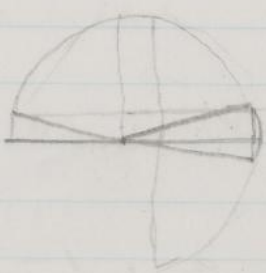
$\frac{\alpha}{10800}$	1	3.1416
	1	.6283

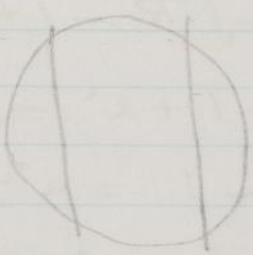
$\sin 2\alpha = ?$ Lin Cos α

$\frac{1}{2\pi} = .159$









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x	A	log A	10 − log A	10 − log A / .48		
1.0	.0000			∞		0
	.184			5.40	109	14
.9	.0158	8.2742	1.726	4.31	65	36
	334			3.66	46	50
.8	0522	8.7177	1.282	3.20	35	
	419			2.75	29	
7	.0941	8.9736	1.026	2.56	24	
	485			2.32	21	
6	.1426	9.1541	0.846	2.11	18	
	530			1.93	16	
5	.1956	9.2913	0.709	1.77	14	15
				1.63	14	13 1.6
4	.2524	9.4021	0.598	1.49	12	
				1.37	11	
3	.3120	9.4942	0.506	1.26	10	
				1.16	10	
2	.3736	9.5724	0.428	1.07	9	
				.98	9	
1	.4365	9.6400	0.360	.90	8	
				.82	8	
0	.5000	9.6990	0.301	.75	7	
				.68	7	
−1	.5635	9.7509	0.249	.62	6	
				.56	6	
2	.6264	9.7969	0.203	.51	6	
				.45	5	
3	.6880	9.8376	0.162	.40	5	
				.36	4	
4	.7476	9.8739	0.126	.31	5	
				.27	4	
5	.8044	9.9055	0.095	.24	3	
				.20	4	
6	.8574	9.9332	0.067	.17	3	
				.13	4	−.14
7	.9059	9.9570	0.043	.11	2	
				.08	3	
8	.9478	9.9767	0.023	.06	2	
				.04	2	
9	.9812	9.9918	0.008	.02	2	
				.01	1	
10	1.0000	0.0000	0.000	.00	1	

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154.20

377460
1398

301269.
20h
301471
150.74

1076.46
1.398
1077.86
53.893

964.62
657
97.119
48.56

304764
48
30524
1526

139800
27
14007
700.3

13281
48
133.29
66.64

102.18 | 6
17.03

13667 | 8
17.08

102.45 | 6
17.07

85.98 | 5
17196



1 div. = 1."78

".427

".854

47.82
14
48.0

Rumford C. A. C. I. I.

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1879phae.proj..485.

.93
.48

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Eclipses of Jupiter's Satellites.

Satellite III.

No.	ap.	mag. .75	Diff.
1	−20	−176	−156
14			
15	−95	+49	144
16	−81		
~~19~~			
20	+30		
27	−177	+64	241

7)1541
140

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Jupiter's Satellites.

Satellite I.

No.	app.	mag. 75	Diff.
2	+48	−55	103
5	+84	+24 (2.)	56
6	+112	180	68
7	+73	+120	47
8	−67	+54	121
9	−3	+108	111
11	−30	+101	131
13	+1	+109	110
17	+4	+80	84
18	+18	+120	138
21	+7	+120	113
22	−9	+60	69
23	−11	+180 (1. 2.)	191
24	~~+155~~		
26	+20	+150	130
29	+67	+90	23
31	+1	101	100
32	+10	+75	65
33	+7	+102	95
34	+34	+110	76

15 | 1731 (96 mean.
162
111
108

19 | 1831
96 171
121

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Jupiter's Satellites.

Satellite II.

No.	ap.	long. ☉	Diff.
3	+24	−80	104
4	−7	−80	73
10	−38	+130	168
25	−75	+40	115
26	+3	+72	75
30	+35	+50	15
37			6)550
			92 mean.
19	−9	97	106
20			

1015

70.0) 1.0
63.3) .9
56.7) .8
50.0) .7
43.3) .6
36.7) .5
30.0) 4
23.3) 3
16.6) 2
9.5

95
85
75
65
55
45

589

60.0 / 1.5 = 9, 8, 7

60.
1015
60.
.9

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Jupiter's Satellites.

Satellite IV.

No.	Obs.	Long. Jup	Diff.
12	-480	-240	200
35	-360	-431	71
36			271
			135

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1879phae.proj.c.485.

Conclusions of I.

Holes	12.95	9.96 mj.	12.68
Stars	13.77		
Clouds	13.54		
Thumb	13.50		

I_1

Holes	—
Stars	11.27
Clouds	11.10

	O	S	J	U	Mean
Holes		~~11.0~~			
~~Stars~~ Holes	11.03	10.95		11.15	11.04
~~Clouds~~ Stars	11.08	11.33		10.91	11.11
Clouds	10.96	11.11		11.08	11.05
					11.10

I'

Thumb	3.0	2.1

	O	S	J	U
Jup.	3.05	2.30		~~2.74~~
11 Mag.	3.21	2.72		~~2.74~~ 2.88
	3.13	2.51		2.81

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Setting Block 1

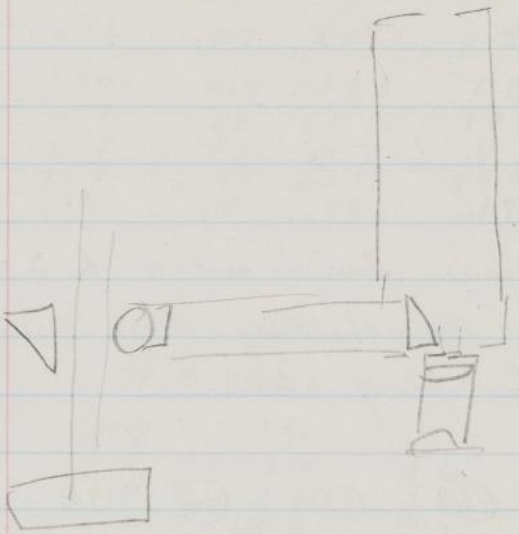
54 Lewis

Ag.		Ag.	
β	α	β	α
.117	.115	27.5	27.4

Ha Zeta = Hydrox = α Hydrox 17.8 ~~17.8~~ cms. out

of focus = Lyr St.

1879phae.proj..485.



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1879phae.proj..485.

Commenced April 19, 1879. F. W.

Checking Ledgers of Bright Stars for volume XI.

(89)

.39 −.10
.55 +.06
.59 +.10
.37 −.12

(85)

Look up No. 1737 – ε Orionis. Found not to be ε. No ledger.

Up to this point (89) the checking has been written on the margin of the proof sheets.

	(89)	(90)	(91)	(92)	(93)	(94)	(95)	(96)
Sum.	592	417	1008	12007	287	019	469	820
Mean	.49	.38	.584	10.01	2.32	602	4.47	.82
Resid. +	49	101	169	264	83	166	92	113
Resid. −	45	102	169	269	84	171	93	113
Resid. Sum	94	203	338	533	167	337	185	226
Resid. Mean ±	.08	.18	.28	.44	.14	.28	.18	.23

	(97)	(98)	(99)	(100)	(101)	(102)	(92) corrected.
Sum.	1088.	+75 −63 12	694	7.94	1710	525	12022
Mean.	6.91	+.01	5.69	5.55	93	2.53	10.02
Residuals +	129	71	101	172	50	80	268
Residuals −	133	69	97	167	55	85	270
Residuals Sum	262	140	198	339	105	165	538
Residuals Mean ±	.22	.14	.20	.24	.09	.17	.45

Ledg. (97) = Jour. 1651

Look up α Canis Majoris. AB. is in Journal & not in Ledger. B is the only one that could be measured with photometer.

(103)

3.34 +.10
3.52 +.28
2.91 −.33
2.49 −.75
3.29 +.05
3.34 +.10
3.17 −.07

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1879phae.proj.:485.

(103)	(104)	(105)	(106)	(107)	(108)	(109)	(110)
236	27	309	1024	292	591	41	93
3.24	7.07	3.28	1.85	5.29	5.59	7.03	2.05
11 1	38	218	101	59	146	260	96
11 5	39	217	97	57	145	261	93
226	77	435	198	116	291	521	189
± .23	.19	.44	.17	.12	.29	.37	.24

(111)	(112)	(113).	014)	(115).	(116)	(117)	(118)
194	902	548	544	670	31	723	301
1.19	1.90	.46	5.54	2.67	1.03	2.72	4.30
83	64	84	176	133	56	114	88
79	66	88	172	133	55	111	87
162	130	172	348	266	111	225	175
.16	.13	.14	.35	.27	.11	.22	.17

(119)	(120).	(121)	(122)	(123)	(124)	(125)	(126)
167	332	655	64 99 −35	744	527	630	627
1.42	5.33	1.65	−.03	4.74	.53	2.63	2.63
71	114	73	79	185	61	85	56
72	117	68	78	181	64	85	59
143	236	141	157	366	125	170	115
.36	.24	.14	.13	.37	.12	.17	.12

(127).	(128).	(129).	(130).	(131)	(132).	(133)
590	496	927	302	564	658	710
2.59	2.40	3.77	6.30	1.56	1.66	1.71
77	83	72	65	84	54	56
77	87	69	63	80	56	56
154	170	141	128	164	110	112
.15	.17	.12	.13	.16	.11	.11

(134)	(135)	(136)	(137)	(138)	(139)	(140)
590	128	396	997	917	454	443
1.59	2.11	3.40	4.00	.92	2.41	2.44
81	82	66	80	73	107	95
81	86	70	83	76	104	92
162	168	136	163	149	211	187
.16	.14	.14	.16	.15	.19	.19

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(141).	(142)	(143)	(144)	(145)	(146)	(147)
159	2043	799	874	612	421	929
2.12	2.04	.80	4.79	4.61	2.42	.93
137	77	93	196	124	66	70
134	74	94	191	129	70	71
271	151	187	387	253	141	141
.21	.15	.19	.35	.25	.14	.14

(148).	(149).	(150)	(151)	(152)	(153)	(154)	(155)	
1070	10217	208	177	159	205	240	1016	Result of 155 on page 131 if there are 12 obs. this is all correct.
.89	10.22	6.21	4.18	2.16	1.20	2.24	.85	
99	249	127	130	47	67	56	85	
97	252	129	133	48	62	56	88	
196	501	256	263	95	129	112	173	
.16	.50	.26	.26	.09	.13	.11	.17	

(156)	(157)	(158)	(159)	(160)	(161)	(162)
105	386	187	947	28 137 109	1055	730
5.07	5.39	5.19	5.86	-.11	1.06	3.73
336	107	183	134	79	95	169
336	111	186	133	78	100	119
672	218	369	267	157	195	238
.45	.22	.37	.24	.16	.20	.24

(163)	(164)	(165)	(166)	(167)	(168)	(169)	(170)
410	116 51 91	66 24 42	237	514	445	518	806
5.34	.09	.04	2.24	1.51	5.44	4.52	.81
148	59	40	113	50	129	126	43
146	58	38	116	46	124	128	47
294	117	78	229	96	253	254	90
.24	.12	.08	.23	.10	.25	.25	.09

Corrected.

(157)	(171)	(172)	(173)	(174)	(175)	(176)	(177)
	51	215			88		
439	100	6.21	177	327	40	766	704
	49	188			48		
5.44	-.04	163	1.18	4.23	.05	1.70	5.70
130	69	331	71	196	60	138	111
131	70		74	194	57	142	107
.26	139		105	390	117	280	218
	.12	.33	.14	.28	.12	.25	.22

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(178)	(179)	(180)	(181)	(182)	(183)	(184)	(185)
354	456	567	103	158	589	924	1182
5.35	7.46	2.52	2.10	2.66	2.59	2.92	9.98
86	160	229	55	+89	158	94	147
72	164	234	52	89	160	90	141
148	324	463	107	176	319	184	288
.15	.32	.42	.11	.18	.32	.18	.24

(186)	(187)	(188)	(189)	(190)	(191)	(192)	(193)	
915	1054	132 185 53	174	492	292	~~258~~ 258	3.88	-.01
8.91	.96	-.05	.16	1.38	1.46	3.26	3.83	-.06
164	67	147	92	88	+05	45	4.33	+.44
159	69	145	90	88	-.05	47	3.69	-.20
323	136	292	182	176	10	92	4.02	+.13
.32	.12	.27	.15	.13	±.05	.09	3.88	-.01
							3.52	-.37

1st ... used (189) 1st not used.

-.76		
+.16		+.09
+.29	254	+.22
-.14		-.21
+.19	.28	+.12
+.08	44	+.01
+.06	43	-.01
+.02	87	-.05
+.04	±.08	-.03
+.01		-.06
+.04		-.03
+.03		-.04
		44
		43
		±.08

(193)	(194)	(195)	(196)	(197)	(198)	(199)	(200)
887	420	892	377	869	963	73	~~490~~ 491
3.89	3.42	3.89	3.31	.87	3.80	4.07	4.01
70	96	72	166	227	118	95	116
73	96	70	161	228	115	93	116
143	192	142	327	455	233	188	232
.14	.19	.14	.27	.45	.19	.19	.23

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Note. The number 99 was substituted for correct no in (2)

(2) Putting in neg. reading	(201)	(202)	(203)	(204)	(205)	(206)	(207)	(208)
	382	171	150	89	183	389	107	111
-.01								
+.42	4.38	2.14	2.15	2.09	2.18	1.94	2.54	2.22
+.24	241	83	107	48	76	07	08	53
+1.66	239	80	107	49	73	06	09	52
-.16	480	163	214	97	149	13	17	105
+.62	.48	.14	.21	.10	.15	.06	.08	.21
-.72								
-.49								
-.15								
-1.49								
294								
302								

The wrong mean was given me here.	(209)	(210)	(211)	(212)	(213)	(214)	(215)	(216)	(217)
	010	325	463	314	79	015	500	665	160
	2.02	1.65	.93	.63	.39	3.10	3.50	3.67	3.16
	31	28	38	57	14	134	66	43	112
	37	28	40	58	13	129	66	48	112
	62	56	78	115	27	263	132	91	224
	.12	.11	.16	.23	.13	.26	.13	.09	.22

(97) Putting in neg. reading

Average deviation

	with 9th omitted. No 2.	Corrected. (No 1)
+.59	9,562	274
-.65	9.56	8.27
+2.10		63
+.50	Result. No. 2.	59
-.96		122
-.09	.00	.12
+.26		
+.35	+.43	
-.51	+.25	
+.43	+1.67	
-.03	-.15	
-.96	+.63	
-.29	-.71	
+388	-.48	
-387	-.14	
131 773 1.59	-1.48	
65	+298	
122	-296	
117	594	
50	±.59	
±.59		

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(218)	(219)	(220)	(221)	(222)	(223)	(224)
876	703	870	150	684	764	895
2.88	2.50	3.87	3.15	3.68	2.75	6.89
71	133	74	72	64	156	180
75	130	74	72	60	152	175
146	263	148	144	124	308	355
.15	.19	.15	.14	.12	.31	.36

(225)	(226)	(227)	(228)	(229)	(230)	(231)
865	991	598	797	839	83	454
4.79	99	4.46	.80	5.83	5.08	4.45
94	55	128	43	83	72	72
78	54	129	46	84	69	68
172	109	257	89	167	141	140
.17	.11	.20	.09	.17	.14	.14

(232)	(233)	(234)	(235)	(236)	(237)	(238)	(239)
882	637	858	972	192	502	472	666
5.88	1.49	5.72	1.97	175	3.50	2.47	4.63
120	122	74	51	.18	123	109	68
118	122	80	49	75	121	107	72
238	244	154	100	80	244	216	140
.24	.19	.13	.10	155	.24	.22	.14
				.16			

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Checks of work. Page, 88. R 51. 4.4M.

184	179	914	605	380
130	957	597	410	317
1044	2256	1511	1015	697
1522	1128	7555	5075	3485
761	5640	3778	2538	1742
8358	8230	8391	8423	4885
4179	4115	4195	4211	2442.5
20895	20575	20978	21058	12212

25.5	187	~~11.7~~	5.2	5.4
209	172	10.9	4.6	2.9
64	159	9.0	98	3
232	1795	199	49	315
1160	8985	995	245	158
4950	4977	4.98	5072	5093
2475	24885	5035	2536	25465
12375	124.42	25175	12680	127.32
		12588		

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Distinct Nebulae

~~#I~~
~~XIII~~
~~97~~

5 52, 53, 53, 57, 57
6 66
7
8 80
9 97
10
11 116
12

XII

5 ~~58~~, 56, 52, 59, 59, 59, 59, 57
6 61
7 78, 70, 70, 76 77, 74, 76 76
8 87 84 81
9
10
11
12

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Catalogue of Nebulæ

Copy from Holden's Index Nos from H I. IV V. ~~Gen Cat.~~

Arrange in order of h. nos.

Copy from Gen. Catl. RA & Decl. N Preceding.

vB, cB, &c. OO r, rr, rrr, !!!,!!!

Select from Ast. Observ., ~~Date~~ & n. of Book.

Read?

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0-4.9	.083	-.140	-.293	-.448	-.112
5.9	.070	-.153			
6.9	.221	-.002	-.155	-.242	-.060
7.9	.138	-.085	-.087	-.145	-.036
8.9	.250	+.027	-.058	-.100	-.025
9.9	.154	-.069	-.042		
10.9	.625	+.402	+.333	+.291	+.073
11.9	.619	+.396	+.798	1.131	+.283

	Cen.	Cen & E.
0 - 6.8	-.1	+.1
6.9 - 9.3	0	0
9.4 - 9.9	+.1	-.1
10.0 - 10.3	+.2	-.2
10.4 - 12.0	+.3	-.3

0	2.9	+434	+211	0 - 6.9	-.2
3.0	4.9	419	+196	7.0 15.9	-.1
5.0	9.9	338	+115	16.0 25.9	0
10.0	19.9	353	+130	26.0 40.9	+.1
20.0	39.9	28	-195	41 ∞	+.2
40.0	59.9	97	-146		
60.0	-	55	-278		

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Altitude Jupiter's dec. Eclipses
Inserted in Catalogue Mags Vol IX

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-.180

0 4.9	083				
5.0	70	153	444	.111	-.069
6.0	221	291	650	.162	-.018
7.0	138	359	747	.187	+.007
8.0	250	388	792	.198	+.018
9.0	154	404	1183	.296	+.116
10.0	625	779	2023	.506	+.346
11.0	+.619	1244			

Mag B

0 - 5.6	+.1
5.6 - 8.9	0
9.0 - 9.7	-.1
9.8 - 10.1	-.2
10.2 - 10.5	-.3
10.5 - 12.0	-.4

0	.434	391	0 - 5.9	-.4	
3.0	.419	376	5.0	13.9	-.3
5.0	338		14.0	23.0	-.2
10.0	.353		23.0	37.0	-.1
20.0	.028		37.0	61.0	.0
40.0	.097		61.0	∞	+.1
60.0	-.055				

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.5729 / 5 / .28645

11.20 / 286 / 8.34 / 1064 / 230

5366 / 11.20 / 2683 / 26.52

.5635 / .1038 / .4597 / 230

564 / 104 / 460 / 230



$$\text{lin}\tfrac{1}{2}\alpha = \frac{d\,\text{lin}\,v}{2D}$$

$$l = \tfrac{1}{2}\,\text{log m vers}\tfrac{1}{2}\alpha\, f(v)$$

$$\text{vers}\,\alpha = 1 - \text{cos}\,\alpha = \tfrac{1}{2}\,\text{lin}^2\alpha$$

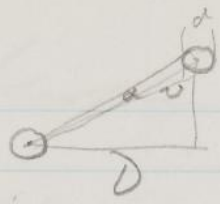
$$1 - \text{cos}^2\alpha = (1-\text{cos}\,\alpha)(1+\text{cos}\,\alpha) = \text{lin}^2\alpha = 2\,\text{lin}^2\tfrac{1}{2}\alpha$$

Since α, ~~is not~~ cannot be very large, $\text{vers}\tfrac{1}{2}\alpha$ will nearly equal $\tfrac{1}{2}\,\text{lin}^2\tfrac{1}{2}\alpha$ or $\frac{d^2\,\text{lin}^2\frac{1}{2}\alpha}{2D^2}$

6° 3°
45 9986
55 0014
14

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$$\sin \tfrac{1}{2}\alpha = \frac{d}{2\frac{D}{\sin v}} = \frac{d \sin v}{2D}$$

$$\tfrac{1}{2} \operatorname{vers} \tfrac{1}{2}\alpha$$

$$l = \tfrac{1}{8} \text{Lo}_n + \frac{2 d^2 \sin^2 v}{D^2}$$

$$\sin^2 v \left(\cos^2 \tfrac{1}{2} v\right)^n$$

$$\tan \tfrac{1}{2} v = .7071 \qquad 35°.26 \qquad .577$$

$$v \qquad 70°.5 \qquad .816$$

$$l = \tfrac{1}{8} \text{Lo}_n$$

$$\underline{d^2 \sin^2 v}$$

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.5729	.5611	.5717	.5911	.5752
2.86	2.81	2.86	2.96	2.88
8.34	8.39	8.34	8.24	8.32

Delignation
Assumed light mags
Deg. light
Ratios
~~Relative Diameters~~
~~Relative Albedo~~
Equiv. diam."
" " Kms.
" " miles
Measured diam.
Rel albedo
albedo

∠ No. Obs

∠ Av. Dec.
Prob. Error. Mag.
Equiv. dia"
" " Kms
" " miles

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Atmospheric Absorption.

Let M', M'' equal mags. of 2 stars app. equal
I', I'' " true light " " " "
α' α'' " altitudes
h = ht. homog. atmos. = Kelvin.
A = absorption " m = absorb. per Kelvin

$\log I' = .4M'$ " $\log I'' = .4M''$.

$$I' m^{h \operatorname{cosec} \alpha'} = I'' m^{h \operatorname{cosec} \alpha''}$$

$$\log I' + h \operatorname{cosec} \alpha' \log m = \log I'' + h \operatorname{cosec} \alpha'' \log m$$

$$h \log m = \frac{\log I' - \log I''}{\operatorname{cosec} \alpha'' - \operatorname{cosec} \alpha'} = \frac{.4(M' - M'')}{\operatorname{cosec} \alpha'' - \operatorname{cosec} \alpha'}.$$

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x	y	log x	log y	⅘ log x			Calc	O-C
1	9	.000	.954	.000	.954	.932	8.55	+.45
2	3	.301	.477	.401	.878	.531	3.40	+.40
3	2	.477	.301	.636	.937	.296	1.98	−.02
4	1.25	.602	.097	.803	.900	.129	1.34	+.11
5	1	.699	.000	.932	.932	.000	1.00	.00

71.97 | 158 — 632 — 877 — 790 — 870 — 790 — 800 — 790 — 100 — .455 — 456

55.91 | 158 — 466 — 931 — 790 — 1410 — 1264 — 1422 — 358

359 × 158 = 2872 + 1795 + 359 = 56722

207936 | 139876 — 68060 — 261

207936 | 124881 — 79055 — 281

124.881 — 5475 — 123406 — 351

5913 | 158 — 474 — 1173 — 1106 — 660 — 374

3600 | 1875

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Reduction of Measures of Decimas. Oct. 14, 1879

Oct. 14 diff mag.

Oct 13	2.62	13.50
17	2.55	2.64
14	2.64	16.14
	13.50	1.15
	16.14	14.99
	1.15	
	14.99	

16.14	16.14
.84	.84
15.30	

.1644
.822

14.6	14.8
4	4
5.84	5.92

439.61 | .4/4
2.64
2.64
444.89 | 116
32 | 278
124
112
128
3 | 444.89
14.89

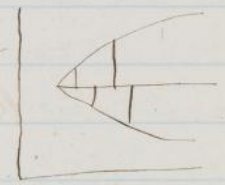
69 2,000 832,000

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Leo of Obs. Jupiters Satellite

$$y_1 = f(x_1 - x_0) + y_0$$
$$y_2 = -f(x_2 - x_0) + y_0$$
$$y_3 = f(x_3 - x_0) + y_0$$



$$y_1 + y_2 = 2y_0 + f(x_1 - x_0) - f(x_2 - x_0)$$
$$y_2 + y_3 = 2y_0 \quad f(x_3 - x_0)$$

$$f(x_2 - x_0) = f(x_1 - x_0) + a$$
$$f(x_3 - x_0) = f(x_1 - x_0) + 2a$$

$$y_1 + y_2 = 2y_0 - a \qquad y_1 + 2y_2 + y_3 = 4y_0$$
$$y_2 + y_3 = 2y_0 + a \qquad y_3 + 2y_4 + y_5 = 4y_0$$
$$y_3 + y_4 = 2y_0 - a$$

$y_2 + 2y_3 + y_4$

$\frac{1}{4}\, y_1 + 2y_2 + 2y_3 + 2y_4 + 2 = 4(n+1)y_0$

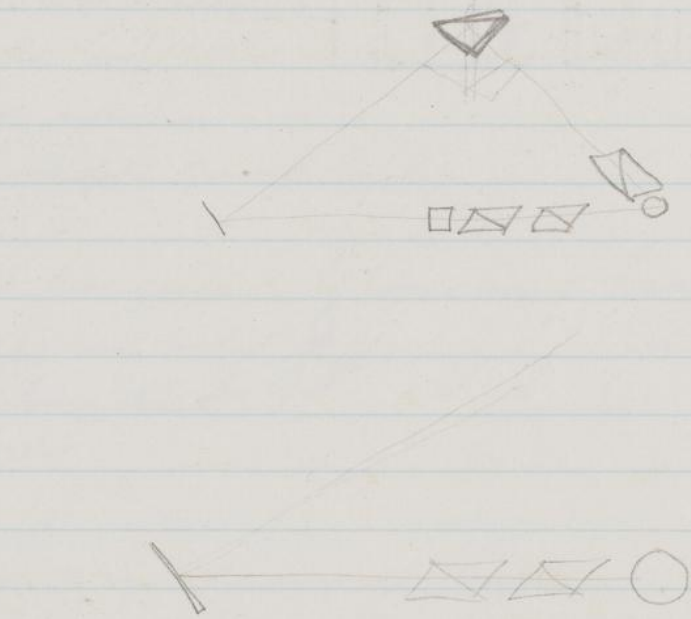
$\frac{a}{4}\, y_1 + 3y_2 + 4y_4 + 4y_5 + k_2 = 4(n-2)y_0$

3	1	3	1
5	2	4	2
7	3	5	3

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Photometer.



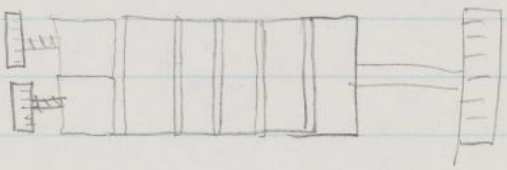
Glass.
Metals
Silver
Nickel
Copper.
Gold.
Steel.

Looking Glass
Quartz
Spar.
Diamond?

Paper.
Plaster
White Lead.
Ground Glass

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A Light transmitted in each plane by media (a) at various angles of incidence.
B Light reflected in each plane by surfaces (b) at various angles of incidence
C. Polarization caused by (A)
D. " " " (B)
E. Light transmitted by translucent bodies (c) 3 planes.
F. Light reflected diffusely by bodies (d) "
G. H. Polarization E, F. "
I Abrdn.

J Color various lenses of light (j)
K. " at with at various temperatures.
L. " various media (l)
M. " " dians.
N. " " pigments

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Sets in Table I not checked

	963	α Cap.	H	Dec 17.	
	-6	β Cap.	H		
x v	1011	Lithog.	I	Dec 22	
v	13				
v	16				
	1058	α Delphini	H	Dec 24	
v	1197	Titan.	I	" 28	
v C	1292-4	Sky	I	Jan 12	
	1301	Lapides			
	1313-18	β Androm.			
	1341	Lapides			
v C	1398-1401	Sky.	I		
C	1479 - 1480	Mars R_3			
	1496	δ Androm			
	1521-4	[illegible]			
	1647	Sirius comp.			
	1655.6	v Cass.			
v C	1672.3	- Caelati			
	1737-42	ι Orionis			
ast.	1695-8	Eva.			
	1987	α Ursae Min	I	127 cos dp	
	2066.7	η Cephei			
Ast.	3018.9	Maintz			
	3425-80	Lists of ast.			
	3584	α Lyrae			
	3597	α Ursae Min.			
	3598	ε Androm			
v	3748-51	Lapides			
v	3791-3	"			
v	3796-8				

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Refraction. Lion Vol.

1240

1606 α Leonis
3334 α Bootis

✓ 3837.8 Jupiter
✓ 3860.1 3078-80 Ge
3957.6 α Aquilae 3994.5

4382 Star a
4387 Jupiter I 4412
4705 Star b

1 Constant II Lunar Sol. Sol. III Jupiter IV Acl

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Prob. Error Relative Intrinsic Brightness

$m = 5 \log R$

$\frac{dm}{} = 5 \frac{dR}{R} .434 \qquad \frac{2.17}{R} B$

$dm = \frac{2.17\, dR}{R}$

3.6 | 55.4
3324 .065
2760 217
13

4.2 | 54
217
84

36
217
72
7.8

1879phae.proj..485.

$$-24 = a0 + 1.000b$$
$$-33 = .5a + .866b$$
$$.866a + .5b$$
$$1.000a$$
$$.866a - .5b$$
$$.5a - .866b$$
$$0a - 1000$$

$$a \sin v + b \cos v + c \sin 2v + d \cos 2v$$
$$= -a \sin v + b \cos v - c \sin 2v + d \cos 2v$$

$$2a \sin v + 2c \sin 2v = 0$$
$$a = 0 \quad c = 0$$

$$b \cos v + d \cos 2v$$

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			.1	.2	.5
0	000	+1000	.100	.200	.500
	500	+.500	.550	.600	.750
	866	-.500	.816	.766	.616
	1000	-1.000	900	800	.500
	866	-.500	.816	.766	.616
	500	+.500	.550	.600	.750
	000	+1000	.100	.200	.500
	-500	+.500	-.450	-.400	-.250
	866	-.500	.916	1.066	1.116
	1000	-1.000	1.100	1.200	1.500
	866	-.500	.916	1.066	1.116
	500	+.500	.450	.400	.250
	000	+1000	.100	.200	.500

Aug 29 16 10 23 16 -11 38
12 43
3h27 -11 38

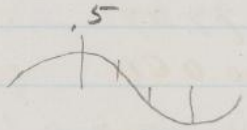
18° alt.

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1.4

.5



45
666
270
270
360
38970

1.1 + 5 − 2 .4

1.1 − 5 − 2 .4

110
465
625

1.05 + .50 − .15 = 1.40

1.05 − .50 − .15

a + b − c = 1.4

a − b − c = .5

2b = 9

a − c = .95 b = .45

a = 110

c = 15

b = .45

107

110

+.000	+15.0	125.	−0.3
+.225	+75	140	−4.5
+.390	−75	141.5	−7.2
+.450	−150	140.	−2.0
+.390	+75	141.5	+8.5
+.225	+75	140	−5.7
000	+150	125	+2.1
−225	+75	95	−7.1
−390	−75	63.5	−0.4
−450	−150	50	−3.0
−390	−75	63.5	−10.0
−225	+75	95.	−11.0
000	+150	125	

Reid

1.07 + .45 lin v + .15 cir v

+2.7
−1.5
−4.2
+1.0
+11.5
−2.7
+5.1
−4.1
+2.6
00
−7.0
−8.0

Σ+ 22.9
Σ− 27.5
500
42

10.6
51.2
20.6

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Aug 17	Oct 2	Dec 23
9.5964	9.6418	9937
.4036	.3682	.0061
1.0043	1.0043	
1.4079	1.3725	
25.58	23.56	
02	23	
25	2333	
25.33		

10
101

.063

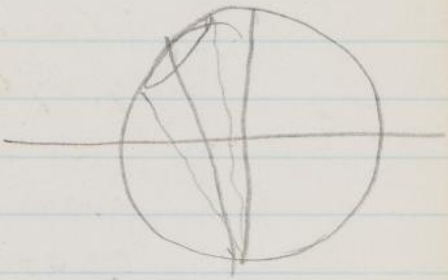
15.2 /
031
45
15.6

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Stereographic Projection

$\tan \frac{1}{2}\alpha$



r = rad.
d = dist. center

$\tan \frac{1}{2}(d - r)$
$\tan \frac{1}{2}(d + r)$

$$D = \tfrac{1}{2}\left[\tan \tfrac{1}{2}(d+r) + \tan \tfrac{1}{2}(d-r)\right]$$
$$R = \tfrac{1}{2}\left[\tan \tfrac{1}{2}(d+r) - \tan \tfrac{1}{2}(d-r)\right]$$

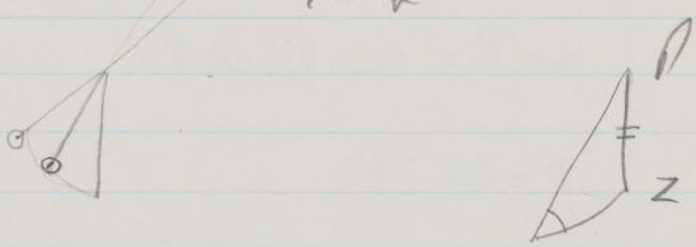


$$\tan\left(\tfrac{1}{2}d + 45^\circ\right) = \frac{\tan \frac{1}{2}d + \tan 45^\circ}{1 - \tan \frac{1}{2}a \cdot 1}$$

$$\frac{1 + \tan \frac{1}{2}\alpha}{1 - \tan \frac{1}{2}\alpha}$$

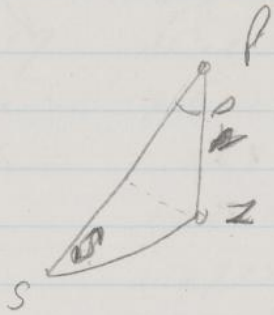
$$\frac{1+h}{1-h} + \frac{1-h}{1+h} = \frac{1+h^2}{1-h^2}$$

$$\frac{4h}{1-h^2}$$



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Given p

$z = f(p)$

$\sin P : \sin S = \sin z : \sin Z$

~~ZDz~~

$\sin ZD = \sin PZ \sin P$

$\tan PD = \cos P \tan PZ$

$\sin DS = \cot S \tan ZD$

$PS = PD + DS$

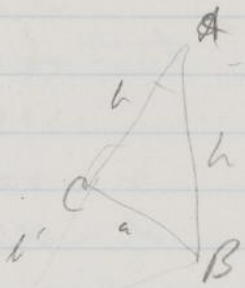
$PD = \tan^{-1}(\cos P \tan PZ)$

$DS = \sin^{-1}(\cot S \tan ZD)$

$\sin ZD = \sin PZ \sin P$

$\cos P = \tan PS \cot PZ$

$p = \tan^{-1} PS$



A, b, h

$\tan b = \cos A \tan h$

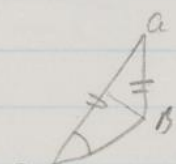
a A b

$\sin b = \cot A \tan a$



a B h

$\cos A = \tan b \cot h$





cos I

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$$\operatorname{cvs} P = \operatorname{cot} PZ \operatorname{tan} PD$$

$$PD = PS - SD$$

$$\operatorname{tan} SD = \operatorname{cvs} S \operatorname{tan} ZS$$

$$\sin PZ : \sin S = \sin ZS : \sin P$$

$$\sin ZS = \sin P \frac{\sin PZ}{\sin S}$$

C, b, c
A, b, B.

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Sept 18, 1879

Planetary Nebulae.

Light compared with Star in 2 comparison Spectrum mono. or continuous.
Diam. Transits. Double Image micrometer, Eder Micrometer.
Position compared with adjacent Stars.
Nebulae. (not to be undertaken at present)



$t \leftarrow$ Dlec $(\alpha + v)$

$t' =$

$D = t' \cos\alpha' \cos v - t' \sin\alpha' \sin v$

$D = t'' \cos\alpha'' \cos v + t'' \sin\alpha'' \sin v$

$$\frac{D - t' \cos\alpha'}{t' \sin\alpha'} = \frac{D - t'' \cos\alpha''}{t'' \sin\alpha''}$$

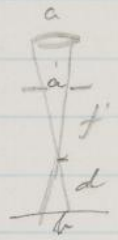
$D t'' \sin\alpha'' - t' \cos\alpha' \sin\alpha'' = D t' \sin\alpha' - t'' \sin\alpha' \cos\alpha''$

$$D = \frac{t' \cos\alpha' \sin\alpha'' - t'' \sin\alpha' \cos\alpha''}{t'' \sin\alpha'' - t' \sin\alpha'}$$

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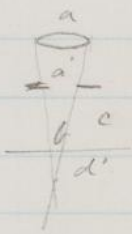
Light Eq. A, a, apertures large & small telescopes
f, f, focal " " "
b = diam ellipse out of focus
d = dist fr focus small telescope
f' = dist ellipse fr focus
a' = diam "



$a : f' = b : d$ $\quad b = a' \frac{d}{f'} = a' \frac{d}{c-d}$

$a : a' = f : c-d \quad a = \frac{a'f}{c-d}$

M = mag star
I = light " $\quad M = -2.5 \log I$



$I \left(\frac{a'f}{(c-d)A}\right)^2 \left(\frac{f}{\frac{3437}{a'\frac{d}{c-d}}}\right)^2$ $\qquad f : c+d = a : a' \therefore a = \frac{a'f}{c+d}$

$\left(\frac{af}{(c-d)A}\right) \frac{Aa'd}{(c-d)}$ $\qquad$ ~~$f \cdot f - d' =$~~

$d'+c : d' = a' : b$

$b = \frac{a'd'}{d'+c}$

Avail. aperture, $a = \frac{a'f}{c-d}$

$b = a' \frac{d}{c-d}$

$I \left(\frac{\frac{a'f}{c-d}}{A}\right)^2 = I \left[\frac{a'f}{A(c-d)}\right]^2 =$ light in ea. ellipse per equal area

$I \left[\frac{a'f}{A(c-d)}\right]^2 \left(\frac{a'd}{c-d}\right)^2 \left(\frac{3437}{f}\right)^2 = I \left[\frac{a'^2 f d\, 3437}{AF(c-d)^2}\right]^2$

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14.86	14.56
4	4
59.44	58.24
40.56	41.76
879000	617.000

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Mean Equatorial Ellipse
Measuring Machine.

$$(a^2 \sin^2 v + b^2 \cos^2 v) x^2 = a^2 b^2$$

$$[b^2 + (a^2 - b^2) \sin^2 v] x^2 = a^2 b^2$$

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Planetary Nebulae.

Bright.

No.	Date.	Hour.	Obj. Cap.	Reading.	Diff. Mag.	Adopted Mag.	Diff.	Remarks

Diam.

No.	Date.	Hour.	. . .	Mean	Diff.	Diff."

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Mars. Jup. Sat. Uran.

No. – –

Name ⊘ no Sats.

Diff & Mag. – –

Log. – –

Ratio –

av Diff.
Probable Error
Mars. Sat.
.1 P.E.
Diff. Unity Mean Dist.
.1 P.S.
Amount.
.1
Ra
.1
Nebu
.1

No
Name.
Diff & Mag
Log.
Ratio
Mass Jup = 1

Mean Dian dist

Mean dist.

1393 | 914
656 8358
7820
6965
8550

Mean diam.
Albedo
Log. Albedo

124 656
744 108
620 5248
744 656
1344 7048

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Asteroids.

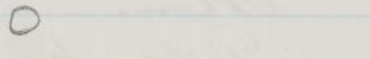
Spectrum	Weight.	Diam.

Units.

~~Asteroids~~ Rel. Weight. Spec. Diam.

Rel. Mass.

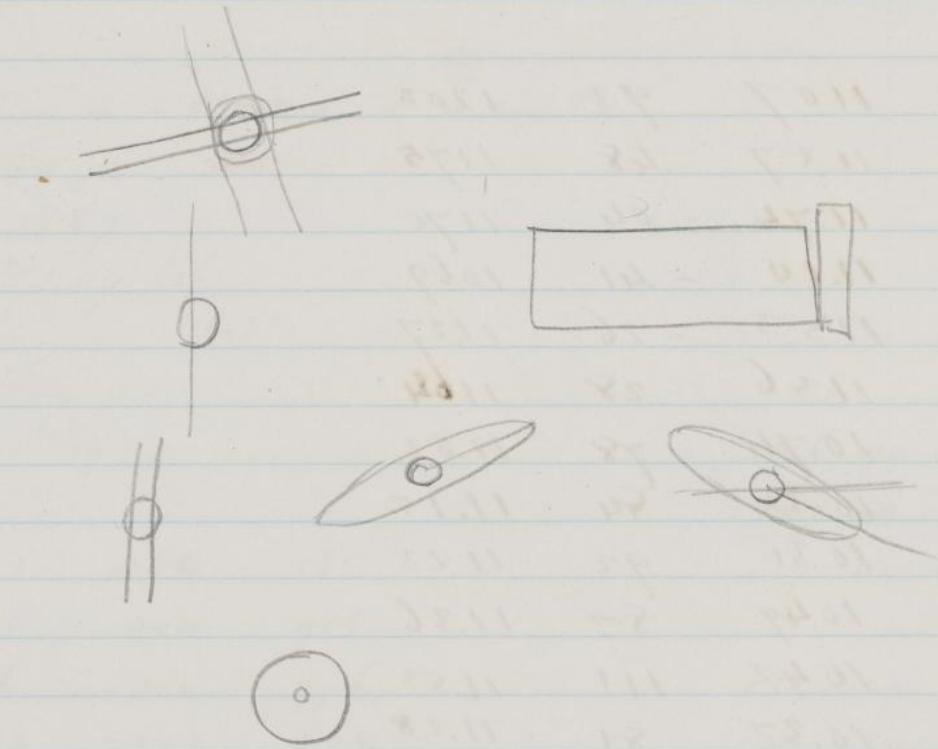






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25" 60"

0:

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11.07	.93	1200
11.27	.48	1175
11.74	-.04	1170
11.10	-.41	10.69
11.53	-.26	11.27
11.36	.28	11.64
10.74	.78	11.52
10.31	.84	11.15
10.31	.92	11.23
10.49	.87	11.36
10.42	1.11	11.53
10.37	.81	11.18

+7.02

.71

6.31

.53

624

.52

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$y = a + b \cos x + c \cos 2x$

199.78
1869
1811.09 / 16
16 — 11.32
21
16
50
48
29

-.41	+164	.164
+.11	-044	.956
+.56	-224	.776
+.93	-.372	.628
+.78	-.312	.688
+.24	-096	.904
-.26	+.104	.104
-.32	+.128	.128
-.40	+160	.160
-.35	+.140	.140
-.59	+.236	.236
-.29	+.116	.116

146 90 60 42
127 80 49
+19 +10 +11

134 145 138
131 172

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$110 + 50 \sin v + 20 \cos 2v \; [+ 10 \cos v$

	$50 \sin v$	$20 \cos 2v$	$110 + 50 \sin v + 20 \cos 2v$ Obs.	Obs.	C − O		Comp.	C − C	
0	0	+20 +10	130	146	−16	−10	136	−6	
30	+25	+10 +9	95	90	+5	−8	82	+13	19
60	+43	−10 +5	57	60	−3	−5	55	+2	11
90	+50	−20 0	40	42	−2	0	42	−2	4
120	+43	−10 −5	57	49	+8	+5	54	+3	5
150	+25	+10 −9	95	80	+15	+8	88	+7	4
180	0	+20 −10	130	127	+3	+10	137	−7	14
210	+25	+10 −9	145	134	+11	+8	142	+3	10
240	+43	−10 −5	143	145	−2	+5	150	−7	10
270	+50	−20 0	140	138	+2	0	138	+2	9
300	+43	−10 +5	143	172	−29	−5	167	−24	26
330	+25	+10 +9	145	131	+14	−8	122	+23	47
					±9			±8	29
					Σ+ = 58			+53	158
					Σ− = 52			−46	
					110			99	

204 / 26 / 1224 / 408 / 420

15 / 127 / 230 / 127 / 1030 / 1016

127 / 118

21 / 134 / 760 / 670 / 900 / 938

134 / 158

17 / 135 / 350 / 270 / 800

135 / 126

130 / 172 / 376 / 8 / 76 / 76 / 1204 / 960 / 860 / 100

21 / 131 / 131 / 790 / 586 / 40

131 / 160

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$110 + 45 \sin v + 10 \cos v + 20 \cos 2v$

Wt	$\frac{1}{1000}$			Wt.	$\frac{1}{1000}$	
$\frac{10}{146}$	= 68	7	4.0	$\frac{20}{5v}$	235.	7.6
$\frac{17}{92}$	184	19	10.3	$\frac{3v}{70}$	189.	6.1
$\frac{7}{60}$	117	12	6.5	$\frac{2v}{46}$	474.	15.5
$\frac{3}{42}$	71	7	3.8.	$\frac{1v}{8v}$	220.	7.1
$\frac{26}{49}$	420	53	28.9.	$\frac{3v}{5v}$	654.	21.2
$\frac{25}{82}$	372	31	16.9.	$\frac{3v}{6v}$	508.	16.5
$\frac{15}{127}$	118	12	6.6	$\frac{1v}{11v}$	130.	4.2
$\frac{21}{138}$	157	15	8.2	$\frac{3v}{171}$	193.	6.3
$\frac{10}{148}$	69	7	3.8	$\frac{1v}{171}$	88.	2.9
$\frac{17}{139}$	126	12	6.5	$\frac{2v}{145}$	172.	5.6
$\frac{13}{172}$	76	8	4.4	$\frac{2v}{154}$	136.	4.4
$\frac{21}{137}$	160	6	3.3	$\frac{3v}{161}$	186.	6.0
		183	97		45 lin v 30 89	99. 23

Comp.	Obs.	O-C	Comp.'	O-C'	
133	140	147	+7 ◦	140	+7	18
86	104	91	-13 ◦	102	-11	13
52	62	60	-2 ◦	58	+2	6
40	40	43	+3 ◦	35	+8	8
62	52	49	-3 ◦	49	0	3
104	86	81	-5 ◦	84	-3	11
140	120	128	+8 ◦	120	+8	10
154	136	136	0 ◦	138	-2	6
148	138	146	+8 ◦	142	+4	10
140	140	139	-1 ◦	145	-6	17
138	148	163	+15 ◦	152	+11	35
136	154	132	-22 ◦	156	-24	31
				2+41	86	168
				2-46	±7	2-46

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v		a + b lin v + c cos v + d lin 2v + e cos 2v			
0	+7	= a = .000	+ c 1.000	+ .000	+ e 1.000
30	-11	+.500	+.866	+.866	+.500
60	+2	+.866	+.500	+.866	-.500
90	+8	+1.000	.000	000	-1.000
120	0	+.866	-.500	-.866	-.500
150	-3	+.500	-.866	-.866	+.500
180	+8	.000	-1.000	.000	+1.000
210	-2	-.500	-.866	+.866	+.500
240	+4	-.866	-.500	+.866	-.500
270	-6	-1.000	000	.000	-1.000
300	+11	-.866	+.500	-.866	-.500
330	-24	-.500	+866	-.866	+.500

Normal in b

0	0b	+ 0c	+ 0d	+ 0e
-6	+.25	+.43	+.43	+25
+2	+.75	+.43	+75	-43
+8	+1.00			-100
0	+.75	-.43	-75	-43
-2	+25	-.43	-43	+25
+1	+25	+.43	-43	-25
+3	+75	+43	-75	+43
+6	+100			+100
+10	+75	-.43	+75	+43
+12	+25	-.43	+43	-25
+29				
-25				
+8	+600	.00	00	00

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$b = +1 \quad c = -4 \quad d = +1 \quad e = -3$

+7	+0	+100	+0	+100	0	0
−10	+43	+75	+75	+43	−10	+.75
+1	+43	+25	+43	−25	+2	+.75
					0	
0	−43	+25	+43	+25	0	
+3	−43	+75	+75	−43	+3	
−8		+100		−100	0	
+2	+43	+75	−75	−43	−2	
−12	+43	+25	−43	+25	+3	
					0	
+6	−43	+25	−43	−25	−10	
−21	−43	+75	−75	+43	+21	
19 Σ −87		600			Σ +29	
−41 Σ −23					Σ −22	
−22 Σ ± 14					Σ +7	

$c = -4$ minus

+7	+100
−6	+25
−2	+25
−8	+100
0	+25
−2	+25
+8	+100
−1	+25
−2	+25
+6	+100
−6	+25
−12	+25
Σ +21	600
Σ −39	
Σ ± 18	
$e = -3$	

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+37
-19
-50
-67
-61
-29
+18
+26
+36
+29
+53
+22

Item
No Obs.
Diff Mag.
Recid.
Number.
" 100.
Weight
~~Recid Number.~~
Computed Mean
Recid No. ∠Diff.
Comp Mag.
Recid Mag.
Diff Mag.

Longitude.
Mag Saturn
" Star
Number.

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+0	+37	+0	+37
-10	-16	-16	-10
-43	-25	-43	+25
-67			+67
-53	+30	+53	+30
-14	+25	+25	-14
0	-18		+18
-13	-23	+23	+13
-31	-18	+31	-~~2~~8
-29			-29
-46	+26	-46	-26
-11	+19	-19	+11
$\Sigma+$ 317	137	132	+201
$\Sigma-$ ~~26~~	100	124	97
~~53~~	37	8	104
$\Sigma+$ 317			
-53	+6	+1	+17

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	$a + b\sin v + c\cos v + d\sin 2v + e\cos 2v$			
0	+ 0	+ 1.000	000	+ 1.000
30	+ .500	+ 866	+ .866	+ 500
60	+ .866	+ .500	+ 866	- 500
90	+ 1.000	.000	000	- 1000
120	+ 866	- 500	- 866	- 500
150	+ .500	- .866	- 866	+ 500
180	.000	- 1000	000	+ 1000
210	- 500	- .866	+ 866	+ 500
240	- 866	- .500	+ 866	- 500
270	- 1.000	000	000	- 1000
300	- 866	+ .500	- 866	- 500
330	- 500	+ 866	- 866	+ 500

-25	0	- 25	0	- 25
- 40	- 20	- 35	- 35	- 20
- 64	- 55	- 32	- 55	+ 32
- 28	- 28			+ 28
- 55	- 48	+ 28	+ 48	+ 28
- 45	- 22	+ 39	+ 39	- 22
+ 5		- 5		+ 5
+ 61	- 30	- 53	+ 53	+ 30
+ 61	- 53	- 30	+ 53	- 30
+ 35	- 35			- 35
+ 44	- 38	+ 22	- 38	- 22
+ 51	- 26	+ 44	- 44	+ 26
Σ+	- 355	133	193	149
Σ-	- 355	180	172	154
Σ	- 355	- 47	+ 21	- 5
	- 59	- 8	+ 4	- 1

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Cont.

−55 Lin 2	+10 Cir 2v					
00	+10	100	+10	120	+27	23
−.28	+5	77	−23	87	+ 4	1
−.48	−5	67	−53	57	+3	5
−.55	−10	65	−65	45	−2	6
−.48	−5	67	−53	57	−8	2
−28	+5	77	−23	87	−6	14
00	+10	100	+10	120	+8	15
+28	+5	133	+33	143	−7	0
+48	−5	163	+43	153	−7	9
+55	−10	175	+45	155	−16	26
+48	−5	163	+43	153	+10	21
+28	+5	133	+33	143	−11	38
				Σ +52		160
				Σ −57		1120
						113
				109		.09
				±.09		

Sat			*	* Ecl	Δ
88	−35	18	147	126	+6
70	−17	6	91	84	−3
46	−11	48	60	55	−2
82	+37	39	43	56	+11
55	−2	20	49	51	−6
65	−22	17	81	76	−11
115	−5	33	128	124	+4
171	+28	10	136	148	+5
171	+18	28	146	154	+1
145	−10	11	139	141	−14
154	+1	17	163	160	+7
161	+18	53	132	142	−1
	Σ +102	300			34.
	Σ −102	212			37
	204				71
	±17				±6

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	−50 lin.	10 cir 20			log.		
0	00.0	+10.0	+10.0	110.0	.041	+.10	−10
10	−8.7	+9.4	+0.7	100.7	.003	+.01 −.11	−01
20	−17.1	+7.7	−9.4	90.6	.957	~~2.39~~	+.11
30	−25.0	+5.0	−20.0	80.0	~~.903~~	~~2.26~~	+.24
40	−32.~~31~~	+1.7	−30.~~34~~	69.~~36~~	.84~~33~~	~~2.10~~ −.~~4039~~	+.39
~~50~~	−38.3	−1.7	−40.0	60.0	.778	~~−.55~~	+.55
60	−43.3	−5.0	−48.3	51.7	.714	−.72	+.72
70	−~~46.~~47.0	−7.7	−~~54.~~54.7	45.~~33~~3	.65~~46~~	−.86	+.86
80	−49.~~32~~2	−9.4	−58.~~36~~6	41.34	.61~~67~~	−.96	+.96
90	−50.0	−10.0	−60.0	40.0	.602	−1.00	+.100
100	−49.~~32~~2	−9.4					
10	−~~46.~~47.0	−7.7					
20	−43.3	−5.0					
30	−38.3	−1.7					
40	−32.~~31~~	+1.7					
50	−25.0	+5.0					
60	−17.1	+7.7					
70	−8.7	+9.4					
80	0.0	+10.0	+10.0	90.0	110.0	.041	10 −10
90	+8.7	+9.4	+18.1	81.9	118.1	.072	18 −18
200	+17.1	+7.7	+24.8	75.2	124.8	.~~99~~6	24 −24
10	+25.0	+5.0	+30.0	70.0	130.0	.114	28 −28
20	+32.~~31~~	+1.7	+33.~~38~~	66.1	133.~~88~~	12~~46~~	32 −32
~~30~~	+38.3	−1.7	+36.16 ~~40.0~~	63.4	136.6	.135	34 −34
40	+43.3	−5.0	+38.3	61.7	138.3	.141	35 −35
50	+~~46.~~47.0	−7.7	+39.~~33~~	60.9	139.~~33~~	.14~~34~~	36 −36
60	+49.~~32~~	−9.4	+39.~~88~~	60.1	139.~~88~~	.146	36 −36
70	+50.0	−10.0	+40.0	60.0	140.0	.146	37 −37
80	+49.~~32~~						
90	+~~46.~~47.0						
200	+43.3						

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	Saturn	Stern
0	10.70	-.70
10	10.79	-.61
20	10.91	-.49
30	11.04	-.36
40	11.19	-.21
50	11.35	-.05
60	11.52	+.12
70	11.66	+.26
80	11.76	+.36
90	11.80	+.40
100	11.76	+.36
10	11.66	+.26
20	11.52	+.12
30	11.35	-.05
40	11.19	-.21
50	11.04	-.36
60	10.91	-.49
70	10.79	-.61
80	10.70	-.70
90	10.62	-.78
200	10.56	-.84
10	10.52	-.88
20	10.48	-.92
30	10.46	-.94
40	10.45	-.95
50	10.44	-.96
60	10.44	-.96
70	10.43	-.97
80	10.44	-.96
90	10.44	-.96
300	10.45	-.95

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Calc.	Obs	O-C
-.70	-93	-.23
-.36	-41	-05
+.12	+04	-08
+.40	+41	+01
+.12	+26	+14
-.36	-28	+08
-70	-78	-08
-88	-84	+04
-95	-92	+03
-97	-87	+10
-95	-104	-09
-88	-81	+07

$\Sigma + = 47$

$\Sigma - = 53$

100

$\pm .08$

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−	.10	10.70	+.37
+	.24	11.04	+.23
+	.72	11.52	+.22
+	1.00	11.80	+.70
+	.72	11.52	+.01
+	.24	11.04	+.32
−	.10	10.70	+.04
−	.28	10.52	−.21
−	.35	10.45	−.14
−	.37	10.43	+.06
−	.35	10.45	−.03
−	.28	10.52	−.15
Σ −	1.83		+1.25
Σ +	2.92		−1.23
	4.75		2.48
+	1.09		±.21
	+.09		

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Jupiter's Satellites

I		II		III		IV	
90	270	90	270	90	270	90	270
−.24							
−.02							
−.22							
−.17							
+.02							

90

I		II	III	IV
+	0 −			
+30	−11			
11	20			
3				
2				
46	31			

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270°

I.		II.	III.	IV.
+ z	∞ − 24			
24	2			
45	22			
4	17			
7	3			
7	33			
8	18			
15	6			
17	4			
9	1			
30	4			
28	10			
	16			
	18			
	22			
196	200			
46	31			
242 | 16	231 | 17			
16 / 82 .15	17 / 61 .14			

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Planet E. Oct 1. 1877.

30.04	24.00	17.00	16.01
9.544	30.53	.53	0
9.666	5.525	.728	

$30.04 = a\,9.666 + b$ $\quad 290.37 = a\,96.04 + 9.666\,b$

$24.00 = a\,5.525 + b$ $\quad 132.60 = a\,30.53 + 5.525\,b$

$17.00 = a\,.728 + b$ $\quad 12.38 = a\,.53 + .728\,b$

$16.01 = \quad + b$ $\quad 0.00 = 0a + .000\,b$

$87.05 = 15.919a + 4b$ $\quad 435.35 = 124.10a + 15.919\,b$

$21.76 = 3.98a + b$ $\quad 27.35 = 7.79a + b$

$5.59 = 3.81\,a$ $\quad a = 1.47$

Solution by least squares distrib. of Zeros.

~~R~~ $= 1.47\sqrt{A} + 15.91$

$A = \frac{1}{1.47}$

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9.666
3804
38664
28998
290366

5.525
24
22100
1105
13260
728
17
5096
728
12.376

539 / 381
381 147
1780 398
1524 1176
2560 1323
2667 441
58506

2176
5.85
15.91

216.09

43535 / 1592
3184 27
11695
11144
5510
4776
7340

12400 / 1592
11144 779
12660
11144
1516 0

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Lists of Stars

20" 300"



20 seconds

$\sin v' = \frac{d}{D}$

$\sin v'' = \frac{d}{D'}$

$v' + v'' = 10°$

$\sin v' \cos v'' + \sin v'' \cos v'$

$\sin v = \frac{d}{D'} \quad \sin(\alpha - v) = \frac{d}{D''}$

$\sin \alpha \cos v - \cos \alpha \sin v = \frac{d}{D''} = \frac{D'}{D''} \sin v$

$\sin \alpha - \cos \alpha \frac{d}{D'} = \frac{d}{D''}$

$\sin \alpha - \cos \alpha \tan v = \frac{D'}{D''} \tan v$

$\tan v = \frac{\sin \alpha}{\cos \alpha + \frac{D'}{D''}} = \frac{\sin \alpha D''}{D'' \cos \alpha + D'} =$

$\tan(\alpha + v) = \frac{\sin 2\alpha D''}{D'' \cos 2\alpha + D'}$

$\frac{\tan \alpha + \tan v}{1 - \tan \alpha \tan v} = \frac{\sin 2\alpha D''}{D'' \cos 2\alpha + D'}$

$D'' \cos 2\alpha \tan \alpha + D' \tan \alpha + D'' \cos 2\alpha \tan v + D' \tan v$
$= \sin 2\alpha D'' - \tan \alpha \tan v \sin 2\alpha D''$

$\tan v = \frac{\sin 2\alpha D'' - D'' \cos 2\alpha \tan \alpha - D' \tan \alpha}{D'' \cos 2\alpha + D' + \tan \alpha \sin 2\alpha D''}$

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$$\tan v = \frac{D''(\sin 2\alpha - 2\sin^2\alpha) - D'\tan\alpha}{D''(\cos 2\alpha + 2\sin^2\alpha) + D'}$$

$$= \frac{2D''\sin\alpha(\cos\alpha - \sin\alpha) - D'\tan\alpha}{D'' + D'}$$

$$r' = \frac{D''}{15\cos\delta} \qquad r'' = \frac{D''}{15\cos\delta}$$

$$\sin(\alpha + v) = \frac{d}{D'} \qquad \sin(\alpha - v) = \frac{d}{D''}$$

$$\sin\alpha\cos v + \cos\alpha\sin v = \frac{d}{D'}$$
$$\sin\alpha\cos v - \cos\alpha\sin v = \frac{d}{D''}$$

$$2\sin\alpha\cos v = 2\sin\alpha = \frac{d}{D'} + \frac{d}{D''} = d\frac{D'' + D'}{D'D''}$$

$$2\cos\alpha\, v = \frac{d}{D'} - \frac{d}{D''} = d\,\frac{D'' - D'}{D'D''}$$

$$d = \frac{2\sin\alpha\, D'D''}{D' + D''}$$

$$2\cos\alpha\, v = \frac{2\sin\alpha\, D'D''}{D' + D''}\,\frac{D'' - D'}{D'D''}$$

$$v = \tan\alpha\,\frac{D'' - D'}{D' + D''} = .10.1\,\frac{D'' - D'}{D' + D''}$$

1763
57.3

9.2463
0.7581
9.0044
2

1879phae.proj..485.

Nebular Catalog.

Spectrum.

No. Obj.	No. Gen. Cat.	Date.	Hour.	Obs.	Remarks.

Micrometer

No. Obj.	No. Gen. Cat.	Date.	Hour.	Obj.	Ass. Magn.	Read.	Diff. Magn.	Adopted Magn.	Resid. Adopted (Obs.)

Dian.

No. Obj.	No. Gen. Cat.	Date.	Hour.	Obj.	Read.	Dian.	Resid.

No. Obj.

No. for Reference
No. Gen. Catalogue
Date
Hour
Object
Assum. Mag. Object
Reading
" Zero
Diff. Magn.
Adopted Magn.
Residual.
Dian "
Resid.
Observer.
Remarks

No. for Reference
No. Gen. Cat.
Obj.
Ass. Mag. Obj. { Nights / obs.
No. obs. Obj.
Diff. Magn.
Adopted Magn.
Ass. Dec.
Rob. Dec.
Spectrum.
No. Nights ?
No. obs.
Dian ±
Mag.
Ass. Dec.
R. A.
Remarks

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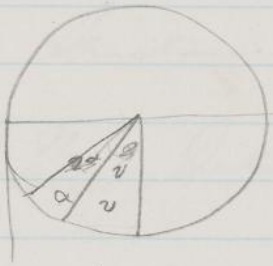
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Heights of Latitudes.

Oct, 13, 1879



$$\sin(v+\alpha) - \sin(v-\alpha) = 2 \sin v \cos\alpha$$

$$1 - \sin v \cos\alpha \begin{cases} v = 0 \\ v = 90^\circ - \alpha \end{cases}$$

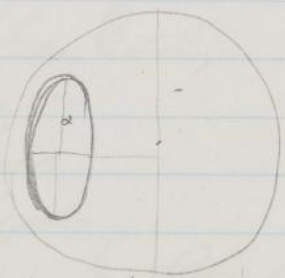
$$\sin v + \sin(\alpha - v) \quad \begin{cases} v = 0 \\ v = -\frac{\alpha}{2} \end{cases}$$

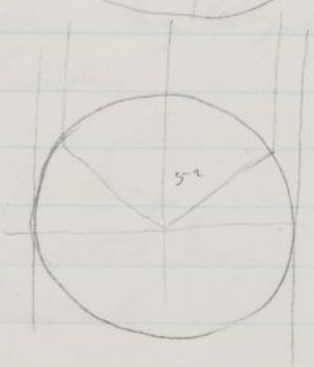
$$\sin(v+\alpha) - \sin v \quad \begin{cases} v = 0 \\ v = 90 - \alpha \end{cases}$$

$$\begin{cases} v = 90 - \alpha \\ v = 90 \end{cases}$$

π.

$$1 - \sin^2\alpha \cos v$$





140 $\frac{2}{7}$

200 | 7

2859

.286

.614 .784

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41 42
65
205
246
2665
65
273

9/27 33

24/27 .89



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Albert. M.

Oct 17 '79

Div or Rack.

No.
Date.
Objects
Setting Rack.
" Pinion
~~Interval Time.~~
Cap with
Internal Rack.
1 div = "

No. Jan Reference
Date.
Objects
Number wires.
Setting Rack
" Pinion
Time
" reduced "
Cap. with.
Internal Rack.
" Lamps
1 div
Obs

132.5
172.9
265 | 3458
265
808

1.305

57.8
74.2 | 1.29
578
1640
1156
4840
5.02

1.284

1.295

3 23.2 ft

203.2
1295

2025
1300
6075
2025
26325

4. 23.
85° 37'

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Stars in Zone 85° > 8.0

5.0	0	50	29'
7.7	1	58	2
6.5	3	52	10
6.0	4	41	45
7.0	4	55	31
6.0	5	15	6
7.5	8	13	33
7.5	10	12	8
7.5	11	20	30
7.0	13	21	31
7.0	13	45	14
7.2	15	50	18
7.5	16	6	43
7.5	18	18	40
7.5	20	21	20
7.5	23	24	37
7.8	23	30	22

398 ?

85 40 8.3
4 19 51.7 18330
33

4 20
55° 40' 41"

23h 24m 85° 37'

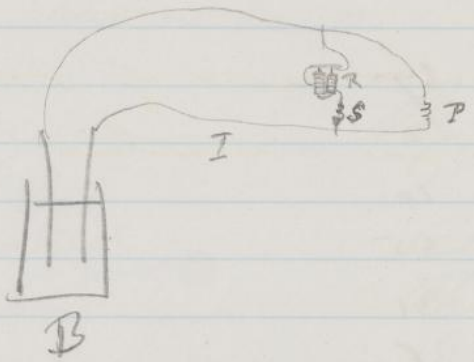
1855 '80

8 1855 18 19 7. 86 35 59. 1
1880 11 2 86 36 32
+ 30" in 25 years
33 in 25 years

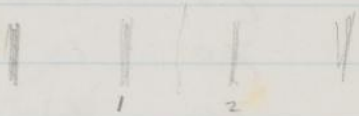
18 14 40

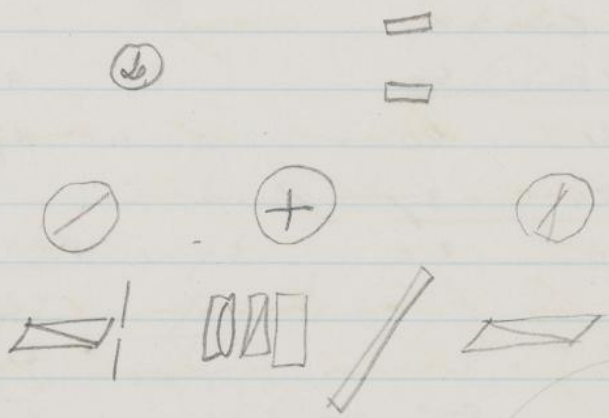
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$$I = \frac{E}{B + \frac{P(R+S)}{P+R+S}}$$





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Diameter of Mars.

Attitude

One three setting for zero of position

Five Ten	Transits over wires inclined	+5° +10°
Five Ten	" " " "	−5° −10°
Five Ten	" " " "	90°

Three setting for zero of position

Repeat with Jupiter

Make observations a three nights good each head and medium wires

Repeat with Mars at mean distance and when near conjunction

Diameter by filar micrometer. Bright field. Four setting head in each 90°

Notes on Jupiter on Satellites on faint stars

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Uncorrected
Corrected.
Diff Each year from mean.
" " catalogue " standard

$$a^2 \sin^2 v + b^2 \cos^2 v = a^2 b^2 r^{-2}$$

$$\frac{dv}{r\,dv}\left(2a^2 \sin v \cos v - 2b^2 \cos v \sin v\right) = -2a^2 b^2 r^{-3}\,dr$$

$$\frac{dr}{r\,dv} = \frac{(a^2 - b^2)\sin 2v\, r^2}{-2a^2 b^2} = \frac{(a^2-b^2)\sin 2v\; a^2 b^2}{-2a^2 b^2 (a^2 \sin^2 v + b^2 \cos^2 v)}$$

$$= \frac{\sin v \cos v (a^2 - b^2)}{a^2 \sin^2 v + b^2 \cos^2 v} = \frac{\tan v (a^2 - b^2)}{a^2 \tan^2 v + b^2} = x$$

$\tan v = t \qquad \frac{a^2}{b^2} = n$

$$x = \frac{t(n-1)}{nt^2+1} \qquad nxt^2 + x = nt - t$$

$$2nt x\,dt + nt^2\,dx + dx = n\,dt - dt$$

$$\frac{dx}{dt} = \frac{n - 1 - 2nt x}{nt^2+1} = \frac{(n-1)(nt^2+1) - 2nt^2(n-1)}{(nt^2+1)^2}$$

$$n^2 t^2 - nt^2 + n - 1 - 2n^2 t^2 + 2nt^2 = 0$$
$$-n^2 t^2 + nt^2 + n - 1 = 0$$

$$t^2 = \frac{1-n}{n-n^2} = \frac{1}{n} \qquad t = \frac{a}{b}$$

If $x = 1$, if $\quad tn - t = nt^2 + 1$

$\frac{1 - 2n - 3n^2}{4n^2}$

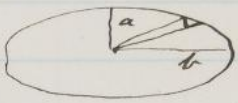
$$t^2 + \frac{1-n}{n} t + 1 = 0 \qquad \frac{1-n}{n} = 2\alpha$$
$$t^2 + 2\alpha t + \alpha^2 = \alpha^2 - 1$$
$$t = -\alpha \pm \sqrt{\alpha^2 - 1} = \frac{n-1}{2n} \pm \frac{1}{2n}\sqrt{1 - 2n - 3n^2} = \frac{n - 1 \pm \sqrt{1 - 2n - 3n^2}}{2n}$$

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Oct 21. 79 Comparative advantages of measuring Angles and Distances of Mars Satellites

Polar Equat Ellipse



$$(a^2 \sin^2 v + b^2 \cos^2 v)\, r^2 = a^2 b^2$$

$$\frac{dr}{r\,dv}$$

$$2a^2 \sin v \cos v\, dv + 2b^2 \cos v \sin v\, dv = a^2 b^2 (-2) r^{-3}\, dr$$

$$\sin 2v\,(a^2 - b^2)\, dv = \frac{-2a^2 b^2}{r^3}\, dr$$

$$\frac{dr}{r\,dv} = \frac{\sin 2v\,(a^2 - b^2)\, r^2}{-2a^2 b^2} = \frac{\sin 2v\,(a^2 - b^2)}{-2(a^2 \sin^2 v + b^2 \cos^2 v)}$$

$$= \frac{-\sin v \cos v\,(a^2 - b^2)}{a^2 \sin^2 v + b^2 \cos^2 v} = \frac{\tan v\,(a^2 - b^2)}{a^2 \tan^2 v + b^2} = x$$

$$\frac{dx}{dv} x = \frac{t(x^2 - 1)}{x^2 t^2 + 1}$$

$$\frac{dx}{dt} = \frac{(x^2 t^2 + 1)(x^2 - 1) - t(x^2 - 1)\, 2x^2 t}{(x^2 t^2 + 1)^2}$$

~~$x^2 t^2 + 1 - 2x^2 t^2 = 0$~~

~~$x^2 t^2 = 1$~~

Substituting $t^2 = \frac{1}{2}$.

$$x = \frac{\sqrt{\frac{1}{2}}\,(n-1)}{2} = \frac{(n-1)}{2\sqrt{n}}$$

$\frac{a}{b} = .2 \quad n = .04 \quad x = \frac{.96}{2 \times .2} \quad \frac{.96}{.4} = 2.4$

Ler Aug 80

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Albedo Jupiters Satellites.

Oct 27 1879.

⊙ ÷ Capella.	= 10.746	10.746
☽ ÷ Cap.	1.809	
Cap ÷ 132 Tauri	1.813	1.813
132 Tauri ÷ Sat I	0.123	.123
Cap ÷ Sat I	1.936	12.682
Jup ÷ Sat I	2.945	

Dia Jup. 36.4 1.561

1.08 0.033

1.528

Ratio areas. 3.056

.111 1.30

889 .774

3.64 / 1.08

⊙ ÷ Sat = 12.682

12.682

9.738

2.944

4π 206.000″ 412.000″ 5.615

π .54″ 9.732

5.883

11.766

12.682

0.916

9.084 .121

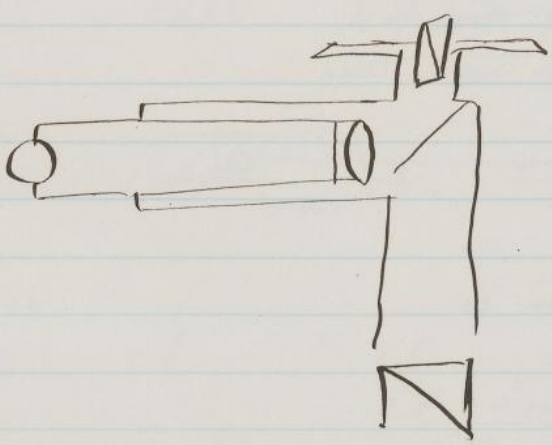
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⊙ ÷ ☽ 9.735

	5.615	5.615
	1.5611	1.260
	4.054	4.355
1.260	8.108	8.710
	9.735	9.435
		8.975 .094
		.9084 .121
		.109

162
27
189
200
14

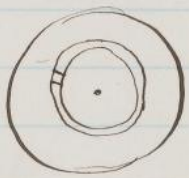


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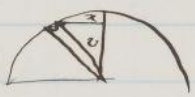
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$2\pi x \qquad x = \sin v$

$2\pi \int \sin v \cos^2 v \, dv$

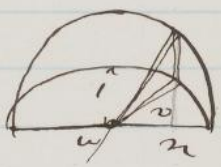


$\frac{2\pi}{3} \cos^3 v$



$\sin u = n \sin v$

$\cos u \, du = n \cos v \, dv$



$\frac{du}{dv} = \frac{n \cos v}{\cos u} = \frac{n \cos v}{\sqrt{1 - n^2 \sin^2 v}}$

$n = .2$

~~$\sin v = n \sin u$~~

~~$\cos v \, dv = n \cos u \, du$~~

~~$\frac{du}{du} = \frac{n \cos u}{\cos v} = \frac{n\sqrt{1 - n^2 \sin^2 v}}{\cos v}$~~

$\tan v = n \tan u$

$\frac{4\pi}{3+4}$

$d \frac{\sin v}{\cos v} = \frac{\cos^2 v + \sin^2 v}{\cos^2 v}$

$\frac{dv}{\cos^2 v} = \frac{n \, du}{\cos^2 u}$

$(1 + \tan^2 v) \, dv = n (1 + \tan^2 u) \, du$

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~~Oct 7 1879~~
Nov 8 1879

$$\tan v = n \tan u$$

$$\frac{dv}{\cos^2 v} = \frac{n\, du}{\cos^2 u}$$

$$\frac{dv}{du} = \frac{n \cos^2 v}{\cos^2 u} = n \cos^2 v \left(1 + \frac{\tan^2 v}{n^2}\right)$$

$$\frac{1}{n}\left(n^2 \cos^2 v + \sin^2 v\right)$$

$$\frac{1}{n}\left(n^2 + (1 - n^2)\sin^2 v\right)$$

$$\frac{dv}{du} = n + \frac{1 - n^2}{n} \sin^2 v$$

$$.2 + 4.8 \sin^2 v$$

v				u
0°	.2	.040	5.0	90°
5		.047		85
10		.064		80
15	.526	.103	4.7	75
20		.152		70
25		.215		65
30	1.400	.292	3.8	60
35		.377		55
40				50
45	2.6		2.6	45

$$\cos 2v = \cos^2 v - \sin^2 v$$

$$1 - 2\sin^2 v$$

$$\sin^2 v = \frac{1 - \cos 2v}{2}$$

.866
134
.067
48
536
268
.3216
48
4.48

$$.32 = n \sin^2 15^\circ$$

$$1.20 = n\, 30^2$$

$$n = 1.33\, v^2$$

$$\frac{4}{3000} v^2$$

1043
10
1033

30.3 hours
60
1818 min = 360

5m = 1°

1818
17820
16362
14580
14544
360

.198

280
.277

1879phae.proj..485.

Angular Motion of Descent

	Cos 2v	1 − Cos 2v	$\frac{1-\cos 2v}{n}$	2+4.8				Obs. Rate per min.
0	1.000		000	.200				.040
5	.985	.015	.008	.238	240	.233	+.005	.047
10	.940	.060	.030	.344	360	.333	+.011	.068
	.866	.134	.067	.522	560	.500	+.022	.103
20	.766	.234	.117	.763	840	.733	+.030	.151
	.643	.357	.178	1.054	1200	1.033	+.021	.208
30	.500	.500	.250	1.400	1.640	1.400	.000	.277
	.342	.658	.329	1.779		1.800	−.021	.352
40	.174	.826	.413	2.182		2.333	−.151	.432
	.000	1.000	.500	2.600		2.900	−.300	.515
50	−.174	1.174	.587	3.027				.599
			.671	3.421				.677
60			.750	3.800				.752
			.822	4.146				.821
70			.883	4.438				.879
			.933	4.678				.926
80			.970	4.856				.962
			.994	4.971				.984
90			1.000	5.000				.990

4394 / 879 — 9356 / 9263 — 9712 / 9615 — 9942 / 9843

.12 / 4 / 52 / .48

30 / 454 / 53 / 401

8 | 1818. / 227 / 563 / 280

$\frac{1-n-2n\frac{1-n}{1+n}}{1+n} = 0$

$1-n^2-2-2n$

04 / 0016 / .0848 / .9152

$\frac{.2 \times .96}{.08}$ / 24

$\frac{\sqrt{2}\ .8}{.4}$ / $2\sqrt{2}$ / .894

.08

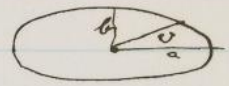
n = .04 / .0016 / .0048 / .0848

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Polar Equation of ellipse

$a^2 r^2 \sin^2 v + b^2 r^2 \cos^2 v = a^2 b^2$



$\frac{dr}{r dv} = \frac{\tan v (a^2 - b^2)}{a^2 \tan^2 v + b^2} = x$

~~$\frac{b}{a} = x$~~

$\frac{b^2}{a^2} = n \qquad x = \frac{\tan v (1-n)}{\tan^2 v + n}$

which gives the relation motion & angle and distance for any angle v

If $v = 0°$ or $90°$ $x = 0$

If $\tan v = t$

$x t^2 + n x = t - t x$. If $x = 1$

$t^2 + (n-1) t = -n$

$t + \frac{n-1}{2} = \pm \sqrt{\frac{(n-1)^2}{4} - n} = \frac{\sqrt{1 - 2n - 3n^2}}{2}$

$t = \frac{1}{2}\left[(1-n) \pm \sqrt{1 - 2n - 3n^2}\right]$

If $n = .104$ ~~$t = .4 \pm \sqrt{.48} = .093$ or $-.293$~~

$t = .48 \pm \sqrt{.9152} = .96 \pm .957$ ~~$= 1.437$ or $-.477$~~ $47.5°$ or $+6.3°$

~~Corresponding position of satellite & orbit~~

~~5.46 or 1.46 $79.6°$ or $55.6°$~~

~~$+198°$ true anom $= 106$ 53 min from conjunct.~~

~~from 280 min & 101 min~~ distances will alter more rapidly than angles between $t = .477$ and 1.437 or $.001$

Max value of x

$t^2 dx + 2tx\,dt + n\,dx = dt - x\,dt$

$\frac{dx}{dt} = \frac{1 - n - 2tx}{t^2 + n} \pm \frac{1-n}{t^2+n} - \frac{2t^2(1-n)}{(t^2+n)^2}$

$= 0$ if $t^2 - t^2 n + n - n^2 - 2t^2 + 2t^2 n = 0$

$-t^2 + t^2 n + n - n^2 = 0 \qquad t^2(n-1) + n(n-1) = 0$

$t = \pm\sqrt{n} \qquad x = \frac{\sqrt{n}(1-n)}{2n}$ ~~$n = .04$ $t = .447$ $x = .894$~~

$t = .2 \qquad v = 11.3 \qquad v = 45° \qquad x = 240 \qquad t = 2$

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$t^2 + n = t - nt$

$t^2 - (1-n)t = -n$ $\qquad \frac{1-6n+n^2}{4}$ ||

$t^2 - (1-n)t + \frac{(1-n)^2}{4} = \frac{(1-n)^2}{4} - n = \frac{1-2n-3n^2}{4}$

$t = \frac{1-n}{2} \pm \frac{\sqrt{1-2n-3n^2}}{2}$

$.48 \pm \frac{\sqrt{1-.08-.0048}}{2} = .48 \pm \frac{\sqrt{.9152}}{2}$

t

$\frac{2.7}{63.}$ 

$.04$

$x^2 \tan^2 v + t^2 n^2 = n^2(1+\tan^2 v)$

$x^2 t^2 + x^2 n^2 = n^2 + n^2 t^2$

$2x^2 t\,dt + 2t^2 x\,dx + 2n^2 x\,dx = 2n^2 t\,dt$

$t = \frac{1-n}{2} \pm \frac{1}{2}\sqrt{1-6n+n^2} = \frac{1}{2}\left((1-n) \pm \sqrt{1-6n+n^2}\right.$

$n = .04 \quad t = \frac{1}{2}\left(.96 \pm \sqrt{1-.24+.0016}\right) = .96 \pm \sqrt{.7616}$

$.96 \pm .8727$

$t = \frac{1}{2}(1.8727) \text{ or } \frac{1}{2}(.0873) \qquad .9164 \text{ or } .0436$

$\tan u = 4.582 \text{ or } .218$

$u = 77.7 \qquad 12.3$

$12.3 \quad i =$

61.5

2574
2576 $\qquad 5544$

From 62 minutes after elongation.

t 62 " before conjunction.

$x = \frac{t(1-n)}{t^2+n} = \frac{t.96}{t^2+.04} \qquad \frac{\frac{1}{t}.96}{\frac{1}{t^2}+.04} = \frac{t.96}{1+.04t^2}$

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0	$\sin i$	$\sin^2$	$\cos i$	$\cos^2 + .04$	$\frac{\cos i}{1 - \cos^2 + .04}$
0	.000		1.000	.04	2.40
11.3 15	.268	.0718	.257	.1118	2.30
30	.577	.3329	.554	.3729	1.49
45	1.000		.960	1.04 $1 + .04 \sin^2$	.92
60			.554	1.0132	.55
75				1.0029	.26
90					

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	1,2		3-5		6,7		8,9						
0	11	2	𝍸	10	1111	4	111	3	19	133	13	7	0
1	1	1	1111	4	11	2	1111	4	11	73	7	14	10
2	11	2	111	3	1111	4	11	2	11	73	7	21	18
3			𝍸 11	7	111	3	𝍸	5	15	100	10	31	26
4	𝍸 111	8	𝍸 𝍸	10	1111	4	111	3	25	166	17	48	40
5	1	1	111	3	𝍸1	6	111	3	13	86	9	57	52
6	1111	4	11	2	𝍸1	6	111	3	15	100	10	67	62
7	111	3	111	3	111	31	1		10	66	7	74	70
8	1111	4	𝍸	5	𝍸111	7	𝍸	5	21	140	14	88	81
9	11	2	11	2	111	3	11	2	9	60	6	94	91
									149	97			

2
10

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Red "
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	125	75	50
Oct 15			
Oct 15 α	1714	1715	1713
"	1706	1719	1686
"	1718	1720	1714
16 δ	1720	1700	1710
24 α	1708	1706	1712
31 δ	1722	1720	1714
"	1709	1716	1700
"	1715	1720	1707
	112	116	56
	1714	1714	1707
	14		
	7		
	35		
	1712	.856	.428

	P	S	Hz	α
P	1714			
S		1704		
F.Hz			1717	
S		1710		~~1707~~
W		"		1709
S		1709		
W				1708
P	1714			
	1714	1711		1708

14	10
4	19
17	8
9	14
44	51
11 α	138

No.	Date	Object	Remin. 25	100	150	Com.	Obs.

Ider. Observer.

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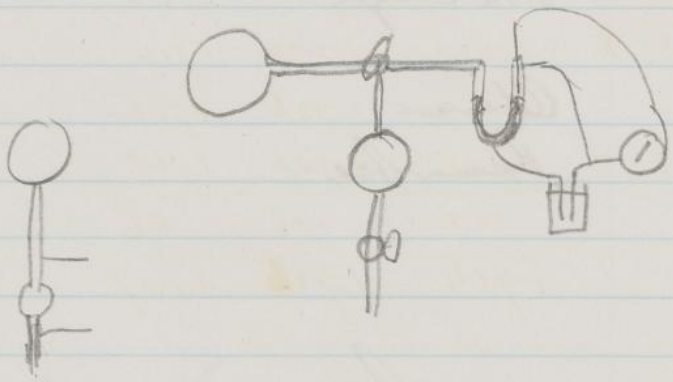
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Differential Refraction.

$$dr = \frac{dR \cos\alpha \sin\alpha}{dz}$$

$$dr = \tfrac{1}{2} \sin 2\alpha \, \frac{dR}{dz}$$





a.	b.	c.	d
Diff. C–O.	Long.	W.C.	a.c.



$\sqrt{a^2+b^2} = m$ $\quad a^2+b^2 = m^2$

$\sqrt{b^2+c^2} = n$ $\quad b^2+c^2 = n^2$ $\quad a^2-b^2 = o^2-n^2$

$\sqrt{a^2+c^2} = o$ $\quad a^2+c^2 = o^2$

$2a^2 = m^2+o^2-n^2$

$2b^2 = m^2-o^2+n^2$

$2c^2 =$

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Satellites of Mars

Details
No for Reference
Date ~~and~~ C.M.T.
Reading
Pos Angle

Observer
Remarks.

Summary.
- No for Reference
  Date C.M.T.
- Dec. Day.
- No. Settings
- Mean ~~Reading~~ Pos. Angle
  Computed Angle
  Error I
  " II
- Mean Setting
  Ave. Time
  Distances
- Observer
- Remarks

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Zeiss.
Mer Jpn Reference.
Date C.M.T.
Hour Angle
Reading
Residual
Observer
Remarks

	Detail	Summary
Decins Aug	872	195
" Dist	260	53
Posts. Aug.	288	79
Zeiss	206	
	1620	327

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Field of Locus of Micrometer.

a, b, c, d ~~m~~

ε = ~~error~~ 1 setting

n = total number intervals

$\frac{\sqrt{2}}{n}\varepsilon$ = prob. diff. between 1 interval deduced from two set intervals

Assuming in groups of n each, diff. of each group will be $\frac{\varepsilon}{\sqrt{n}}$

Accuracy 1 interval nearly $\frac{\sqrt{2}}{\sqrt{n}(n+1-n)}\varepsilon$

$\sqrt{n}(n'-n) = \text{maximum} = x$

$\frac{dx}{dn} = \frac{1}{2}n^{-\frac{1}{2}}(n'-n) + \sqrt{n} = \frac{n'-n-2n}{\sqrt{n}} = 0$

$\therefore$ max, or diff. min if $n = \frac{1}{3}(n+1)$

$n = 5 \quad \frac{\sqrt{2}}{5}\varepsilon = .2\sqrt{2}\varepsilon \quad .28\varepsilon$

$n = 5, \; n = 2, \; \frac{\sqrt{2}}{\sqrt{2}}\frac{\varepsilon}{4} = .25\varepsilon \quad = .25\varepsilon$

$n = 5 \quad n = 3, \; \frac{\sqrt{2}}{\sqrt{3}\;3} = \frac{\sqrt{6}}{9}\varepsilon \quad = .27\varepsilon$

1+6 2+5 3+6

5 3 1

$\frac{\sqrt{6}}{9} \quad = \quad = .27\varepsilon$

$\frac{\sqrt{4}}{4} \quad = .25$

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.300 = 9.16
35 = lateral wires
086 = chain wires

.01 = .32

32	35	32
44	160	86
128	96	192
128	1120	256
1408		2.75

420 | 13
39 | 323
30
26
40

2.00	7	2.86	
4.43	14	3.15	
6.63	20	3.32	
2.20	6	3.67	
4.20	13	3.23	763.

$\frac{\sin v}{v}$ = .855975

$\frac{v}{\sin v}$

693.	87'.00004	
415	52	2
271	34	1
163	20	0
304	38	1
182	23	0

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A is great.

Phot. Nt.	Diam. Nt.	Spect.
No.	No.	No.
Date.	Date.	Date.
Hour.	Hour.	Hour.
Objt. – Comparison	Micr.	Spectrum.
Adopt. Mag.	E. Diff.	Obs.
Reading A	Diam. in "	
" B	Resid.	
" Trans. – Small telescope	Obs.	M = monoc
Diff. Mag.	~~Comparison~~	C = continuous
Adopt. Mag.		
Resid.		
Obs.		

Catalogue of Nebulae

No.
E.C. Number.
R.A.
Dec.

Continuous
Monochromatic

Phot. Nt.
No.
Av. Dec.
Phot. Em.

Monoc. & Con

M – M, C. & t.
M_c –
M_m
M_n
C –

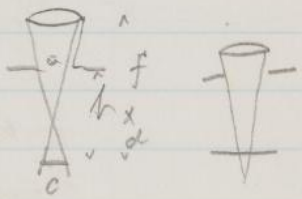
Diam.
No.
Av. Dec.
Phot. Em.

Structure.
No.

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Rich. Obst.



$a : b-d = c : d$

$c = \frac{ad}{b-d}$

~~$a : b + d$~~

$g : f = a : b-d$

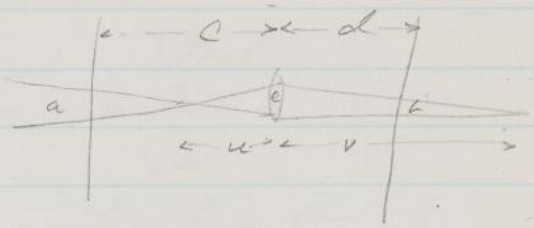
$g = \frac{fa}{b-d}$

$G : C = g : c = f : d$

6 No —
3 Date —
4 Hour —
4 Avg. value B —
4 Res Avg
4 Mean —
Diff —
Dia "
Resid
— } Minor axis
— } Minor axis
Obs —

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$$\frac{1}{u} + \frac{1}{v} = \frac{1}{c} + \frac{1}{d}$$

$a : c-u = e : u$

$b : v-d = e : v$

$a : c = b : d$

$ad = bc$

$cdv + cdu = duv + cuv$

$$\frac{c-u}{au} = \frac{v-d}{bv}$$

$bcv - buv = auv - adu$

$(a+b)uv - adu - bcv = 0$

$(c+d)uv - cdu - cdv = 0$

$$u = \frac{bcv}{av+bv-ad}$$

$$u = \frac{cdv}{cv+dv-cd}$$

~~$bc^2v^2 =$~~ $bcv^2 + bdv^2 - bcdv = adv^2 + bdv^2 - ad^2v$

$a : c-u = e : u$

$e = \frac{au}{c-u}$

$v : r-d = e : b$

$b = \frac{e(v-d)}{v} = \frac{au(v-d)}{v(c-u)}$

Given a, c, d, u, f to find b

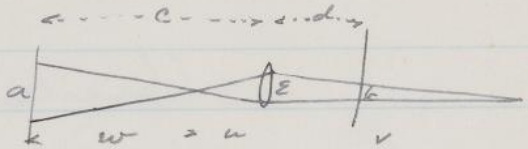
$\frac{1}{c} + \frac{1}{d} = \frac{1}{f}$

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\quad uf + vf = vu$ $\quad v = \frac{uf}{u-f}$

$$b = \frac{au\left(\left(\frac{uf}{u-f}\right)-d\right)}{\frac{uf}{u-f}(c-u)} = \frac{(au^2-afu)\left[\left(\frac{}{}\right)-du\right]\ uf-ud+fd}{ufc-u^2f}$$

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$c + u : u = a : \varepsilon$

$\varepsilon = \frac{au}{c-u}$

$\frac{1}{u} + \frac{1}{v} = \frac{1}{c} + \frac{1}{d}$, $cdv + cdu = cuv + duv$

$\therefore v = \frac{cdu}{cu + du - cd}$

$v : v - d = \varepsilon : b$ $\quad b = \frac{\varepsilon(v-d)}{v} = \varepsilon - \frac{\varepsilon d}{v}$

$b = \frac{au}{c-u} - \left(\frac{au}{c-u}\right) d \left(\frac{cu + du - cd}{cdu}\right)$

$= \frac{au}{c-u} - \frac{adcu^2}{cdu(c-u)} + \frac{ad^2u}{cdu}$

$= \frac{acdu^2 - acdu^2 + acd^2u - ad^2u^2}{cdu(c-u)} = \frac{acd^2u - ad^2u}{cdu(c-u)}$

$= \frac{ad^2u(c-u)}{cdu(c-u)} = \frac{ad}{c}$ $\therefore c : d = a : b$ Q.E.D.

$\frac{1}{v} = \frac{1}{c} + \frac{1}{d} - \frac{1}{c-w}$

$v = \frac{cd(c-w)}{(c+d)(c-w) - cd}$

$\frac{v-d}{v} = \frac{cd^2 - (cd + d^2)(c-w)}{cd(c-w)}$

$= c$

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Variation of Light of Jupiter's Satellites

$x^2+y^2=r^2 \qquad \pi r^2 = 1$



$A = f(x)$

$A \sin\alpha \, dx$

$\left(\frac{2a}{\pi} - \frac{1}{2}\operatorname{Rsin} 2\alpha\right)$

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Method of Reduction of Jupiter's Satellites.

Assume approx. time for transit near zero & disappearance



$$R = R_a + \frac{d\Delta R}{dt} t$$

$$t = \frac{R - R_a}{\frac{d\Delta R}{dt}}$$

$$\frac{d\Delta R}{dt} t = R - R_a$$

$$t = \frac{\Sigma R - \Sigma R_a}{\Sigma \frac{d\Delta R}{dt}}$$

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23.36	71.72
24.48	74.88
25.60 +	78.16
26.80 +	81.52
28.04	85.04
29.36	88.68
30.72	92.40 +
32.16	96.28
33.64	100.28
35.20 +	104.36
36.84	108.60 +
38.56	112.96
40.32	117.40 +
42.20 −	121.96
44.12	126.64
46.16	131.40 −
48.28	136.24
50.48	141.20 −
52.76	146.20 −
55.16	151.28
57.68	156.44
60.24	161.60 −59
62.96	166.84
65.76	172.08
68.68	177.36

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2.0	177.4	
1	177.3	172.1
2	172.0	166.9
3	166.8	161.67
4	161.6	156.5
5	156.4	151.3
6	151.2	146.2
7	146.1	141.2
8	141.1	136.3
9	136.2	131.4
3.0	131.3	126.7
1	126.6	122.0
2	121.9	117.5
3	117.4	113.0
4	112.9	108.7
5	108.6	104.4
6	104.3	100.3
7	100.2	96.3
8	96.2	92.5
9	92.4	88.7
40	88.6	85.1
1	85.0	81.5
2	81.5	78.2
3	78.1	74.9
4	74.8	71.8
5	71.7	68.7
6	68.6	65.8
7	65.7	63.0
8	62.9	60.3
9	60.2	57.7
5.0	57.6	55.2
1	55.1	52.8
2	52.7	50.5
3	50.4	48.3
4	48.2	46.2
5	46.1	44.2
6	44.1	42.2
7	42.1	40.4
8	40.3	38.6
9	38.5	36.9
60	36.8	35.3
1	35.2	33.7
2	33.6	32.2
3	32.1	30.8
4	30.7	29.4
5	29.3	28.1
6	28.0	26.9
7	26.8	25.7
8	25.6	24.5
9	24.4	23.4
7.0	23.3	22.4

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Stellen Spectra.

λ			1st Diff.	log λ	4th Diff.	λ − 3880	
3699		1	9	3.56805502	.95	198	505
3708		2	10	5690 5492	1.00	207	
3718		3	8	5702 5480	.90	217	461
3730		4	15	5716 5466	1.18	229	
3745		5	25	5733 5449	1.40	244	410
3768		6	25	5762 5420	1.40	269	
3795		7	41	5791	1.61	294	340
3835		8	53	5838	1.72	335	
3887		9	78	5897	1.89	388	258
3966	3968 H	3968	3955 10	4 134	5984	2.13	499
4100	4101 2	4101	4080 11	63240	6128	2.38	600 166
4340	G 4307 40	43312	42554		6375		840 119
			4580 13	3			
4861	4861	5080	14	2	.1182		1361 73.5
		5040	15				
3968 H	3962 +6		16				
4101 2	4089 +12		17				
4340 G.	4344 −4	C 6562	6580	181			
4861							
5004	5708 −104						
6562 C	6636 −74						

6562 − 4861 = 1701

6562 − 3580 = 2982

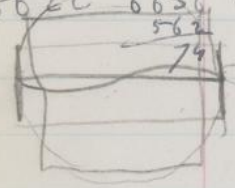
1528 / 2 = 764

3580 / 1281 | 1528 / 1281 / 2470 / 2561 / 11490 / 1.2 / 1.2

2982 | 1528 / 149100 / 370 / 2982 / 11490 / .5013

6636 / 64

3580 / 1020 / 4600



3717 3769 3888 4307

187 220 348 767

167 200 328 747

3580 / 1528 / 1528 / 6636

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λ − 3160		3580		360	3580		n	53n		Comp	O-C
538	186	138	725	1020	118	847	16	26	115	3695	+3
547			88		127	787	15	24	125		−2
537	180	1	637	855	137	730	14	22	135		−2
569			106		149	671	13	20	150		+1
584	171		543	694	164	610	12	18	167		+3
609			116		189	529	11	16	184		−1
634	158		427	515	214	487	10	14	214		0
675			122		255	392	9	12	250		−5
728	137		305	347	308	325	8	10	300		−8
806			120		386	259	7	8	375		−11
940	106		185	200	520	192	6		500	4080	−2
1187	87		134	135	727 760	138 132	5		600	4180 4330	−10
			48				4				
							3			4580	
1701	89		88	79	1281	78		2½	1500		+29
			85								
							2			5080	+40
3402	29		33	34	2982	33	1		3000	6580	+18
									1	6580	
									2	5080	
									4	4330	
									6	4080	

$\frac{1}{\lambda - 3580} = a\,n$

$\frac{1}{\epsilon} - \frac{1}{3} = \frac{1}{12}$

$\lambda = 3580 + \frac{3000}{n}$

3000 / 2.5
1200
3580
4780

$\lambda = 3580 + \frac{3000}{n}$

3000 / 26
26
40
n
115
138

3000 / 18
18
120
4320
167

3000 / 214
214
60
n 14
14

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$x \quad \lambda$

$x + a = (\lambda + b)^n$

$\frac{dx}{d\lambda} = (\lambda + b)^{n-1} = X$

$\log X = (n-1) \log (\lambda + b)$

$\frac{2}{6562 - m} = \frac{1}{4861 - m}$

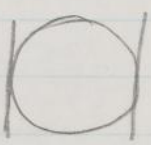
$9722 - 2m = 6562 - m$

3160

$3402 \qquad 1701$

4307
3160
1147

$3698 - m = \frac{1}{2}\ 3835$
3698
137
3561



$\lambda - a = \frac{b}{m}$

$d(n-1) = m\lambda \qquad \lambda = \frac{d}{m}(n-1)$

$d(n-1) - am = b$

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$$\frac{n-1}{n} = \frac{m}{d}\lambda$$

$$n - 1 = A + \frac{B}{\lambda^2}$$

$$\frac{1}{n} = \frac{d - m\lambda}{d}$$

$$n = \frac{d}{d - m\lambda} = A + \frac{B}{\lambda^2} = \frac{A\lambda^2 + B}{\lambda^2}$$

$$d\lambda^2 = Ad^2 - Am\lambda^3 + Bd - Bm\lambda$$

$$\lambda - a = \frac{b}{m}$$

$$d(n-1) = m\lambda \qquad (n-1) = \frac{m\lambda}{d}$$

$$n\pi + a_n = m\pi$$

$$m\lambda + a = m'\pi$$

1312 77 3694

13134 37

1114 35.5

203

180

$$\lambda - a = \frac{b}{m} = \text{Obs. relation}$$

$$d\left(\frac{n-1}{n}\right) = m\lambda$$

$$1 - \frac{1}{n} = \frac{m}{d}\lambda$$

$$\frac{1}{n} = \frac{d - m\lambda}{d}$$

$$n - 1 = \frac{d + m\lambda}{d - m\lambda}$$

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D' 524
h 518 533
508 573
γ 486 655

$\frac{10}{32}$

420 = ε − γ.

152
76 1551
579 147
1113
556

a Adj. −13 = −36
" −15 = −40
Obs. −6 = −14

H 3968
h 4101
G 4340
500.4
495.7
γ 4861 4860

1528
764
509
382
306
255
218
191
180
153
139
127
118

$\lambda = 3580 + \frac{3000}{n} + \frac{40}{n}$

$3580 + \frac{3030}{n}$

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$3580 + \frac{1528}{n}$

$3580 + \frac{3056}{n}$

		O	C	O-C		O-C		
13		3699	3695	+4	-3	+1	3697	+2
12		3708	3705	+3	3	0	3707	+1
11		3717	3715	+2	4	-2	3718	-1
10		3730	3730	0	4	-4	3733	-3
9		3745	3747	-2	4	-6	3750	-5
8		3768	3768	0	5	-5	3792	-4
7		3795	3794	+1	5	-4	3798	-3
6		3834	3830	+4	6	-1	3834	0
5		3887	3880	+7	35 7	0	3886	+1
4	H	3968	3955	+13	42 9	+5	3962	+6
3	h	4101	4080	+21	42 11	+11	4090	+11
2	G	4340	4330	+10	20 16	-5	4345	-5
			4580		139			
1			5080	+40	35	44	5108	$\Sigma+=21$
		4861				04	5094	$\Sigma-=21$
		6562	6580	-18		+17	6608	± 42
						-27		.03

61
-2
± 5

$E = a + \frac{h}{n} - 4$

6s 3580 / 1514 / 5094

3580 / 2019 / 55

1528

3028 | 35

3056 | 26 / 118

26 / 45 / 26 / 196 / 182 / 14

3580 / 3698

306 / 3580 / 3886

3750 / 3580 / 170

3733 / 3580 / 153

5636

3056 / 1528 / 3580 / 5108

3056 / 3580 / 6636

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$$a + \frac{b}{n} - R = \varepsilon$$

13	$a + .08b$	$- 4 =$	$.01b$	$-.32$	2
12	$.08$	$- 3 =$	$.01$	$- .24$	2
11	$.09$	$- 2$	$.01$	$- .18$	3
10	$.10$	0	$.01$	0	3
9	$.11$	$+ 2$	$.01$	$+ .22$	3
8	$.12$	0	$.02$	0	4
7	$.14$	$- 1$	$.02$	$- .14$	4
6	$.17$	$- 4$	$.03$	$- .64$	4
5	$.20$	$- 7$	$.04$	$- 1.40$	6
4	$.25$	$- 13$	$.06$	$- 3.25$	7
3	$.33$	$- 21$	$.11$	$- 6.91$	9
2	$.50$	$- 10$	$.25$	$- 5.00$	14
	$12a + 2.09b$	$- 65 = 0$	-2.58	17.90	

$2.09a + .58b - 17.9 = 0$

$a + .17b - 5.4 = 0$

$a + .28b - 8.5 = 0$

$.11b = 3.1$

$b = 28$

$11a + 1.59b - 55 = 0$

$1.59a + .33b - 12.9 = 0$

$a + .14b - 5 = 0$ $\quad -1 + 6.2 - 5 = 0$

$a + .21b - 8.1 = 0$ $\quad -1 + 9.2 - 8.1 = 0$

$.07b = 3.1$

$b = 44.$

$12a + 58.52b - 65 = 0$

$2.09a + 16.24 - 17.4 = 0$

$a = -1$

$a = \frac{6.48}{12} = .54$

$a \sim$

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$\lambda = 3580 + \frac{1528}{n}$

3056
3580
6636

D = diam. theirs

V = velo. in trans.
v = " " sphere





$D(v - V) = n\lambda$

$DV(n-1) = n\lambda V$

$DV(n-1) = n\,3580 + \frac{n\,1528}{n}$

$\lambda = a - \frac{b}{na} = \frac{an - b}{n}$

$n\lambda = c$

$n\lambda = an - b$

$an - b = c$

$DV(n-1) = n\lambda$

$\lambda = a - \frac{b}{n}$

$\lambda = a - \frac{b\lambda}{DV(n-1)}$

$(n-1)DV = \frac{a - \lambda}{b\lambda}$

$n - 1 = \frac{ab\lambda - b\lambda^2}{DV} = a + b\lambda - b\lambda^2$

$D(n-1) = n\lambda$

$\lambda = a - \frac{b}{n}$

$D(n-1) = na - b$

$n\lambda = an - b$

$n = \frac{b}{a - \lambda}$

$n = 1 + \frac{n\lambda}{DV}$ $D(n-1) = \frac{b\lambda}{a-\lambda}$

$ac = c\lambda = b\lambda$

$DV(n$

$n - 1 = \frac{b}{D}\,\frac{\lambda}{a-\lambda}$

$\frac{\lambda}{a-\lambda} = \frac{\frac{1}{2}}{a - \frac{1}{2}}$ $\frac{1}{an-1}$

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V = velocity of wave

v = " " ether

$V = v\,n$

D = diam ether [illegible] v = dist

$m\lambda =$

$$\frac{D}{V} = \frac{D - m\lambda}{v} \quad \frac{D}{v} - \frac{m\lambda}{V}$$

$$D = Dn - m\lambda$$

$$m\lambda = D(n-1)$$

$$\lambda = a - \frac{b}{m}$$

$$(m+c)\lambda = D(n-1) \qquad \lambda = a - \frac{b}{n}$$

$$\lambda = a - \frac{b\lambda}{D(n-1)}$$

$$a - \lambda = \frac{b\lambda}{D(n-1)} \qquad D(n-1)\,a - D(n-1)$$

$$n - 1 = \frac{b\lambda}{(a-\lambda)D} + 1$$

$$n = \frac{aD - \lambda D + b\lambda}{(a-\lambda)D} = \frac{[illegible] + f\lambda}{a-\lambda}$$

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$\lambda = a + \frac{b}{n}$

$3699 = a + \frac{b}{13}$

$3795 = a + \frac{b}{7}$

~~$5561 = a + 1$~~

$5004 = a + b$

$1305 = \frac{12}{13} b$

$1209 = \frac{6}{7} b$

1	1410	5004
2	705	4299
3	570	4164
4	352	3946
5	282	3876
6	225	3819
7	201	3795
8	176	3770
9	157	3751
10	141	3735
11	128	3722
12	118	3712
13	108	3702

1305 | 13 → 3715, 1305, 16985 | 12 → 1414

1209 | 7 → 2015, 7, 14105

$108 = a + b$

$0 = a + \frac{b}{13}$

$108 = b$

$-8 = a$

5004 − 1410 = 3594

$\lambda = 3594 + \frac{1410}{n}$

$n = a + \frac{b}{\lambda^2}$ $\qquad D(n-1) = Da - D + \frac{b}{\lambda^2}$

$n\lambda = D(n-1) = a + \frac{b}{\lambda^2}$

$n = \frac{a}{\lambda} + \frac{b}{\lambda^3}$ $\qquad \frac{a\lambda^2 + b}{\lambda^3}$

13 × 37 = 481 (91, 39)

$\lambda = .37$ $n = 13$ $\qquad 13 \times 3.7 = 48.1 = a + b \quad .07.30$

$= .38$ $= 7$ $\qquad 26.6 = a + b \quad .06.93$

$= .50$ $= 1$ $\qquad .5.0 = a + b \quad .04.00$

431 | 33 → 1293, 99, 1306

$4.3 : 1 = 3.30\, b$ $\qquad b = 1.306$

$2.16 = b\ 2.93$

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1	1544	5124	120
2	772	4352	+12
3	515	4095	+6
4	386	66	+2
5	309	89	-2
6	257	837	-3
7	221	801	-6
8	193	773	-5
9	172	752	-7
10	154	734	-4
11	140	729	-3
12	129	709	-1
13	119	3699	0

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−32	10	3	3	H.C.
19	28	5	9	Sw. 72
37	7	1	2	Mul.
29	12	2	4	Engel
28	13	2	4	Engel 64
34	9	2	3	Swe.
31	10	2	3	C.S. Hayn
−39	7	1	2	Mad 60
43	5	1	2	
51	4	1	1	

$$R = R_a + \frac{d\Delta\omega}{d\omega}\,r$$

$$r = \frac{R - R_a}{\frac{d\Delta\omega}{dt}}$$

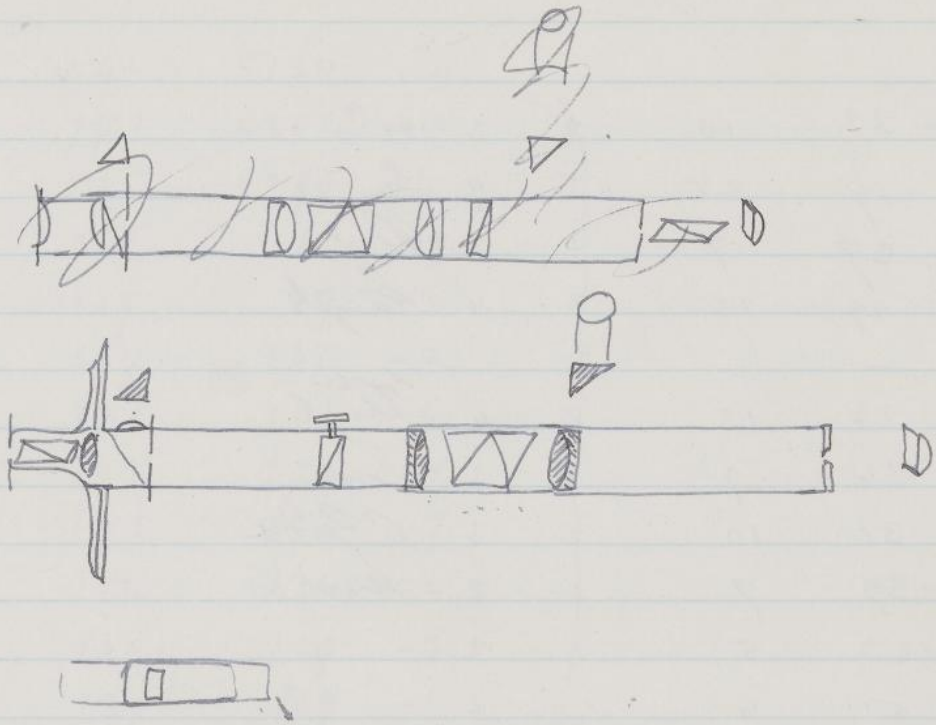
$$r\frac{d\Delta\omega}{dt} = R - R_a$$

$$\frac{\Sigma r\frac{d\Delta\omega}{dt}}{\Sigma\frac{d\Delta\omega}{dt}} = \frac{\Sigma R - \Sigma R_a}{\Sigma\frac{d\Delta\omega}{dt}} = \frac{\Sigma R}{\Sigma\frac{d\Delta\omega}{dt}}$$

$$\frac{d\Delta\omega}{dt}R - \Sigma R_a\frac{d\Delta\omega}{dt} = 0$$

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	Hardy
-.3	-.94
+1.0	+.97
+8.5	7.0
+2.0	+1.3

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Emerg Hrs 38663 Reg on S Limb - 3 mm div

Sl Spc.	2	23	30	~0 ? Slow	0	0	-.3
	4	2	50 ?	-53	27	+26	
	4	3	35 ?	-51	28	+23	1.9
	5	5	33	-93	53	+40	1.7
Zero.	6	9	56	-112	82	+30	.6
	6	20	10	-122	92	+30	1.0
	7	0	5	-126	96	+30	1.0
	8	0	0	-136	120	+16	.4
	9	1	55	145 [155] ?	148	-1	.4
		21	0	168	165	+3	1.0
	10	20	5	191	188	+3	1.0
	11	20	35	201	202	-11	
	12	1	1	203	217	-14	
	12	21	0	215	227	-12	
	13	20	0	235	250	-15	
	15	0		275 ?			

15	8	0	0	0	+1.0
15	20	5	-15	12	
16	11	15	-24	27	
	20	15	-34	35	
	23	17	-15		+8.5
17	5	46	+24 ?		
	10	30	+65		8.5 in the day
18	0	0	64 +160		
	0	2	-20		+2.0
	8	0	-9		
18	8	2			+0.2
	10	20	-6.5		
	19	50	-4.		∴ 1 div = 100 sec day
19	6	37	-5		
	20	0	-11		

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29	20	0	−10	E
21	19	55	−16	
22	20	0	−12	
23	20	5	−3	
24	20	59	−8	
25	20	12	−12	
26	20	5	−23	
27	20		−32	
28	20		−31	
29	20		−44	
30	20		−52	+1 minute.
May 1	8 A.M.		+8	
2	9 ?		+16 ?	
3	8		−1	
4			−14	
5			−24	
~~6~~			~~−52~~	
6	9 20		−52	+1 Min.
6	9 30		+7	Reg. at +0.8
7			+26	
8			+25	
9	9		+16	
10	1. P.M.		−4	
11	8 A.M.		−18	
	8 A.M.		−40	
13	8 A.M.		−40	
14	8.55		−42	
18	4 30 P.M.		−73	
19	8 6		−78	
21	9		−129	Reg. at +20

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6

May 22 8 − 18°

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