KG
11365
468

1868phae.proj..469P

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

R 25 to 11365.468

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1998phae.proj..469P

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

1868phae.proj..469P

45 Position comparables of ○ Cété. 1880.0
115 Correction Position Angles for Libration
117 Comparison L.S Lick Min. Tables Phot.

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

1868phae.proj..469P

KG 11365.468

HARVARD
UNIVERSITY
LIBRARY
MAY 7 1956

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

1868phae..proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

Ephemerides of Saturnian Satellites

Iapetus. 79.337 ~~83~~
4
396.6
315.2
31.4

- 38.4

21.29 / 365.24
2129
17 15236
14903
3310

17 rev. 3.3 days over

Sept 29	aug	95°	230"
30		97	217"
Oct 1		100	184"

16s R.A. decreasing
100" Dec inc.

23 59 51
0 8 21

23 3 0 8 26
1 27 9
23 1 33 8 33

23 11 7 42

3111
28
24888
6222
87.108

9-10	23	9	37.7	7°	33' 13"
8-9	23	10	38.7	7°	49' 44'

1 27.1
8 10.8

19.5
28
1560
390
5460"
91 6
42 19
33' 13"

1 27.1
9 14.6
10 38.7

7 58 50
9 6
49 44

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

1868phae.proj..469P

22h 37m
60
1357 | 1440
83 | 1357
527 | 832
496 | 6
29

1 8 32h 53
6
1973

$\frac{1}{1+\frac{1}{16}}$

17 in 16

1440
16
864
144
23040 m

1357
17
9499
1357
23069

Mimas revolves 17 times in 16 days +29 min
Encel. revolve 8 " " 11 days −56 min

1973 | 1440
1440 | 1066
533 | 374
374
159

$\frac{1}{1+\frac{1}{2+}}$

$1\frac{3}{8}$
144
144

1973 8
15784
15840
56

231
18
36
54
18
4158
18
24
12

1 21 18
45 18
60
2718
9
24462
24480
18

9 Rev = 17 days − 18 min

1440
17
960
1008
144
24480

23 20
1 3
24 23
25 0

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

1868phae.proj..469P

Stars near Saturn.

4737	9.10	23	9	37.9		7	33	13
		23	10	38.7		7	49	44

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

1868phae.proj..469P

Sept 29 Oct. 1877

	3000 Titan	Iapetus	Rhea	Dione	Tethys	Enceladus	Mimas
24 cts	40.72	15.53	22.74	17.34	13.99	7.43	
	33.97	15.46			15.17		
s	35.08	16.51			13.66		
25 cts			20.94	16.36			
s			25.20	16.42			

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

1868phae.proj..469P

P. Hyades	S.	U.	P		
1.36	2.49	1.09	.095	7	49
1.52		2.19	.106	4	16
1.28	2.09		.089	13	169
1.624		1.018	.113	11	121
1.538	1.376		.107	5	25
734	596	430	510	40	380
1.47	1.99	1.43	.1020 ± .007		
			.111		

$\frac{3}{5} \cdot \frac{1.7}{5}$

734
596
430
1760 | 11
160

.408 ± 38

72

18" = 72
1" = 400

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

1868phae.proj..469P

Rec. * mean Joh. Sept-25d

17	41	35.7		23	20		
		1.2			60		17.8
		16.6					35.6
* 17	41	53.5		23	19	48	Δ
22	50	52		12	44	48	
		4				63	
22	30	56		12	45	51	

Appl. Saturn.

1876 Aug. 27 5
1877 Sept 9 2

Aug 27 – Aug 27 365 377d 21h.

21 7 8
625 | 1440
2880
297
14030
12960
10450
1008

21, 297
21.3 | 365
213
17 1520
1491
29

17 rev. = 1 year – 29 days

1491
213
3621

Diff. 23d.

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

1868phae.proj..469P

1h 23m

3h 50m

Sept. 27th. Contact R 24, 35

1.330 / .6610 — 2.012

13220 — 2.012

0800

661

1390

1330 / 6381

12762 — 21

6380

6380

8014 / 4077 — 1965

4077

39370

36693

26770

24462

22080

8014 / 4218 — 1.900

4218

37960

37962

2.012 / 2100 — 2.056

1965 / 1.900 — 1.952

1.994

50.7	36.6	12.5	−3.4	
50.9	37.2	12.4	3.6	
50.7	36.8	12.0	3.6	
50.7	36.9	12.3	3.6	

36.2	33.7	10.1		5.3
37.9	34.4	10.3	+2.0	5.2
37.0	34.0	10.2	+2.5	5.5
37.4	34.2	10.2	2.2	5.3

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

1868phae.proj..469P

Min.

22 37

5h 39m 1.68

1h 23m .84

3h 46s 1.47

Encl.

32 53

8 13 2.16 27

5 28 1.89

2 44 1.08

43 18

10 50 2.66 33

7 14 2.33

3 37 1.33

65 41

16 25 3.42 43

10 56 2.99

5 28 1.71

T D

25 10.8 25 10.8

7.8 13.2

25 18.6 26 0

Mimas 3.

Encladus 5.5

Tethys 7.7

Dione 13.2

Rhea 22.8

27.8

+1.6

+.9

+2.85

+1.7

+4.7

Titan

11.1

15 22 41 94 181

3 23 35 72

95 35 120

1 8 52

2 32 52

65 42

27 18 = 8

7 23

19 19

35 17

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

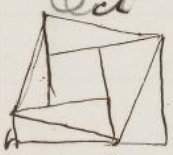
1868phae.proj..469P

Elong Hyperbola

Aug 1st. 9.
12
22d. 10
11
Sept 3 9.5
Sept 12.5
20
22.5
32.5

.274 .137
.274
9.960
10.508 5.254
29.468
-.906
19.562 9.781

Oct 22 aug 275° dist 233/48
13


a

.274
9.960
10.234
-.906
9.328

9.910
4.664

9.328
9.328
.906
19.562

1.2936 .08922
2.262 89.7846
89.87382
3.5556
86.3182

.274
.274
.5638
6.186
3.093

39
39
762
840
.420



.840
.762
1.602
243
1.359
243
1.116
.558

.680

6.186
5.638
11.824
-.664
11.160
5580
.664
4916

11.160
664
10.496
5.248

.7498 .7887
1.0570 31.378
1.8068 32.1637
1.8068
30.3569

.01501 .03990
2427 .53176
3.781 .57166
4.781 .03928
.53238

30.044
24.000
17.000

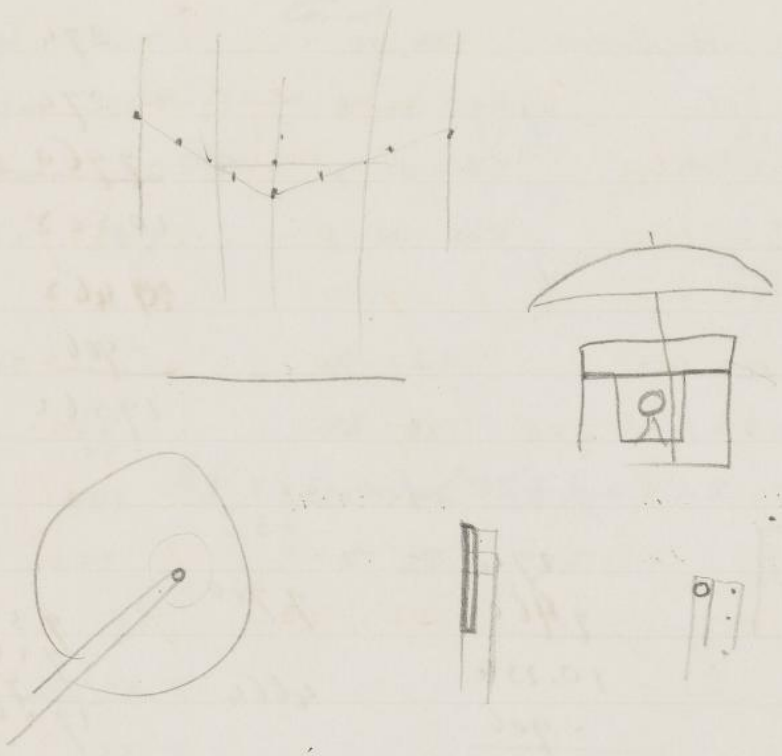
9.291
5.510
.729

9.291
5.510
.729

6.044 3.781
7.000 4.781

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

1868phae.proj..469P



27.8
3.123
834
556
278
834
87.219 88
1m 27.2s
5° 8-50 G 11

19.34
27.8
15472
13538
3868
537.652
8 57".6

77.8
52.8

.312
1056
528
1584
164.736

19.35
528
15480
3870
9675
10241.680
2m 45s
17'

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

1868phae.proj..469P

B.A.C. 8050	7½	59	24.1	8	30	3	0m	59.31	8°	21′	6″	

Stars near Lalande.

Lacaille 4717	9	0	36.2	8	4	38	1	3.2	7	55	41	
4719	9	1	24.7		7	26	2	51.7	7	58	29	*
4721	9.5	2	1.9	7	57	12	3	28.9	7	45	15	
4722	9	2	35.8	8	37	4	4	2.8	8	28	7	†
4725	9.5	3	6.1		27	5	4	33.1	8	18	8	
Lalande 5	8.5	0	6.		15	31	2	51.	7	58	31	*
29	8	1	18		45	10	4	3	8	28	10	†
83	8	4	17		56	43	7	2	8	39	43	

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

1868phae.proj..469P

$4.78 : .732 = 7 : x$

$478 \overline{)5124} \quad 1072$

478

3440

3346

940

2.262

1.2936

3.5556

97.930

$.08932$

98.01932

3.5556

94.46372

9.67

$.732$

$8.938 : .732 = 13.044 : x$

13044

2928

2928

2196

732

$8.938 \overline{)95.48208} \quad 10692$

8934

6142

5628

77920

80442

$8 : 15 = 20 : x$

$8 \overline{)300} \quad 16$

25

$.375$

18.835



$A = x^2 - .0144$

$A = x(x + .24)$

$y^2 = x^2 + .24x + .05926 - .05926$

$y^2 = (x + .12x)^2 - .05926$

$(x + .12x) = \sqrt{y^2 - .05926}$

$5.5097 : .72966 =$

724

$4.98 : .72966 = 7 : x$

$478 \overline{)5107} \quad 10685$

478

3276

2868

4082

3824

2580

$9.7.19 :$

729

$899 : .7296 = 13044 : x$

$9 : 7304$

13044

29216

29216

21912

7304

$9 \overline{)95273376} \quad 10593$

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

1868phae.proj..469P

9781 969

991

97 81

88029

88029

96.92971

9.6677

7266

8.938 : .72966 = 13,044 : 2

73 = 13039

73

39117

91273

951847 | 8938

8938 1065

58047 05

53628 1.0 6495

44190

44690

5000

8.938

5.50

.72

4.78 : .72966 = 7

478 | 507762

478

297

478 | 510762

4817

.683

92.4637 | 47.307

934497 | 473

93181 197568

2687

894 | 13044

78 .6853

111

104

70

65

50

197.22

.35

.97184

.7071

97184

680288

680288

.687188064

30,356 9 473

28

303524

30272

804 64.0170

8.9381 | 13044

8908 .684

78

110

104

64

1700

1594

1.06

4817

.683

5324

473

694 1.147

300

157

141

12

A = x² - .0144

x = 15.94

198.810

7568

64.80 25

017

1.1236

.147

14.10

8.06

1.06

1600 1600

+1.272 +.35

+.785 +.017

-.024 +.147

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

1868phae.proj..469P

30.044
14.056
15.988
15.999
15.929

984 | 24 = 41
96
24
1

410 | 244 = 1.680
244
1660
1464
1960
1952

984 24
3936
1968
23.616

23616 | 244 = .968
2196
1656
1464
1920
1708
212

	93.4637	30.357	.53224
	9.6677	5.5097	.72966
	30.044	24	17
	14.134	8.054	1.067
	15.990	15.946	15.933

30.044
14.04

Measured	199.76	64.867	1.1345
Calc. as	198.81	64.9636	1.1236
		+.1030	+.0109
	+ .95	+.065	+.0909

2

R − 15.94	14.10	8.06	1.06
( )	198.81	64.9636	1.1236
	197.56	64.017	1.147
+	1.25	+ .947	−.024

$(R-15.94)^{1} + (R-(15.94)\frac{1}{10} =$ 197.41 64.16 1.018

+.15 −.14 +.12

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

1868phae.proj..469P

	true area	$(R-15.74)^2$				
14.10	197.568	198.81	−1.24	+340	14.054	14.04
8.06	64.017	64.96	−.94	+.017	8.001	8.00
1.06	1.147	1.12	+.03	+.147	1.051	1.00

π^4 .0042
.017

$197.568 = (30.044 - a)^2 + b^2$
$64.017 = (24. - a)^2 - b^2$
$133.551 = 730.84 - 32.088a$
$a = \frac{596.29}{32.088}$
$133.551 = 350.84 - 12.088a$

$64.017 = 14.04$

197.23
$.57$
34

$92.684 - 60.088$
$196 \quad -48$
$730.84 \quad 120$
134.55
596.29

$596.29 / 32088$
$32084 \quad 15$
275410

92.684
576
350.84
134.55
$216.29 / 12088$
$120.88 \quad 1$
96

90.264
32.664
133.55
$19309 / 12088 \quad 15.974$
12088
72210
60440
117700
108792
89080
84.1
44

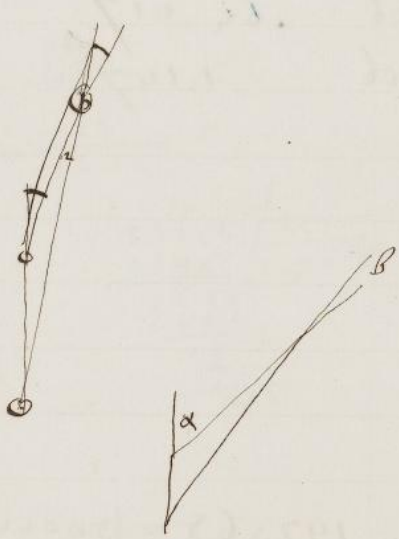
$197.568 = 90.264 - 60.088a + a^2 - b^2$
$64.017 = 576. - 48\,a + a^2 - b^2$
$133.55 = 326.64 - 12.088a$

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

1868phae.proj..469P

287
62.870 / 14
224.130 1801
14
84
84

790
762
782
234
778
.536



lin α : R β =
♄ ☉ : ⊕ ☉

~~.24166~~
~~.24583~~
.2500
416
.254166
.25833

1h = .04166
.1h = .00416
.0125

27.8
3111
278
278
278
834
46.4854

199.4
278
27.6
2
552.
912

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

1868phae.proj..469P

$64.017 = 576. - 48a + a^2 - b^2$

$1.147 = 289 - 34a + a^2 - b^2$

$62.870 = 287. - 14a$

6. .017 14044 240

.147

x	Cor.	Interval		
14.10	-.05	14.054	14.04	.01
8.06	-.06	8.001	8.00	.00
1.06	-.01	1.051	1.00	.05
.0[illegible]	.	.000	0	

15.94

Vesta ④

B.A.C. ⊙' 23 32.00 15 3.1

⊙² 34 56 15 22.3
21 9.2
30 15 55.2

B.A.C. ⊙' 33 26.5 14 53.9

B.A.C ⊙' 36 22 15 13.1

31 41 15 46.0

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

1868phae.proj..469P

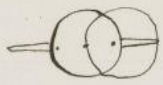
5.0		8.0	11.0
1	.2125		
2			
3			
4	.2250		
5			
6			
7	.2375		
8	.2417		
9	.2458		
60	.2500		
1	.2542		
2	.2583		
3	.2625		
4	.26666		
5	.27083		
6	.2750		
7			
8			
9	.2875		
70			
1			
2	.3000		
3			
4			
5	.3125		
6			
7			
8	.3250		
9			

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

1868phae.proj..469P

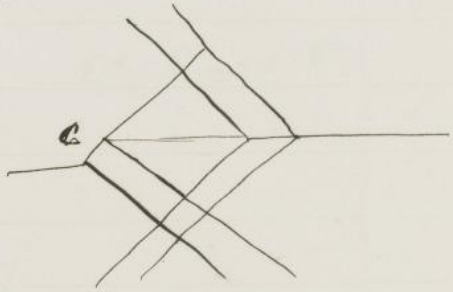
	Oct. 1.	Nov. 1	Dec. 1
R.A. ☽	23 9 55	23 ~~3~~ 45	23 3 37
⊙	0 30 49	2 27 8	4 31 4
1h = 15° 1s = 15'	8° 27' 54"	3 23 23	5 27 27
	~~24° 3' 36~~	203.4	327.4
α	20°.2	50°.8	81°.9
	18	45°	
Lg. α	9.538	9.890	9.995
+ Lg ⊙ ⊕	000	9.996	9.994
+ ac Lg ⊙☽	9.016	9.016	.017
	~~9.554~~	~~9.902~~	~~9.883~~
Lg tg β	9.554	9.802	9.906
	.0,358	.0634	.0805
	.39	.70	.88
	.8 rad	1,40	1.7







0041 66
0125



$$ax^2 + bx = A$$

$$\frac{x^2}{2} + c\frac{x}{\sqrt{2}} = A$$

$$A : x^2 + c\sqrt{2}\,x$$

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

1868phae.proj..469P

Oct. 7	2	~~21~~	52	3	0	23	16	
11	1	58	52	3	16	23	11	8
15		55	36	3	32		3	11
19		52	~~34~~	3	44	22	52	14
23		48	20				38	16
							22	19
							3	21
						21	42	22
							20	23
							57	

α Aquilæ	2	0	14	22	52	48

Oct. 9 (123)	2	0	22	23	13

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

1868phae.proj..469P

23	44.3	-14.3		1	51		
Sept 21	30.0	-12.8	+2.5	3	4	+K 73	-10
Oct 11	17.2	-7.2	+5.6	4	7	+ 63	-33
31	10.0	+.2	+7.4	4	37	+ 30	-43
Nov 20	10.2	+7.1	+6.9	4	24	- 13	-41
Dec 10	17.3	+12.7	5.6	3	30	- 54	-35
30	30.0			2	1	- 89	

Oct-21 $17.2 - 7.2 \cdot .5 = .125 \times 7$

17.2 − 1.75
5.3 − 3.6
11.9

$10.0 + .5 \times .2 - .25 \times 7.0$

10.0
1.75
8.35

$37 - 6.5 + 10$

40.5

$7 + .5 \times .30 + .25 \times .43$

7.15
11
7.26

15
11
7
33

$\frac{5 \times .5}{2} = .125$

$+ 17.2 - 3.6 - .9 = 12.7$

$10.0 + .1 - .84 = 9.26$

$17 - 6.5 + 5 = 35.5$

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

1868phae.proj..469P

Area of Cardboard.

$93.4637 = ax^2 + cx^2 x$

30.3569

$.5324$

14.04 14.03

8.00 7.99

1.00 .99

196

197.12 + 98.56 5.10 2.37

64.00 32.00 1.64 1.36

1.00 .50 .0324 .17

1.404
1404
5616
5616
1404
197.1216
1414
12
2828
1414
16968
14.
17.
8
136 23868

$5.10 = ax^2 + bx$

$1.64 =$

$.03$

20 dis. 7 7

9 8

6 3?

22 18

7.3 6

diff 8

8 83

9

12

37

9.2

~~7 dis~~

20 dis = .7

.7

14 di.

20 dis = 1

.14

.18 = diff by the ends

17

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

1868phae.proj..469P

.17 = c

$\frac{.99}{\sqrt{2}} \times \frac{.99+.17}{\sqrt{2}}$

$.99^2 + .99 \times 16$

1494
5976
7470
2988
379.476

16.01 15.77 799 1144

1420
1403
4268

816
815
8
65.40

99.813 | 9346
19 .9364

572
142
199.626
65.40
41.44

99.813
3270
.57

30.357 | 32.70
2943 93
927
9811

1/15 99.813 32.70 .57
6.654 2.18 38
93.159 30.52 .532

57 5

327
936
1962
9811
2943
30.607

57
936
342
17
513
.5335

93.6

197.568 | 199.63
37 37
197938 | 2
9897

Ans.

199.63
199
197.63

65.40
65.4
64.746

1147
14
1136

$\frac{.389}{.5122} = .7$

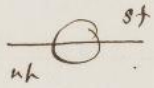
log 0.1
− log 5
+ log. sin 5'
− " " 15"

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

1868phae.proj..469P

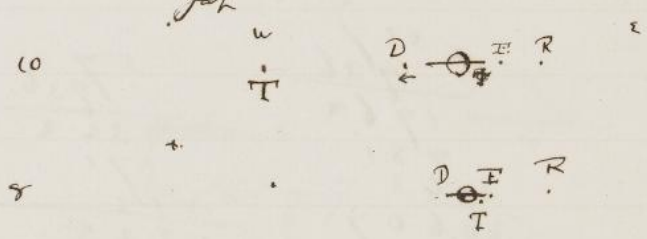
Lg. 15" 2.5792 2.5792 8.1106 8.1106 .13735 1373
5' 2.1036 3" 1.88349 9.5244 9.3043 5243 3043
9.5244 9.3043 7.5862 7.4149 .6617 4416
R>
7.6350

Q 1.5" 7.6350 7.6617
Q 13" 7.4149 7.4416



9d 10 8

M. 143 W
Ecl 11 E 2.1 E
Diam 2 W inc.
Lith. inf. —
Area 9.19 E 3 E
Lith
Hyth
Jv



P	S	U
147	137	159
159	156	170
158	121	159
153	136	162
154	175	
149	175	
153	153	
	157	

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

1868phae.proj..469P

	Em	as	m.	&	1	D	R.
Cu 9.	16	11	+1.5	-1.2	-1.7	+3.2	-1.6
	13	8	+1.5	-2	-.7	+2.7	-2.4

22 59.8 — 1.35 — 58.45

2 17 — 14 — 2 31

52.9 — 1.35 — 51.55

57.7 — 1.35

15.5

11 58.45

51.55

56.35

2 23

2 31

2 2

0 46

52 52 — 1 23 — 54 15

3 1

50 — 27

3.1 — .248 — 248

19

77.4 — 25 — 52.8

309 — 4752 — 15844 — 1631 — 12230

528 — 19.30 — 15844 — 475 2 — 525 — 101904 — 17'

217 — 62 — 86.14

1426

9'

19.3 — 28 — 15444 — 386 — 540.4

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

1868phae.proj..469P

Wien +2m43 −17

1202	9	55	17.7	2°	50	58	1	2	33
1257	9	56	58.7	3	2	58	11	2	45
		1	23.		17				

Diam 2 mms $\frac{1}{200}$ $\frac{0.13}{15}$ $\frac{13}{6}$ .012

0 211
.035
33
35
38
.035

1m26s 9'

22	56	35		2	42	58	1	2	23
		1	26						
9049	10		52	33		2	59	53	57	50
			53	57		2	53	55	17	44
			54	6		2	19	55	32	10
			56	35		2	42	58	1	33
9092	10		59	56		2	55	1	24	46

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

1868phae.proj..469P

.10363
5772
9.5244
8.9106
7.6350

1.88349
2.5772
9.3043
8.1106
7.4149

.01372
274
.01345
2/1372
69
.1303

.5244
.1149
.6393

3043
1149
.4192

85205

1.4795

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

1868phae.proj..469P

Jupiter.	8th	10th	11th	12th	13th
2.55	2.55	2.55	2.34	3.31	3.63
3.23	3.23	1.75	2.56	4.18	3.63
2.34	3.13		3.31	2.45	4.03
2.56	3.65		3.08	4.13	4.18
3.63	2.90		2.52		
3.63	2.72				
2.61	2.85				
2.86	2.81				
3.09	8|22.84	2|4.30	6|13.81	4|14.07	4|15.47
26.50	2.85	2.15	2.30	3.52	3.87
2.944					

7\|19.24
2.75

			Cents.		
22.84	8	8th	2.85	4|.1528 8|.1625	9.
4.30	2	10th	2.15		
13.81	6	11th	2.30		
14.07	4	12th	3.52	4	1262
15.47	4	13th	3.87	5	1336
2.61	1	9th	2.61		
19.23	6	22d	3.20		
92.33	31				

2.985 mean.

68
203
279
263
248
150

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

1868phae.proj..469P

		4th	5th	12	13	16	23
19th	22	1					
2.61	2.86	.1631	.1486	.1016	.1296	.1557	.1764
	3.09	1340	.1722	.0984	.1497	.1538	.2461
	4.26	1614	.1481	.1509	.1144		
	2.86	1596	.1721	.1540	.1290		
	3.25	1461	.1630		.1451		
	2.91		.1860				
			.1383				
			1721				

2.61	1923	5 | 7642	8 | 13004	5049	6678	3095	4225
2.61	320	.15284	.1625	.1262	.1336	.1547	.2112

		.2306	.1826	.1135	.1602	2074
		.1636	.2605		.1542	
		.3942	.4431	.1135	.3144	2074
		.1971	.2215	.1135	.1572	.2077

5	7642				.3942
8	13004				.4431
4	5049				.1135
5	6678				.3144
2	3095				.2074
2	4225				
26	39693	Apsis:	379.5	2.5792	
.1527	26		2.985	0.4748	
	136				
	130	Sun Sat-	.1838	9.2643	
	69	Earth	.1527	9.1838	8 | 14706
	52				.1838
	173				.1527
	162				

Sun
Earth

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

1868phae.proj..469P

$$
\begin{array}{r|l}
265 & .035 \\
132 & \underline{265} \\
 & 550 \\
 & \underline{795} \\
 & 550 \\
 & 530
\end{array}
$$

$$
\begin{array}{l}
.00132 \\
\underline{\quad 45} \\
660 \\
528 \\
\underline{\quad\quad} \\
5.94
\end{array}
$$

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

1868phae.proj..469P

0.4748
2.5792
7.8956 = log cos

7.8956
9.1838
7.0794

9.2643
9.1599

~~.002038~~ .001445
45
7220
5780
6.5027

.00120
45
60
48
5.4

D Diam. outer Satellite = 5.4 miles log 2 = 4500
D " inner " = 6.5 " " " "
B " outer " 5.94 " " " "

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

1868phae.proj..469P

16.6
~~28.8~~
1328
332
464.8
+ 7' 44".8

3.2
25
256
64
89.6

7.75

RA
+8.5 Dm 336 – II 19m 28.80 N 12 0' 3."
Neptune Calculated II 19 30.76 11 59 38.7

30h 14m
302h 20m
907 2.|24
72 37
187
169
16

~~78.8~~ 80.
55
25

37d 16h

7' 15"
7.5 25
1 15.5 7'
1' 15".5

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

1868phae.proj..469P

Position of comparison stars for o Cet for 1880

o	Cet	II	13	16	3° 31.3
c			13	23	35.0
v			15	10	47.0
s			15	33	39.5
u			16	45	55.2
b			17	36	47.0
r			19	9	4 5.0
g			14	3	38.5
h			18	19	35.7
n			6	37	4 53.9
m			13	39	

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

1868phae.proj..469P

1" = .03315 mm. = .001305 ins.
5

.03315
.03937
23205
9945
29835
9945
.001305115

.001305
24
5220
2610
.0313 2

.0825

.0013
.004

.065

18" = dia T

1 div = .0002

18 :

380 : 1.5 = 18 : x

.07

270 | 380
266 | .071
40

4 | 13051
39153 | .3065
8470
74306
63940

1" = .0013 1 div. = .0004

1 div = 3/13" 1/5" + 1/39

613
210,44

1287
1293 4
1290

2758 5
184
2777

25133
54
25187

251.33
539
25672
12836

25746
54
25800

25746
539
26285

2642
2
2644

1 div = .1532

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

1960phae.proj..469P

$$\frac{x - \frac{1}{7}x}{6} = \frac{7x - 1x}{42} = \frac{1}{7}$$

10
15
10
27
62
154

Jahrbuch

Col 5	8.350
7	3.918
	4.156
13	4.364
	4.742
17	2.638
	2.648
18	3,81 (1)
4	2.732

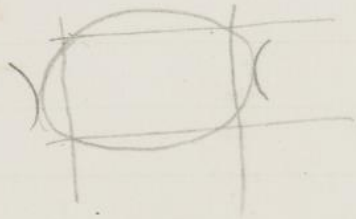
43136	331.87	33.214 (46 / 33.168)
431.3	331.87	33.210
435.26	334.95	33.515
420	323.47	32.347

Sun (40)

99.8 92.6
99.7

μl 4	eμ 4	μl 2	
.27184	.30103	.94300	.97220
.70	.70	.95	.95
97.184	100103	1.8950	.9222
93.71	100.24	77.63	83.60

240
933
72
72
216
223.9



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

1868phae.proj..469P

Identifications of Satellites of Saturn

Sept 24	d	7.8	Enckes	E	1.75	Mimas	W 1.7
Oct	7	9.8	"	W	1.5	"	W 1.2
"	13	10.0		E	1.6 –		———
	17	9		E	1.9 +		E 1.6 +

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

1868phae.proj..469P

12.5
9.2
E 3.3
14.5
9.8
4.7

12.5

10.0
4.7
14.7
10.5
4.2

9.7
4.7
14.4
17.1
2.6

.5252 .5211 .5213
.7452 .7456 .7444
.2704 .2663 1.2654
186.4 184.6 184.2

17 9.47
17 13.7

16.2
13.7
2.5

	Ec. 4	Ec. h		Obs. 4	Equ. 4	Obs. h	Equ. h
Angle				93.71	100.24	77.63	83.60
Elem.			5.55	92.6	99.8	73.4	81.1
Fr.			5.55	92.425	99.703	75.184	81.105
Eq.	.927	.927	5.55	93.424	99.704	76.00	81.106
Obs.				93.2 92.3 92.1			

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

1868phae.proj.469P

Jupiters Satellites.

Oct. 17th 6h 40 C.M.T.
24. W.M.T.

15 7h 22.6

			W	N
1	8.4	I x'	-108.9	+.5
14	0.7	II	-88.9	+10.5
3d	6.5h			

30.4
22.6
7.8

1 7.8

6.30
0.7

	I	109.1	~~103~~
	II	92.5	10.3

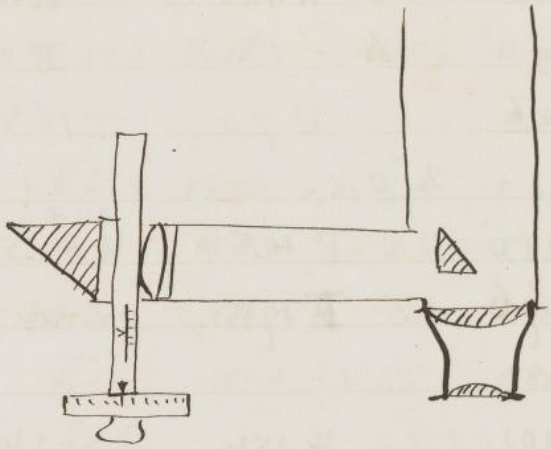
I	II	III	IV
3.752			
~~4.374~~	4.374	6.574	2.618
3.652			
	10.140	16.886	12.232
	6.768		
	10.996	17.996	9.720

6 7
3 4
2 23

	I	II
Oct-6d7	23h5	2d23h
	-35	-156

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

1868phae.proj..469P



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

1868phae.proj..469P

		Identification	Saturn's Di.	Satellites Rh.
	13.7			
	"			
Aug 27	9.5	E +1.5	W+11.8 nf	W+16.1
Sept 2		—	—	E 2.4
" 11	10.5	E 14.6	E 7.0	E 16.8
13	8 ? Cl.	Cm E 10.2	Mi E 16.4	
23	8.5	W 21.0	E 10.5	22d W 23.6
24	8	E 19.6	E 19.3	25 5.8 E
25	8	W 18.3	26 4.1 W.	"
Oct 1	9	W 10.1	W 15.4	24.3 W
5	9			
7				
13				
17				
18				

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

1868phae.proj..469P

Mi	Em	L.	Di	Rh.
W 9.2	W 12.1	W 16.3	W. 5.8	Mrd 18,9 / 13.1

at 8 Rh	Rh =	13,1 h	3.4
	Ie	8.3	1.5
	Di	2.2	3.3
9.5	L.		1.5
	Engl		4.9

210^2 75 9/16 $\frac{80}{100}$ 5625

44,100
5625
49,725

446.

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

1868phae.proj.469P

XXIII h ← XXIII h 3

Stars near Antiope (90) −9° 15′ − 9° 30′

Mag.	Dec.	m			
8	9° 27′	0	46.5	46.4	46.5
11	30		49.7	50.2	49.7
12	24			53.3	53.0
12	25 24	1	12.1	12.1	54.4
12	26				12.4
	26		23.8	23.0	
	34		26.5	26.3	
	23		57.7	58.0	
				59.1	
	32	2	58.7	8.2	
				14.3	
9	27		59.2	18.5	
				22.0	
9	28		58.7	58.0	

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

1868phae.proj..469P

Dec.

8	0	46.5	46.4	46.5	46.6	27
11		49.7	49.5	49.7	50.1	29
11		53.0		54.6	53.3	23.5
13		58.8	58.4	58.9	59.2	27.
				3.4	4.0	33
12	1	12.4	11.9	12.0	12.4	23
12		"	"	"		25
12		23.0		23.0	23.3	26 ?(90)
11.5				26.7	25.6	33
		29.7		29.4	29.6	22 ?(90)
		57.8		57.8	58.0	22.5
		59.1		59.3	59.3	25.5
				0.4	1.6	34
	2	8.7		8.4	8.6	32
					9.8	22
		13.8		13.7	13.9	34
9		19.3		19.0	19.2	28
		22.3		21.0		20 23 19
9		58.9				

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

1868phae.proj..469P

Write Comp stars for Vesta.

28h. 20m — −13° 15′

445	49	20	51.71	13	50	22		
		22	858	14	21	49	3526	197.8
		22	1178	13	9	28		
		22	43.82	12	53	49	312.	19.8
	9	23	12.4	14	85	8		
	9	23	1566	14	36			
	7	24	95	13	34	29		
	89	24	16.7	13	37	55		
525	9	25	30	13	17	34		
	8	26	8	12	32	37	3.11	

19.8 × 53. = 594 + 990 = 1049.4 ÷ 17.5

312 × 53 = 936 + 1560 = 16536 ÷ 245

26 41 − 2 45 = 23 56 ; 13 15 + 17.5 = 13 42.5

25 30 13. 11

23 19 45 + 2 45 = 23 17 0 ; 17 53

21 10 + 2 45 = 23 15 25 ; 13 53

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

1868phae.proj..469P

23	37.8	14	7.8
24	54	14	39.3
24	57	13	27.0
25	31	13	12.3
25	57	14	52.6
26	0	14	53.5
26	54	13	52.0
27	7	13	55.4
28	15	13	35.8
28	53	12	50.1

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

1868phae.proj..469P

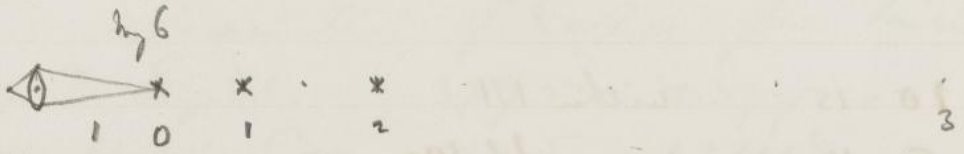
2.2m.

10	9.5	314925	213.856	25	100
	9.0	101.069			
2	8.5	48246	53823	9	25
1	8.0	25320	22926	4	11
	7.5	14077	11243	2	5
1	7.0	8016	6061	1	3
	6.5	4121	3895		2
	6.0	2107	2014		1

100	0	1.00	90.0	1.00
94				
	1	.60	23.5	.398
	2	20	9.1	.158
	3	6.80	3.7	
	0	.4		

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

1868phae.proj..469P



$\log \frac{I}{I} = \frac{1}{x^2}$

$\log I + 2 \log x = 0$

$4 = 2 \log x$

	0	1.000	4
.2	= 1	1.585	5
.4	= 2	2.51	6
.6	3	3.98	7
.8	4	6.31	8
1.0	5	10.00	9

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

1868phae.proj..469P

-20	-25	within 1H.
-5	10	1½ 30m
-0	5	2h

-30	]	1h	-30	) 2
-20	]	1h	-10	)
-10	]	1h.	-5	) 2 30
-5	]	1h 30	0	) 3
0	]	2	+10	) 3 30
+10	]	2 30	20	) 4
+20	]		30	) 4 30
			40	) 5
			50	5 30
			60	6
			70	7
			75	8
			80	9
			90	12

$\frac{\pi d^2}{4}$

250

209.5

208.94

.0	104.7	2.0?
.5	83.2	1.9?
1.0	66.1	1.8?
1.5	52.5	1.7?
2.0	41.7	1.6?
2.5	33.1	1.5?
3.0	26.3	1.4?
3.5	20.9	1.3?
4.0	16.6	1.2?

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

1868phae.proj..469P

Diameter of Cells for Inked Circle

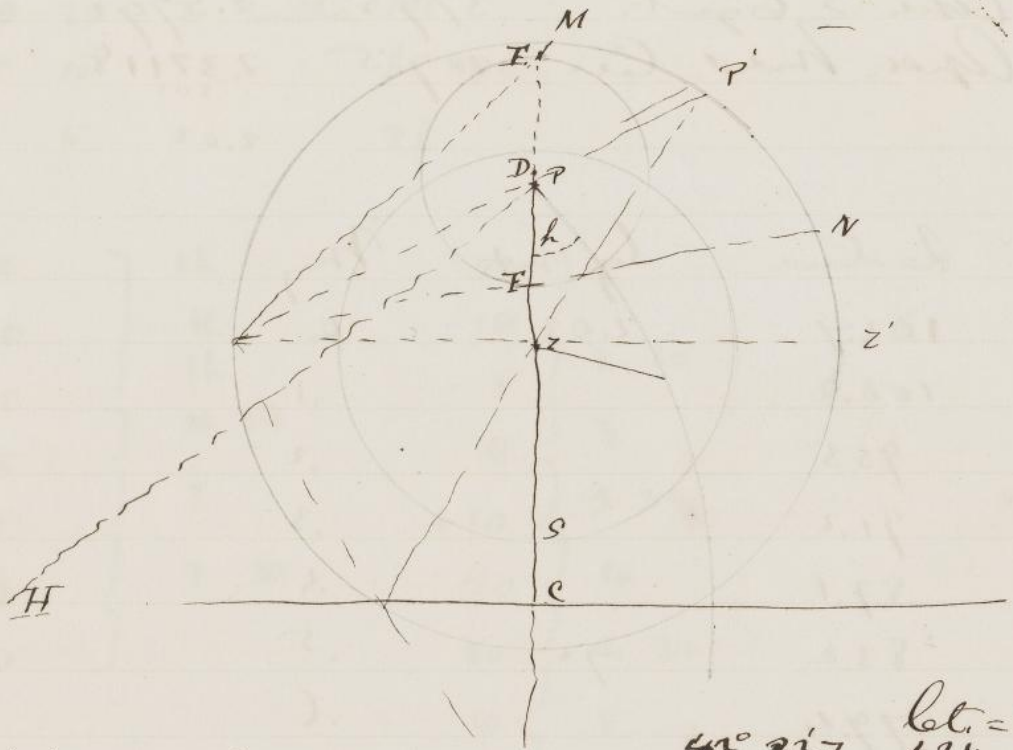
Area Ext. Equal.	379.5	2.5792
Area Inscr. Circ	209.5	2.32118
		.301
		2.02

Radius	log rad.	Mag.
104.7	2.02	0.
100.0		.1
95.5		.2
91.2		.3
87.1		.4
83.2	9	.5
79.4		.6
75.9		.7
72.4		.8
69.2		.9
66.1	1.82	1.0
63.1		

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

1868phae.proj..469P

Stereographic Projection



lat. = 42° 23′

$P'Z = 90° - \text{latitude} = 90 - \lambda$ $R = 47° 37.3$ 47.6 42° 22.7 42.4

$PZ = \tan \frac{1}{2}(90 - \lambda) = \tan 23° 48.6 = \tan 23.8 = .4411$

$ZR = \tan \frac{1}{2}(90 + \lambda) = \tan 66° 11.4$ $66.2 = 2.1673$ .9131 $= .9131$

$ZC = \frac{1}{2}(PZ + ZR) - PZ = \frac{1}{2}(ZR - ZP)$

$= \frac{1}{2}[\tan \frac{1}{2}(90 + \lambda) - \tan \frac{1}{2}(90 - \lambda)] =$

For meridian at hour angle H, $CH = CP \cot h$
For circle at zenith distance z, $ZS = \tan \frac{1}{2} z$
For declination circle at north polar distance p

$P'M = P'N = p$

$ZF = \tan \frac{1}{2}(90° - \lambda - p) = \tan (23.8 - \frac{1}{2}p)$

$ZE = \frac{1}{2}(90° - \lambda + p) = \tan (23.8 + \frac{1}{2}p)$

$ZD = \frac{1}{2}(ZF + ZE)$

$DE = \frac{1}{2}(ZF - ZE)$

Compute once for all. PZ, ZC $PZ = .4411$ $ZC = .9131$

" for every 1°, $CH = CP \cot h$, $ZS = \tan \frac{1}{2} z$

" " " " " $= 1.3542 \cot h$

$\log CP = .1317$

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

1868phae.proj..469P

park

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

1868phae.proj..469P

μ or h.	0°	1°	2	3	4	5
log CH = log cot h +0.1317	∞	1.8898	1.5886	1.4123	1.2871	1.1897
CH	∞	77.49	38.78	25.84	19.37	15.48
23.8 + ½p	23°8	24.3	24.8	25.3	25.8	26.3
23.8 − ½p	23°8	23.3	22.8	22.3	21.8	21.3
log (23.8 + ½p) = ZF	0.4411	0.4515	0.4621	0.4727	0.4834	0.4942
log (23.8 − ½p) = ZE	0.4411	0.4307	0.4204	0.4101	0.4000	0.3899
ZF + ZE	0.8822	0.8822	0.8825	0.8828	0.8834	0.8841
ZF − ZE	0.0000	0.0208	0.0417	0.0626	0.0834	0.1043
ZD = ½(ZF+ZE)	0.4411	0.4411	0.4412	0.4414	0.4417	0.4420
DE = ½(ZF−ZE)	0.0000	0.0104	0.0208	0.0313	0.0417	0.0521

μ or h.

log CH = log cot h +0.1317

CH

23.8 + ½p

23.8 − ½p

ZF = log (23.8 + ½p)

ZE =

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

1868phae.proj..469P

6	7	8	9	10	11	12
1.1101	1.0426	.9839	.9220	.8854	.8430	.8042
12.89	11.03	9.636	8.551	7.681	6.966	6.371
~~128~~	109	~~95~~	~~85~~	~~78~~	~~68~~	~~63~~
26.8	27.3	27.8	28.3	28.8	29.3	29.8
20.8	20.3	19.8	19.3	18.8	18.3	17.8
0.5051	0.5161	0.5272	0.5384	0.5498	0.5612	0.5727
0.3799	0.3699	0.3600	0.3502	0.3404	0.3307	0.3211
0.8850	0.8860	0.8872	0.8886	0.8902	0.8919	0.8938
0.1252	0.1462	0.1672	0.1882	0.2094	0.2305	0.2516
0.4425	0.4430	0.4436	0.4443	0.4451	0.4459	0.4469
0.0626	0.0731	0.0836	0.0941	0.1047	0.1152	0.1258

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

1868phae.proj..469P

13	14	15	16	17	18
.7683	.7349	.7036	.6742	.6464	~~.6468~~ .6199
5.865	5.431	5.054	4.723	4.430	4.168
58	50	49	47	44	41

30.3	30.8	31.3	31.8	32.3	32.8
17.3	16.8	16.3	15.8	15.3	14.8
0.5844	0.5961	0.6080	0.6200	0.6322	0.6445
0.3115	0.3019	0.2924	0.2830	0.2736	0.2642
0.8959	0.8980	0.9004	0.9030	0.9058	0.9087
0.2729	0.2942	0.3156	0.3371	0.3586	0.3803
0.4479	0.4490	0.4502	0.4515	0.4529	0.4543
0.1364	0.1471	0.1578	0.1685	0.1793	0.1901

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

1868phae.proj..469P

19	20	21	22	23	24
.5941	.5706	.5475	.5253	.5038	.4831
3.933	3.920	3.928	3.952	3.990	3.042
~~39~~	~~36~~	~~35~~	~~33~~	~~42~~	~~29~~
33.3	33.8	34.3	34.8	35.3	35.8
14.3	13.8	13.3	12.8	12.3	11.8
0.6569	0.6694	0.6822	0.6950	0.7080	0.7212
0.2549	0.2456	0.2364	0.2272	0.2180	0.2089
0.9118	0.9150	0.9186	0.9222	0.9260	0.9301
0.4020	0.4238	0.4458	0.4678	0.4900	0.5123
0.4539	0.4575	0.4593	0.4611	0.4630	0.4650
0.2010	0.2119	0.2229	0.2339	0.2450	0.2561

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

1868phae.proj..469P

25.	26	27	28	29	30
.4130	.4434	.4245	.4060	.3879	.3703
2.904	2.777	2.658	2.547	2443	2.346
28	26	26	25		
36.3	36.8	37.3	37.8	38.3	38.8
11.3	10.8	10.3	9.8	9.3	8.8
0.7346	0.7481	0.7618	0.7757	0.7898	0.8040
0.1998	0.1908	0.1817	0.1727	0.1638	0.1548
0.9344	0.9389	0.9430	0.9484	0.9536	0.9588
0.5348	0.5573	0.5801	0.6030	0.6260	0.6492
0.4672	0.4694	0.4715	0.4742	0.4768	0.4794
0.2674	0.2786	0.2900	0.3015	0.3130	0.3246

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

1868phae.proj..469P

31	32	33	34	35	36
.3529	.3359	.3192	3027	2865	2704
2.254	2.167	2.085	2.008	1.934	1.864
39.3	39.8	40.3	40.8	41.3	41.8
8.3	7.8	7.3	6.8	6.3	5.8
0.8185	0.8361 (32)	0.8481	0.8632	0.8785	0.8941
0.1459	0.1370	0.1281	0.1192	0.1104	0.1016
0.9644	0.9702	0.9762	0.9824	0.9889	0.9956
0.6726	0.6962	0.7200	0.7440	0.7681	0.7924
0.4822	0.4851	0.4881	0.4912	0.4944	0.4978
0.3363	0.3481	0.3600	0.3720	0.3840	0.3962

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

1868phae.proj..469P

37	38	39	40	41	42
.2546	.2389	.2233	.2079	.1926	.1773
1.797	1.733	1.672	1.614	1.558	1.504

42.3	42.8	43.3	43.8	44.3	44.8
5.3	4.8	4.3	3.8	3.3	2.8
0.9099	0.9260	0.9424	0.9590	0.9759	0.9930
0.1928	0.0840	0.0752	0.0664	0.0577	0.0489
1.0027	1.0100	1.0176	1.0254	1.0336	1.0419
0.8171	0.8420	0.8672	0.8926	0.9182	0.9441
0.5013	0.5050	0.5088	0.5127	0.5168	0.5209
0.4085	0.4210	0.4336	0.4463	0.4591	0.4720

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

1868phae.proj..469P

43	44	45	46	47	48
.1620	.1469	.1317	.1165	.1014	.0861
.1452	1.1403	1.1354	.1308	1.1263	1.1219

45.3	45.8	46.3	46.8	47.3	47.8
2.3	1.8	1.3	0.8	0.3	−0.2
1.0105	1.0283	1.0464	1.0649	1.0837	1.1028
0.0402	0.0314	0.0227	0.0140	0.0052	−0.0035
1.0507	1.0597	1.0691	1.0789	1.0889	1.0993
0.9703	0.9969	1.0237	1.0509	1.0785	1.1063
0.5253	0.5298	0.5346	0.5394	0.5444	0.5496
0.4851	0.4984	0.5118	0.5254	0.5392	0.5531

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

1868phae.proj..469P

49	50	51	52	53	54
.0709	.0555	.0401	.0245	0.0088	9.9930
1.177	1.136	1.097	1.058	1.020	0.9840

48.3	48.8	49.3	49.8	50.3	50.8
−0.7	−1.2	−1.7	−2.2	−2.7	−3.2
1.1224	1.1423	1.1626	1.1833	1.2045	1.2261
−0.0122	−0.0209	−0.0297	−0.0384	−0.0472	−0.0559
1.1102	1.1214	1.1329	1.1449	1.1573	1.1702
1.1346	1.1632	1.1923	1.2217	1.2517	1.2820
0.5551	0.5607	0.5664	0.5724	0.5786	0.5851
0.5673	0.5816	0.5961	0.6108	0.6258	0.6410

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

1868phae.proj..469P

55	56	57	58	59	60
9.9769	9.9607	9.9442	9.9275	9.9105	9.8931
0.9482	0.9135	0.8794	0.8463	0.8138	0.7818

51.3	51.8	52.3	52.8	53.3	53.8
−3.7	−4.2	−4.7	−5.2	−5.7	−6.2
1.2482	1.2708	1.2938	1.3175	1.3416	1.3663
−0.0647	−0.0734	−0.0822	−0.0910	−0.0998	−0.1086
1.1835	1.1974	1.2116	1.2265	1.2418	1.2577
1.3129	1.3342	1.3760	1.4085	1.4414	1.4749
0.5917	0.5987	0.6058	0.6132	0.6209	0.6288
0.6564	0.6721	0.6880	0.7042	0.7207	0.7374

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

1868phae.proj..469P

61	62	63	64	65	66
9.8755	9.8574	9.8389	9.8199	9.8004	9.7803
0.7508	0.7201	0.6901	0.6605	0.6315	0.6030
54.3	54.8	55.3	55.8	56.3	56.8
− 6.7	− 7.2	−7.7	− 8.2	−8.7	− 9.2
1.3976	1.4176	1.4442	1.4715	1.4994	1.5282
−0.1175	−0.1263	−0.1352	−0.1441	−0.1530	−0.1620
1.2741	1.2913	1.3090	1.3274	1.3464	1.3662
1.5091	1.5439	1.5794	1.6156	1.6524	1.6902
0.6370	0.6456	0.6545	0.6637	0.6732	0.6832
0.7545	0.7719	0.7897	0.8078	0.8262	0.8451

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

1868phae.proj..469P

67	68	69	70	71	72
9.7596	9.7381	9.7159	9.6928	9.6687	9.6435
0.5749	0.5471	0.5199	0.4929	0.4665	0.4400
57.3	57.8	58.3	58.8	59.3	59.8
-9.7	-10.2	-10.7	-11.2	-11.7	-12.2
1.5577	1.5880	1.6191	1.6512	1.6842	1.7182
-0.1709	-0.1799	-0.1890	-0.1980	-0.2071	-0.2162
1.3868	1.4081	1.4301	1.4532	1.4771	1.5020
1.7286	1.7679	1.8081	1.8492	1.8913	1.9344
0.6934	0.7040	0.7150	0.7266	0.7385	0.7510
0.8643	0.8839	0.9040	0.9246	0.9466	0.9672

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

1868phae.proj..469P

73	74	75	76	77	78
9.6170	9.5892	9.5598	9.5285	9.4951	9.4592
0.4140	0.3883				
~~60.3~~	~~60.8~~	0.3629	0.3377	0.3127	0.2879

60.3	60.8	61.3	61.8	62.3	62.8
-12.7	-13.2	-13.7	-14.2	-14.7	-15.2
1.7532	1.7893	1.8265	1.8650	1.9047	1.9458
-0.2254	-0.2345	-0.2438	-0.2530	-0.2623	-0.2717
1.5278	1.5548	1.5827	1.6120	1.6024	1.6741
1.9786	2.0238	2.0703	2.0186	2.1670	2.2175
0.7639	0.7774	0.7913	0.8060	0.8012	0.8370
0.9893	1.0119	1.0351	1.0590	1.0835	1.1087

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

1868phae.proj..469P

79	80	81	82	83	84
9.4204	9.3780	9.3314	9.2795	9.2208	9.1533
0.2633	0.2388	0.2145	0.1903	0.1663	0.1423

63.3	63.8	64.3	64.8	65.3	65.8
-15.7	-16.2	-16.7	-17.2	-17.7	-18.2
1.9883	2.0323	2.0778	2.1251	2.1742	2.2251
-0.2811	-0.2905	-0.3000	-0.3096	-0.3191	-0.3288
1.7072	1.7418	1.7778	1.8155	1.8551	1.8963
2.2694	2.3228	2.3778	2.4347	2.4933	2.5539
0.8536	0.8209	0.8889	0.9077	0.9275	0.9481
1.1347	1.1614	1.1889	1.2173	1.2466	1.2769

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

1868phae.proj..469P

85	86	87	88	89	90
9.0737	8.9763	8.8511	8.6748	8.3736	$-\infty$
0.1185	0.09469	0.07097	0.04729	0.02364	0.00000

66.3	66.8	67.3	67.8	68.3	68.8
-18.7	-19.2	-19.7	-20.2	-20.7	-21.2
~~1.4994~~ 2.3781	2.3332	2.3906	2.4504	2.5129	2.5782
-0.3385	-0.3482	-0.3581	-0.3679	-0.3779	-0.3879
1.9396	1.9850	2.0325	2.0825	2.1350	2.1903
2.7466	2.6814	2.7487	2.8183	2.8908	2.9661
0.9698	0.9925	1.0162	1.0412	1.0675	1.0951
1.3483	1.3407	1.3743	1.4091	1.4454	1.4830

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

1868phae.proj..469P

91	92	93	94	95	96
-8.3736	-8.6748	etc.			
-8.1162	-8.4114	-8.8577	-8.7129	8.8103	-8.8899
-8.3736	-8.6748	-8.8514	-8.9763	-9.0727	-9.1523

69.3	69.8	70.3	70.8	71.3	71.8
-21.7	-22.2	-22.7	-23.2	-23.7	-24.2
2.6464	2.7179	2.7929	2.8716	2.9544	3.0415
-0.3979	-0.4081	-0.4183	-0.4286	-0.4390	-0.4494
2.2485	2.3098	2.3746	2.4430	2.5154	2.5921
3.0443	3.1260	3.2112	3.3002	3.3934	3.4909
1.1242	1.1549	1.1873	1.2215	1.2577	1.2960
1.5221	1.5630	1.6056	1.6501	1.6967	1.7454

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

1868phae.proj..469P

97	98	99	100	101	102
~~8.9174~~	~~9.0161~~	~~9.0680~~	~~9.1146~~	~~9.1570~~	~~9.1958~~

72.3	72.8	73.3	73.8	74.3	74.8
-24.7	-25.2	-25.7	-26.2	-26.7	-27.2
3.1334	3.2305	3.3332	3.4420	3.5339	3.6806
-0.4599	-0.4706	-0.4813	-0.4921	-0.5029	-0.5139
2.6735	2.7599	2.8519	2.9499	3.0310	3.1667
3.5933	3.7011	3.8145	3.9341	4.0368	4.1945
1.3367	1.3799	1.4259	1.4749	1.5155	1.5833
1.7966	1.8505	1.9072	1.9670	2.0184	2.0972

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

1868phae.proj...469P

103	104	105	106	107	108
-9.2347	-9.2651	-9.2964	-9.3288	-9.3636	-9.3861

75.3	75.8	76.3	76.8	77.3	77.8
-27.7	-28.2	-28.7	-29.2	-29.7	-30.2
3.8118	3.9520	4.1022	4.2635	4.4373	4.6252
-0.5250	-0.5362	-0.5475	-0.5589	-0.5704	-0.5820
3.2868	3.4158	3.5547	3.7046	3.8669	4.0432
4.3368	4.4882	4.6497	4.8224	5.0077	5.2072
1.6434	1.7079	1.7773	1.8523	1.9334	2.0216
2.1684	2.2441	2.3248	2.4112	2.5038	2.6036

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

1868phae.proj..469P

109	110	111	112	113	114
9.4053	9.4294	9.4525	9.4747	9.4962	9.5169

78.3	78.8	79.3	79.8	80.3	80.8
−30.7	−31.2	−31.7	−32.2	−32.7	−33.2
1.8288	5.0504	5.2924	5.5578	5.8502	6.1742
−0.5938	−0.6056	−0.6176	−0.6297	−0.6420	−0.6544
4.2350	4.4448	4.6748	4.9281	5.2082	5.5198
5.4226	5.6560	5.9100	6.1875	6.4922	6.8286
2.1475	2.2224	2.3374	2.4640	2.6041	2.7599
2.7113	2.8280	2.9500	3.0937	3.2461	3.4143

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

1868phae.proj..469P

115	116	117	118	119	120
~~9.5370~~	~~9.5565~~	~~9.5755~~	~~9.5940~~		

81.3	81.8	82.3	82.8	83.3	83.8
-33.7	-34.2	-34.7	-35.2	-35.7	-36.2
6.5350	6.9395	7.3962	7.9158	8.5126	9.2052
-0.6669	-0.6796	-0.6924	-0.7054	-0.7186	-0.7319
5.8681	6.2599	6.7038	7.2104	7.7940	8.4733
7.2019	7.6191	8.0886	8.6212	9.2312	9.9371
2.9340	3.1299	3.3519	3.6052	3.8970	4.2366
3.6009	3.8095	4.0443	4.3106	4.6156	4.9685

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

1868phae.proj..469P

121	122	123	124	125	126
84.3	84.8	85.3	85.8	86.3	86.8
−36.7	−37.2	−37.7	−38.2	−38.7	−39.2
10.019	10.988	12.163	13.617	15.464	17.886
−0.7454	−0.7590	−0.7729	−0.7869	−0.8012	−0.8156
9.2736	10.229	11.390	12.830	14.663	17.070
10.764	11.747	12.936	14.404	16.265	18.702
4.6282	5.114	5.695	6.415	7.331	8.535
5.382	5.873	6.468	7.202	8.132	9.351

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

1868phae.proj..469P

127	128	129	130	131	132
87.3	87.8	88.3	88.8	89.3	89.8
−39.7	−40.2	−40.7	−41.2	−41.7	−42.2
21.205	26.031	33.694	47.740	81.847	286.48
−0.830	−0.845	−0.860	−0.875	−0.891	−0.91
20.375	25.186	32.834	46.865	80.956	285.57
22.035	26.876	34.554	48.615	82.738	287.39
10.187	12.593	16.417	23.432	40.478	142.78
11.617	13.438	17.277	24.307	41.369	143.69

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

1868phae.proj..469P

133	134	135	~~136~~	~~137~~	~~138~~
90.3	90.8	91.3			
-42.7	-43.2	-43.7			
-190.98	-71.615	-44.066			
-0.92	-0.939	-0.956			
-191.90	-72.554	-45.022			
-190.06	-70.676	-43.110			
-95.95	-36.277	-22.511			
-95.03	-35.338	-21.555			

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

1868phae.proj..469P

~~139~~ ~~140~~ ~~141~~ ~~142~~ ~~143~~ ~~144~~

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

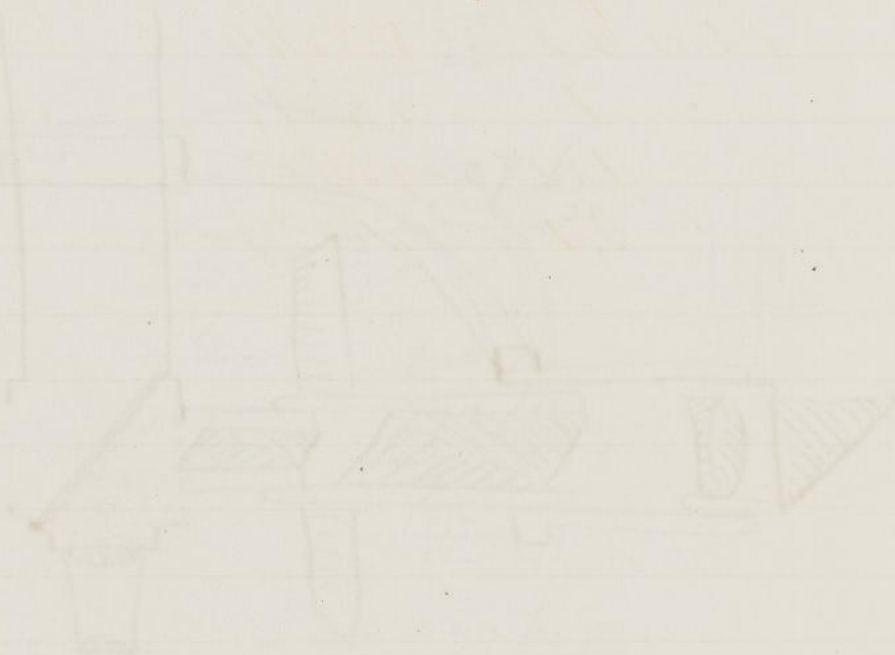
1868phae.proj..469P

Determination of terms of Seidel stars ~~in~~ ~~terms~~ of Uranometria Nova.

Class 3.2 = 8.8849
" 1 = 9.9319
" 1.2 = 9.5318
" 2.1 = 9.4637

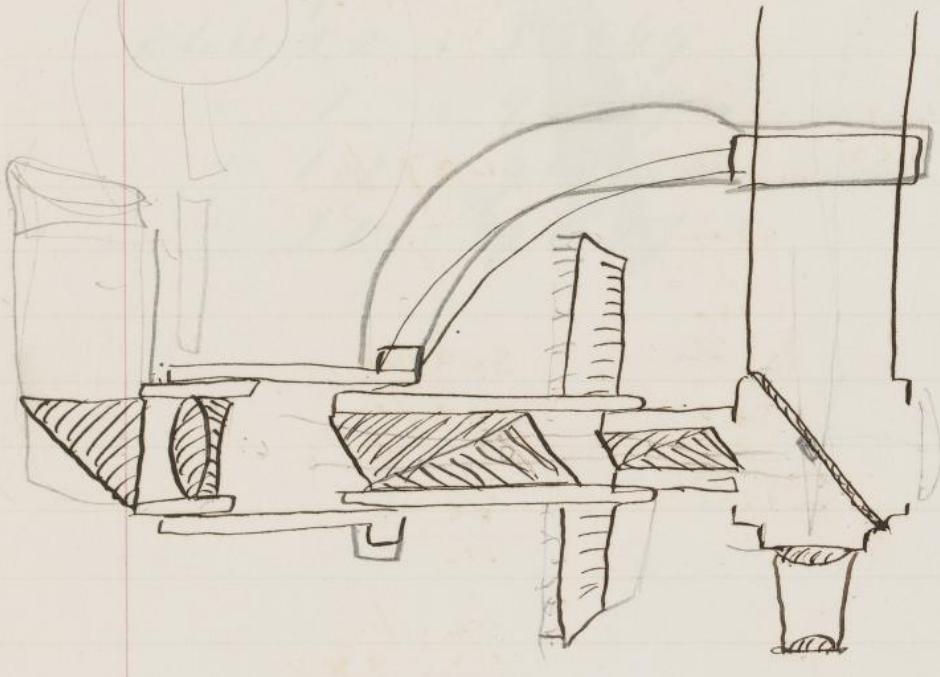
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

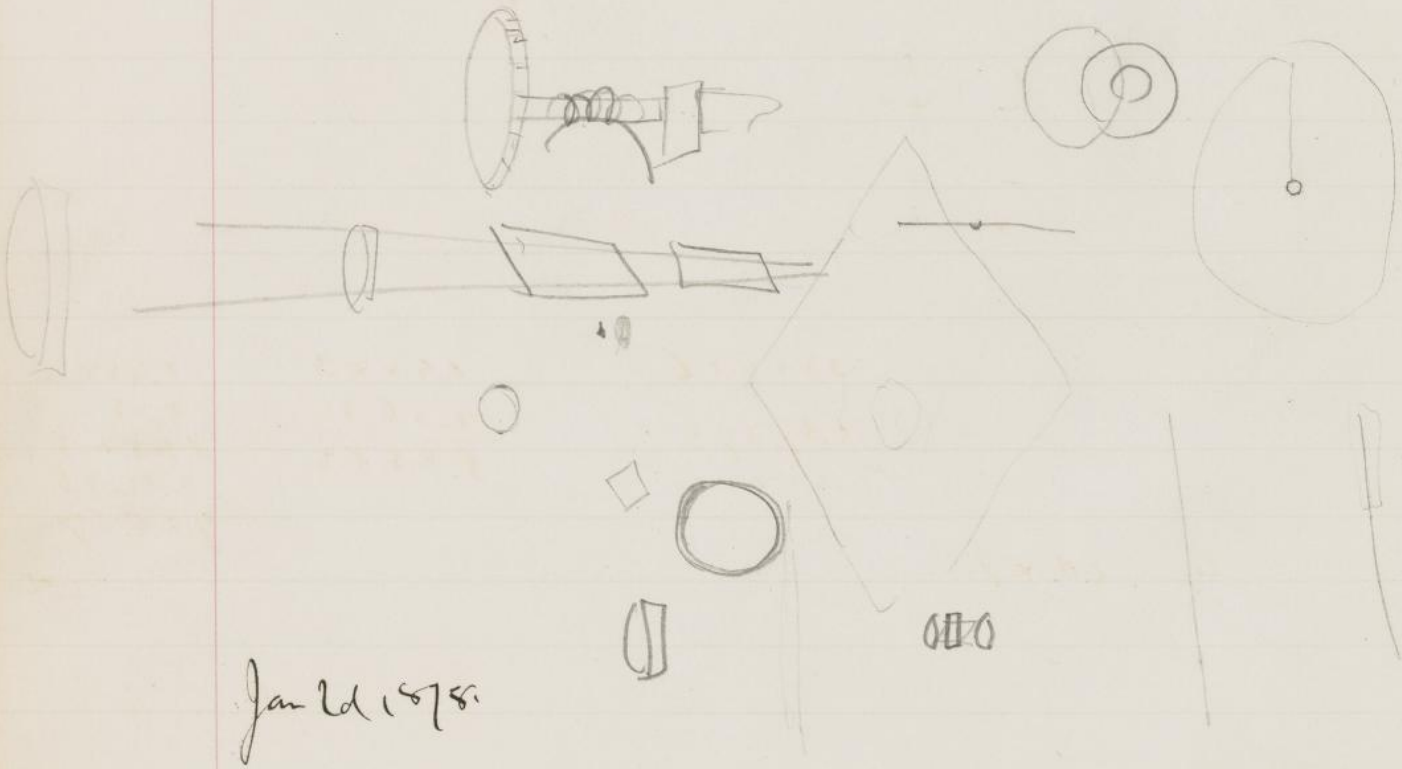
1868phae.proj..469P



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

1868phae.proj..469P





Jan 2d 1878.

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

1868phae..proj..469P

1338
408
5352
107
5459

1338 / 408
1224 328
1140
816
3240

458
94
1832
4172
4.3052

857
94
3404
7659
79974

5825
94
23300
52425
547??

325 / 14
28 23
45
42

427 / 14
42 305
7

800 / 14
792 / 14
76 56
95
84
110

542 / 14
42 387
122
112
100

A b
− +a

− −
1 1



382426
2.37392
1.45034

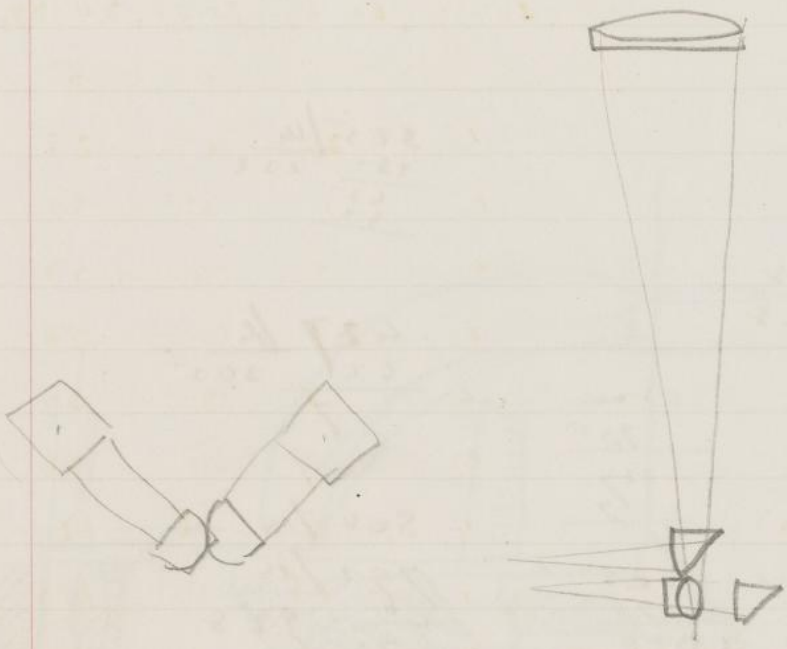
1,4503
2.5635
8.8868

1.4503
256
1,4503
2.1036
9.3467

6. E.A. × ℓ₀

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

1868phae.proj..469P



23	23	1 - 5.9	2.0
12	63	60 - 6.9	4.0
31	31	7.0 - 7.9	4.3
5	27	8.0 - 8.7	4.5
32	14	90	4.7
108	158		< 5.0
	17		5.2
			5.3
			< 5.5
			> 5.7
			5.8
			5.9

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

1868phae.proj..469P

		4.0 – 5.9	6.0 – 6.9	7.0 – 7.9	8.0 – 8.9	9.0 – 9.5
9	89			1	5 3	32
38	88	2.0	1	2	22 11	115
13	87	5.0	1	1	56 37 13	176
21	86	4.5 5.7	2	5	10 4 57 22	279
28	85	5.0 5.0	2	4	13 9 76 26	317
11 6	84	5.0 5.5	2	6	31 18 89	431
14 10	83	5.0 5.0 5.2	3	7	4 21 86	558
15 10	82	4.0 5.0 5.0 5.5	4	6	5 16 120	605
20 17	81	4.3	1	16	3 35 115	677
30 23	80	4.9 5.3 5.5 5.5 5.7 5.8 5.9	1	16	7 42 135	593
199			23	63	163	

		5.0 – 5.9	6.0 – 6.9	7.0 – 7.9	8.0 – 8.9	9.0
80	30	7	16	7		
81	20	1	16	3		
82	15	4	6	5		
83	14	3	7	4		
84	11	2	6	3		
85	28	2	4	3	10	9
86	21	2	5	5	5	4
87	13	1	1	1	4	6
88	35	1	2		2	4 15 11
89	9			1		5 3
199						

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

1868phae.proj..469P

Diameters of Planets.

	Amer. Almanac			Dist. 1	Brit.
Mars.	2.842	0.25	1.78	5.06	5.35
Jupiter p	18.78	.70	5.01	94.08	92.42
e	20.00			100.20	99.704
Saturn p	8.77	.95	8.91	78.14	75.18
e	9.38			83.57	81.106

			Am.
Oct. 17	42.37	2.68	$16.9^2 = 285.61$
	28.18	1.78	$16.9 \times 18.2 = 308.10$

Area Ell. 113.55

Circle π ~~3.68~~ .50.16

63.39

308.10 + 113.55 − 50.16 − ~~19.48~~

421.65 − 19.48 = 402.17

20.054 diam. equiv. circle

m $\frac{\text{equiv. diam.}}{\text{Mer. diam.}}$ = 1.1866

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

1868phae.proj..469P

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

1868phae.proj..469P

$\frac{1}{50}$ = 25.4 .508 = 1 Cubit = 15.324

.508 | 3315 663 | .
1016 | 663 15.32 41 3315 | 508 | 6552
663 3045
3530 2670
3315 2540
2150 1300
1989 1016
1610 2840
1326
2840
2652
880

241 | 153 153 | 158
153
880
765
1150

283
1132
11603
41
283

log 15.3241 = 1.18547
122.5928 1.0884 65

185259
116
185475

36
18
540

450
225
675

450 = 2 diam.

35.54
3.

4.20
15
63.0

Eq
10.065
10.705

log 150 17609
.08846
.26455

117855 112292
8455 8455
338114 338114
451674 446111
126310 120747
35.54 34.75

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

1868phae.proj - 4690

Cy 150	.17609	.26455	18.39			
	.624158	1.53570	34.33 ε	35.54	.7469	.2817 .7897 .7
	.65350	.56504	36.73 ε		"	.3110
	.61371	.52525	33.51 p	34.75	"	.2742
	.63484	.54638	35.19 p		"	.2924
	.66984	.58138	38.14 ε		"	.3274
	.63478	.54632	35.18 p		"	.3923
	.38198	.29352	19.66		9.7145	1.7080 .4790
	.30657	.21811	16.52		"	.8326
	.65760	.56314	36.57		.7470	.3101
	.63875	.55029	35.50		"	.2973
	.62335	.53489	34.27		"	.2819
	.33546	.24700	17.66		.9758	.2228 .9940
	.17370	.08524	12.17		9.9052	.9904
	.09129	.00273	10.06		"	.9079
	.11786	.02940	10.70		"	.9346
	.19302	.10456	12.72		"	.0098
	.30758	.21912	16.56		.9758	.1949
	.35707	.26861	18.56		"	.2444
	.29224	.20378	15.99		"	.1796

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

1868phae.proj..469P

Mount Cuchi of Obs't I.

$\frac{1}{5}$ 125.4
3.175

4 log π .4971
log 377 2.5792
2.5792
9.3979
5.0534
10.9118
~~4.1446~~
5.8584
99
486

0.5017
0.8017
9.9542
9.9542
4.9118
3010
10.6108
5.0534
.5574

635.60	632.10	631.80	629.50	
634.70	253.80	248.90	250.20	
127.030	7| 88590	88070	87970	1266
127.03	126.56	125.81	125.67	012657

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

1868phae.proj..469P

Lead of Light by reflection

95.4 Conf. 912

91.0

1.05 254

250.900

.0001

.1027

127
254
267 | 2507
2507 | 10
1580

.1373 | 5
.1027 |
.0346

.0692

16.975 123.9

16.9 .01245

17.05 .01233

4.65 08

4.49 08

4.58 01

172

4.57

.01265 128.5 124.5

.01263 128.1 1245

.01253 127.3 1233

01252 127.2 1233

.01260 1281 1239

12525
1264

1.15
126.4
115
114

.011

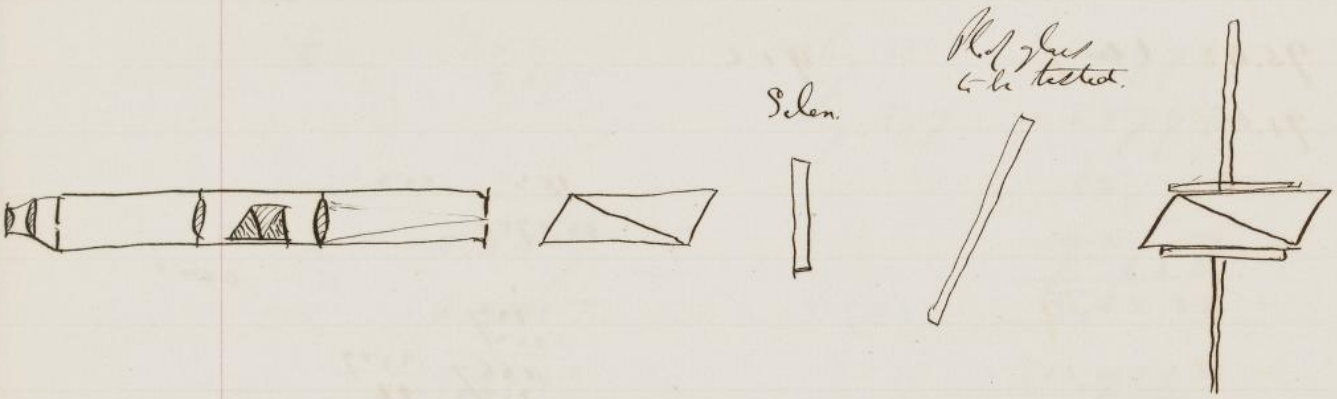
.0126

00014

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

1868phae.proj..469P

Micrometer. Jan 13 A. 1878



E line = ~~A~~ 5" hole plum

~~.4109~~	5" 2.1036	.4654
		.5798
Q 9.5911	3" 1.8835	.4654
R 9.5601		.5763
		.4594
		.4564

1.8835
9.5911
1.4746

2.1036
9.5911
1.6947

1.8835
9.5601
1.4436
9.4564
.9992

1.8835
.3632
1.6637

.8835
.5601
1.4436

2.1036
2.1036
9.5601
1.6637
1.4564
2.2073

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

1868phae.proj..469P

+12.5
+ 7.0
− .9
+ 4.9
− 2.1

+ 3 − 4
+ 21 − 27
+ 16 − 25
+31
+13
3.1

.0331 | 0129
39
9945
2930

1204 | 3315
994 3
2408 | 663
1989 .3632
4190
3978
2120
1989
1310

73
036
3

Jupiter

Sept 9th	37.0	38.0
11	36.7	37.7
13	36.5	37.5
19	35.9	36.9

2.1036
9.8808
1.9844
1.4654
.5190

21036
~~.5911~~
.6947
4654
.2293

21036

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

1868phae.proj..469P

Visual Diameter of Mars.

				Vis. D.
Aug. 18	28".4	.984	8	28.2
Sept. 7	29.2	.998	1	29.2
27	26.4	.975	12	26.2
Oct. 17	21.6	.933	33	20.9
Nov. 6	17.4	.901	50	16.5

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

1868phae..proj..469P

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

1868phae.proj..469P

	Jupiter		Mars.					
	56.8	10			115.7			
	58.9	10			241.1			
			57.9	10				
8th			35.52	6				
			62.9	11	8th	356.8	62	5.755
			56.7	10	10th	108.9	20	5.445
			5.3	1	11th	285.1	50	5.705
			22.8	4	12th	220.6	38	5.805
10th			56.1		13th	237.9	40	5.947
			52.8		19th	56.3	10	5.63
11th	56.1		~~56.1~~		22d.	345.1	60	5.752
	56.8					1610.7	280	
			58.4			458.5	78	
			57.8			1152.2	202	
			56.0					
12th			57.8					
			59.8					
			55.2					
			47.86					
			~~59.7~~ 57.7	8				
13th	59.1							
	59.2							
			59.6					
			60.0					
	56.3							
	56.9		59.9					
	57.8		56.5					
			57.6					
			56.4					

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

1868phae.proj..469P

Amell. 5.684 Brit 5,55

4.86

9|679 67.9 90.
5.754 190

.4536
.25
.7036

11928|17
15
114
52
35
148
133
150
6278

Mean of Jupiter 5754
5.752

5.054

517.9
10928
16107|28
140 5.753
210
196
147
140
70

10928|19
95 5.752
142
133
98
95
30

.7443
.0407
.0814

4500
108
360
45
4536

250

51687
220.6|38
190 57
306 5.805
266
400
266
304
20

3568|62
310 5.755
468
434
340
310
300

5.755
5.760
5.770

11522|202
1010 5.704
1422
1414
80 108

9.1838
785
7.03

Contact of D for Stars 5.75 7.85
5.70
Adj. Sc. 5.60
Clouds 5.56

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

1868phae.proj..469P

July Equals 2000 1.3010

.8548
.8473
.0075

2.834256
5.31443
8.51983

h Equals 9.38

99.704
.364
99.34 = mean.

99.70
.364
mean Brit. 96.06

.9825
Amer. .9876
.0051

81.106
.0365

4055
4466
2433
2.96015
81.106
78.146

.8929
.8577
.0647

100
.927
.9635
.0365

3878
19.39

h. .2876
.70
.9876

97.2

938
877
1515
9075
.9578
.90
.8578

72.1

Mean Diam.
Brit - Amer. +.0051
+.0647
+.0814

July
Sat-
Mean

	Brit.	Amer.	Brit.	Equals Amer.	Mean Brit	Amer
Mean diam.		9	5.55	5.054		
July	96.06	97.2	99.704			
Sat.	72.1	72.1	81.106			

E lie = $\frac{A}{F}$

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

1868phae.proj..469P

$u+v=$	290.3	305.3	964.8	947.3
$u-v=$	51.4	84.9	446.0	51.7
$2u$	341.7	390.2	1110.8	999.0
$2v$	238.9	220.4	818.8	895.6
u	170.85	195.1	555.4	499.5
v	119.45	110.2	409.4	447.8
$\frac{1}{u}$	.58531	.51256	.18005	.20020
$\frac{1}{v}$	.83717	.90744	.24426	.22331
$\frac{1}{F}$	1.42248	1.42000	.42431	.42351
F	70.30	70.42	235.677	236.121

$70.36 = 1.8473$

235.68 04
236.12 44

1.80
235.90

T 2.5635
1.8473
4.4108
3.8342
0.5766
.7493
.8273

250

2.1036
1.8473
3.9509
3.8341
.1168
.7493
.3675

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

1868phae.proj..469P

68284 / 206265
618795 3311
640450
618795
216550
206265
163000

Aperture Ref. D 1 turn = 1.0583 arcsec

254 / 24
24 1583 1.0583
140
120
20

2.116

254
24
127 / 12
12

16129 / 144
144 1200
172
144
289
288
100

19757 / 112
112 176.34
855
672
784
710
672
380
336
440

1.15 / 1.12
112 103
30

6402 / 112
560 57.16
802
784
180
112
680

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

1868phae.proj..469P

98.785 / 99.38

32.01 / 32.20

.575 / .578

99.38 | 198.81

99475 | 199 / 200 / .9975

198.81 / 99.40

64.96 / 32.48

112 / .56

30.044 / 1594 / 14104

.485 / .488 / 976

235.9 / 221.1

.3727 / .3446 / .0281 / .0562 / .6884 / .7446

5554

.81 / 555 / 405 / 405 / 405 / 44955

366.

45,804 / 4208 / 2924 / 2104 / 8200

10,52 | 428 | 13395 / 134.000 / .785 / 670 / 1072 / 938 / 105.190

785

2.5635 / 2.5635 / .3183 / 9.3979 / 4.8432 / .6532 / 4.1900

9.6532 / 4.8432 / 4.8100

2.5635 / 2.5635 / .4971 / 9.3979 / 5.0220 / 65

9.6532 | 50220 / 4.6312

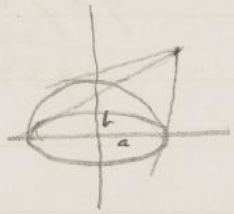
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1868phae.proj..469P

Tangent to ellipse

$a^2y^2 + b^2x^2 = a^2b^2$

$A = a^2 \quad C = b^2 \quad F = -a^2b^2$



$a^2y'y + b^2x'x = a^2b^2$

$a^2y'dy + b^2x'dx = 0$

$y'y + x'x = a^2$

$\frac{dy}{dx}dx = -\frac{b^2x'}{a^2y'}$

$\frac{dy}{dx_c} = -\frac{x'}{y'}$

$\frac{dy}{dx_{circle}} - \frac{dy}{dx_a} = \frac{x'}{y'}\left(1 - \frac{b^2}{a^2}\right) = \frac{x'}{y'}\left(\frac{a^2-b^2}{a^2}\right)$

$a^2y'y + b^2x'x = a^2b^2$

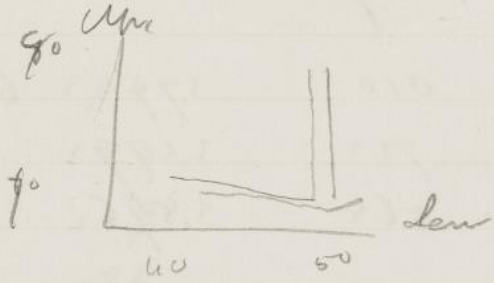
$a^2y^2 + b^2x^2 = a^2b^2$

$y'y + x'x = a^2$

$y^2 + x^2 = a^2$

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

1868phae.proj..469P



.6884
.3010

.9894
0.0106
6312
.6418

Constant of G 379.5

235.9 9

168

219.1

$219.1^2 : 235.9^2 = 506 : A$ $A = 5.867$

0.7042 2.3406
2.3727
2.3727
5.4496
4.6812
.7684

2.5792 19.7684
2.5792 5.0534
0.4971 4.7150
0.3979
0.0534 5.7150
7

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

1868phae.proj..469P

	E	I		
α Lyrae	3.990	.010	3.990	6.010
β Delphini	2.757	.722	3.479	
α Andromedae	3.328	.568	3.896	

16.7 23 501 334 3540 +6.4

32 23 96 64 736 +140 +1 on 14 P.

3142 12 13 16 ~~+6~~ 328

41 48.5 37.9 27.7 62.7 26.7 9.0

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

1868phae.proj..469P

174
123
129
236
19
157
145
166
1003 | 72
724 .001393 45
283
216
670 5.572
648 696
220 6.27

6.27
557 5.70
173



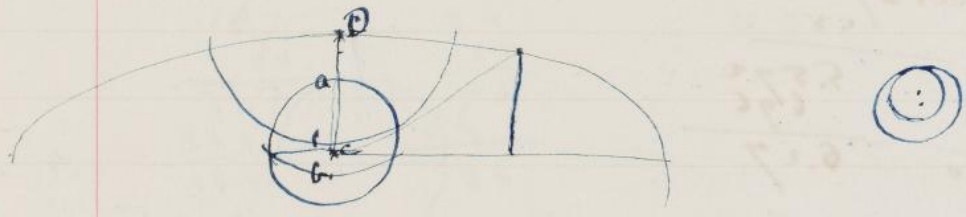
Sat. Neptune.
" Venus
Stars near Mars.
Cent. a Mars.
" " Pluto

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

1868phae.proj..469P

Size of Mars.

Amer.	5.05	8.85
English.	5.55	8.94
Hind	"	8.86
Selenographic	"	8.85
Hamilton	"	"



αb $\quad aD = DC - ac$

$\quad bD = bD$

$ab = bD - DC + ac$

1

$DC = 1 + R - \Delta$

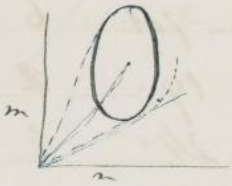
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1868phae.proj..469P

Correction of Position Angles for Ellipticity

$$a^2y^2 + b^2x^2 = a^2b^2$$

$$a^2\rho^2\sin^2 v - 2a^2\rho\sin v\,m + a^2m^2$$
$$+b^2\rho\cos^2 v - 2b^2\rho\cos v\,n + b^2n^2 = a^2b^2$$



$$\rho^2(a^2\sin^2 v + b^2\cos^2 v) - 2\rho(a^2m\sin v + b^2n\cos v) = a^2b^2 - a^2n^2 - b^2n^2$$

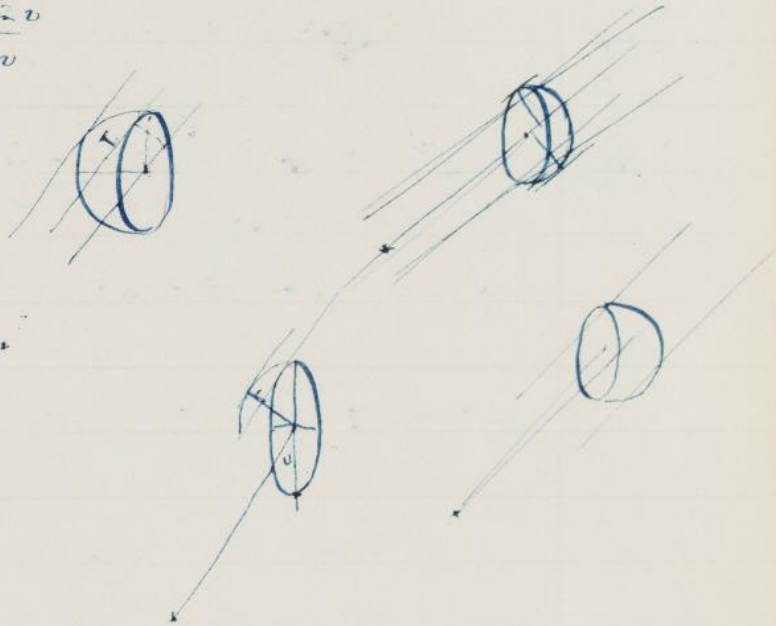
$$- 2\rho\, a^2m\cos v\,dv + 2\rho\, b^2n\sin v\,dv$$

$$2(a^2\sin^2 v + b^2\cos^2 v)\rho\,d\rho + 2\rho^2(a^2\sin v\cos v + b^2\cos v)\,dv - 2(a^2m\sin v + b^2n\cos v)\,d\rho$$

For tangency $dv = 0$

$$2\rho^2(a^2\sin v - b^2\cos v) - 2\rho\, a^2m\cos v + 2\rho\, b^2n\sin v$$

$$\rho = \frac{a^2m\cos v + b^2n\sin v}{a^2\sin v - b^2\cos v}$$



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

1868phae.proj..469P

	δ		λ		Mean.
Jan 7th.	6	9.304	6	9.287	9.295
" 19.	4	9.108	4	9.081 ~~9.295~~	9.094
" 24.	2	9.030	3	8.891	8.960
Feb 2nd	3	8.829	3	8.621	8.725
" 4th	2	9.272	3	9.096	9.184
Jan. 26th	4	9.606	4	9.597	9.601
Feb. 6th	1	9.449	2	9.171	9.310

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

1868phae.proj..469P

Comparisons of λ and δ Ursae Minoris from readings of Zöllner Photometer, Jan. 7 – Feb. 6, 1878.

			δ − λ	
138-9	Jan 7th	λ	0.704	+0.02 ~~27 62 74 0.739~~
145-6	"	"	0.758	−0.04
147-8	"	"	0.726	−0.01
169-70	"	"	0.822	−0.10
171-2	"	"	0.872	−0.15
184-5	"	"	0.818	−0.10
186-7	"	19th	0.832	−0.11
199-200	"	"	0.695	+0.03
207-8	"	24th	0.731	−0.01
220-1	"	"	0.720	0.00
239-41	Feb. 2nd		0.632	+0.09
253-4	"	"	0.459	+0.26
257-8	"	"	0.595	+0.13
269-70	"	4th	0.566	+0.15
224-25	Jan 26th		0.944	−0.22
226-7	"	"	0.714	0.00
233-4	"	"	0.958	−0.24
235-6	"	"	0.549	+0.17
291-2	Feb. 6th		0.622	+0.10
276-82	"	4th	0.739	−0.02

99 / 14
761 / 55
136 / 19.5
21/44.49 / 40.0975
0.72249 ± 0.243 mean deviation

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

1868phae.proj..469P

Stars not in Chal-

Jan 7th	87.169	6.70
" "	88.	6.04
" "	87.217	7.60
" "	86.347	6.97
" "	85.398	7.71
" "	84.523	7.44
" "	84.517	5.35
" "	84.573	6.78
" "	82.704	6.63
" "	82.700	6.85
" "	82.707	4.95
" "	84.406	7.49
" "	84.412	7.02
" "	84.415	7.44
" "	84.413	7.44
" "	84.405	7.19
" "	83.527	7.19
" "	83.530	6.46
" "	83 532	6.89
" "	83.534	6.67
Jan 19th	82.742	6.90

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

1868phae.proj..469P

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

1868phae.proj..469P

321.90

~~548.80~~

356.50

108.80

285.00

220.40

238.00

22.800

56.30

345.00

223.45

2922.15 | 517

2585 5.652

3371

3102

2695

2585

1100

547

478

419

2922.15

548.80

2373.35 | 419

2095 5.666

2783

2514

2690

2514

176.

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

1868phae.proj..469P

Area of Saturn's Disk



$\pi(1^2 - .8801^2 + .8599^2 - .6650^2) \times \text{lin } \varepsilon$
$- d2[1 - .8801 + .8599 - .6650] \times \text{lin } \varepsilon$

π

1.8599	.7746	1.7394
1.5451	.4422	1.2168
.3148	1.2168	.5226
2		

$(\pi .5226 \times \text{lin} - .63d)\ \text{lin } \varepsilon =$
$- .63 \times .63$

37.04

8.93

Aug 23d. 42.88 18.6 plates
Sept 4 42.82 17.86 plates

$.5226 \times \frac{\pi}{4}$
.785
26130
41808
36582
.410241

18.6 / 42.88
17152 .434
14480
12864
16160

43
63
129
258
.274

.5226
3.14

2.5
8
1.7

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

1868phae.proj..469P

864 | 43.16

5. 4320
-005- 4000

2.5

.41
6.25
205
82
246
2.5625
819
1.7435
104
25
2.6
315
130
26
78
.8190

7.74) 3848
3870
220
03

2 .315 × 1.039 × 2.5

39.311 / 17053
4
157244

15.381
4
524
15.381
15.724

39311
4
157244

17.053 / 15381
15381 1.11
16720
15381
13390

39.311 / 15381
30.762 2.556
85490
76905
95550
76905
8945

2.556

2.4985
2.4975

2.4975
2.4975

2.556

4.995
497

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

1868phae.proj..469P

1.0787

.785 / 1.27
7416 / .847 / 3.14
4340
3708
6320
3388
847
2541
2.66958

II. .785 × 1. × 1.0787

.848

1.0386

$\Delta = l$	.0285	.0410	.0535	.0631	.0680	.0674	.0606
$1/4\ \Delta = l$	.0495	.0713	.0931	.1097	.1183	.1173	.1054
$A = 2\pi l$	.897	.919	.941	.958	.966	.965	.953
d	1.069	1.082	1.095	1.105	1.109	1.108	1.102
D''							
$1/4\ \Delta = l$							

.0491	.0329	.0145	2.01	.3032
.0854	.0572	.0252	1.87	.2718
.933	.905	.873		.0314
1.090	1.074	1.055		.063

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

1868phae.proj..469P

Comparison Photo H. I

			Mag.
α Andromedae	~~8.3~~	1.3°	8.3
α Cass.		2.7	
φ Eridani		5.0	
a Ursae Minoris		2.7	
~~+ Cet~~		7.0	
β Orionis		3.	
δ Orionis		7.	
" "		7	
σ a Lyrae.	d	5.	
~~39 Draconis~~		.6	10
β Delphini		2.5	
52 Cygni		6.	
f "		7.	
δ Equulei		3.	
I Aquilae		6.	
β Cephei		6.	
κ Aquilae		4.	
ψ Aquarii		7.	
ψ Cass.		6.	
η Persei		7	
o "		6.	
ζ "		3.	
ε "		6	
40 Eridani		5	
ε 6553 Lah.		6	
α Ca Maj.		.8	
δ Gemin		7.	

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

1868phae.proj..469P

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

1868phae.proj..469P

α Geminorum 2

β "

Γ "

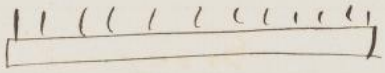
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1868phae.proj..469P

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

1868phae.proj..469P

Probable Error of Scale.



Let ε = prob. er. 1 setting

ε' = " " 1 div.

m settings on each of n divs.

μ = interval of mean

$\sqrt{\varepsilon}$ $\qquad \frac{\varepsilon}{\sqrt{m}}$ = prob. er. 1 setting div.

$\frac{\varepsilon}{\sqrt{mn}}$ $\qquad \sqrt{\left(\frac{\varepsilon}{\sqrt{n}}\right)^2 + \varepsilon'^2}$ = prob. er. mean

$\frac{\varepsilon}{\sqrt{mn}}$ = ell. mean if $\varepsilon' = 0$

$\frac{\varepsilon'}{\sqrt{mn}}$ = " " " $\varepsilon = 0$

$\frac{\sqrt{\varepsilon^2 + \varepsilon'^2}}{mn}$

$\sqrt{\frac{\varepsilon^2}{mn} + \frac{\varepsilon'^2}{n}}$ $\qquad \frac{\sqrt{\varepsilon^2 + \varepsilon'^2}}{\sqrt{mn}}$ = prob. er.

ε = ell. each div.

$\frac{\sqrt{\varepsilon^2 + \varepsilon'^2}}{\sqrt{n}}$ $\qquad \frac{\sqrt{\frac{\varepsilon^2}{m} + \varepsilon'^2}}{\sqrt{n}} = \frac{\sqrt{\varepsilon^2 + m\varepsilon'^2}}{\sqrt{mn}}$

$u' = \frac{\varepsilon^2}{m} + \varepsilon'^2$

$u = \frac{\sqrt{\varepsilon^2 + m\varepsilon'^2}}{m(a-m)}$ $\qquad \frac{\varepsilon^2 + m\varepsilon'^2}{am - m^2}$

$$\frac{du}{dm} = \frac{-(a-2m)(\varepsilon^2 + m\varepsilon'^2) + (am - m^2)\varepsilon'^2}{am - m^2}$$

$-am\varepsilon'^2 - m^2\varepsilon'^2 - a\varepsilon^2 - am\varepsilon'^2 + 2m\varepsilon^2 - 2m^2\varepsilon'^2$

$2m\varepsilon^2 - 3m^2\varepsilon'^2 - a\varepsilon^2 = 0$

$m = \frac{a\varepsilon^2}{2\varepsilon^2 - 3\varepsilon'^2}$

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

1868phae.proj..469P

Probable Error.

Group of n at each end. Odd number $= a$

$$I = \frac{\sqrt{2}\,\frac{\varepsilon}{\sqrt{n}}}{a-n} \qquad I'^2 = \frac{2\varepsilon^2}{n(a-n)^2} = \frac{2\varepsilon^2}{a^3 p(1-p)^2} \qquad I' = \frac{\varepsilon}{a}\sqrt{\frac{2}{a}}\,\frac{\sqrt{p}}{p(1-p)}$$

I' min when $n(a-n)^2$ max

$$u = n(a-n)^2 = a^2 n - 2an^2 + n^3$$

$$\frac{du}{dn} = a^2 - 4an + 3n^2 = 0$$

$$\frac{n}{a} = p \qquad a^2 - 4a^2 p + 3a^2 p^2 = 0$$

$$3p^2 - 4p + 1 = 0$$

$$p^2 - \frac{4}{3}p + \frac{4}{9} = -\frac{1}{3} + \frac{4}{9}$$

$$p - \frac{2}{3} = \sqrt{\frac{1}{9}}$$

$$p = \pm\frac{1}{3} + \frac{2}{3}$$

$$p = \frac{1}{3}$$

.01	10.
.1	3.571
.2	2.795
.3	2.608
.33	2.598
.4	2.635
.5	2.828

.1 / .09 .01×9

1 $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{10}$

$\frac{\sqrt{.1}}{.1\times.9}$ $\frac{\sqrt{.1}}{.09}$ $\frac{\sqrt{.2}}{.16}$ $\frac{\sqrt{.3}}{.21}$ $\frac{\sqrt{.4}}{.24}$ $\frac{\sqrt{.5}}{.25}$ $\frac{\sqrt{\frac{1}{3}}}{\frac{2}{9}}$

.3162 .4472 .5477 .6325 .7071 .57734

.09 .16 .21 .24 .25 .22222

.02458 .02828 .03333 .03849 .04547 .03810

3.513 2.795 2.608 2.6384 2.8284 2.5983

3.571 .1
2.795 .2
2.608 .3
5.69

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

1868phae.proj..469P

Effect a Photometer of two images not adjacent



pts dist a 0 180°

" " b 0+α 180°+α

light of a at v = $A^2 \sin^2 v$

" " b " " = $B^2 \cos^2(v+\alpha)$

$A^2 \cos^2 v = B^2 \sin^2(v+\alpha)$

$\frac{A}{B} = \cos\alpha \operatorname{tg} v + \sin\alpha$

$\operatorname{tg} v = \frac{M - \sin\alpha}{\cos\alpha}$

$\operatorname{tg} v = M \sec\alpha - \operatorname{tg}\alpha$

$M \sec\alpha - \operatorname{tg}\alpha = M$ if $M = \frac{\operatorname{tg}^2\alpha}{\sec\alpha - 1}$

$\frac{\frac{\sin^2\alpha}{\cos^2\alpha} + \operatorname{tg}\alpha}{\operatorname{tg}^2\alpha} = \frac{1}{2\cos\alpha\sin\alpha} + \cot\alpha$

$2\operatorname{cosec} 2\alpha + \cot\alpha$

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

1868phae.proj..469P

Frequency of Errors in Dh. as on 4 C.S.P.

	0 – 9	10 – 19	20 – 29	30 – 39	
0	1	𝍸 !	!!	!	
1	!	!!	!!	!	!
2	!!	!!!			
3	𝍸	𝍸 !!	!		
4	!!!		! !		
5	!!!!	𝍸			
6	𝍸 !!	!!!			
7	𝍸 !				
8	!!	!!!			
9	!!!!	!!	!		

0 – 4	12
5 – 9	23
10 – 14	18
15	13
	7
	1
	2
	0
	1

Σ Probable	2.2 – 2.7	+100	+25	+.18
	2.8 – 3.2	+43	+10.7	
	3.3	+68	+13.6	+8.6
	3.8	+18	+3.6	
	4.3	−28	−5.6	−7.0
	4.8	−42	−8.4	
	5.3	−70	−14.0	−16.0
	5.8	−90	−18.0	
	6.3	−66	−13.2	−10.2
	6.8	−36	−7.2	
	7.3	−38	−7.6	−8.6
	7.8	−48	−9.6	
	8.3	−31	−6.2	−9
	8.8	+22	+4.4	

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

1868phae.proj..469P

Comparisons of 2 Comets

$w - x$			$= a$	$= 1.46$
w	$- y$		$= b$	1.47
w		$- z$	$= c$	2.62
	$x - y$		$= d$	$.17$
	x	$- z$	$= e$	$.92$
		$y - z$	$= f$	1.22

$3w - x - y - z = a + b + c = 5.55$

$-w + 3x - y - z = a + d + e = 2.55$

$-w - x + 3y - z = b + d + f = 2.86$

$-w - x - y + 3z = c + e + f = 4.76$

Eliminate z.

$4w - 4x = b + c - d - e$

$4w - 4y = a + c - d - f$

~~$+0w - 2x - 2y = 3a + 3b + 2c + e - f$~~

$20w - 4x + 4w = 6a + 6b + 4c - 2e - 2f$

$+ a + c - e - d - f$

$16w - 4x = 5a + 6b + 5c - d - 2e - 3f$

$12w = 5a + 5b + 4c - e - 3f$

$9w - 3x - 3y - 3z = 16.65$

$-w - x - y + 3z = 4.76$

$8w - 4x - 4y = 11.89$

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

1868phae.proj..469P

$4w - 4x = 3.00$

$4w - 4y = 2.69$

~~$10w - 2x - 2y = 3 \times 5.55 + 4.76$~~

$8w$

$w - x = .75$

$w - y = .6725$

$2w - x - y = 2.9725$

~~$w - x = a \quad x - y = b \quad y - z = c$~~

$a - b = x \quad b - c = y \quad c - d = z$

$x = 1.46$ 4.44

$x + y = 1.47$ 1.085

$x + y + z = 2.62$ 5.525 $2y = .025$

$y = .17$ 2590

$y + z = .92$ 2.565 $2y = .025$

$z = 1.22$

3.255

1.48

4.735 .025

$3x + 2y + z = 5.55$

$2x + 4y + 2z = 5.18$ } normal equations

$x + 2y + 3z = 4.76$

$6x + 4y + 2z = 11.10$

9.52

$4x = 5.92$ $x = 1.48$

$4z = 4.34$ $z = 1.085$

$y = .025$

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

1868phae.proj..469P

Resultant val. by least-squares

$x = 1.48 \quad y = .025 \quad z = 1.085$

		Obs	Comp	C-O
x	=	1.46	1.48	+.02
$x+y$	=	1.47	1.505	+.035
$x+y+z$	=	2.62	2.59	-.03
y	=	.17	.025	-.145
$y+z$	=	.92	1.11	+.19
z	=	1.22	1.085	-.135
				.555
				±.0925

∴ Prob. E. of observed diff = about .08

~~if y val = 17 instead of + agreement would be much closer~~

x	1.46	1.565	+.105	1.565	+.105
$x+y$	1.47	1.335	-.135	1.335	-.135
$x+y+z$	2.62	~~2.480~~ 2.420	2.	2.42	-.20
y	-.17	-.23		-.23	-.06
$y+z$	.92	.855		.855	-.065
z	1.22	1.085		1.085	-.135
					.700
					10

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

1868phae.proj..469P

	P	S	u	P	S	u
ab	6.24	4.30	1.12	1.56	1.43	1.12
ac	6.60	5.20	1.40	1.65	1.30	
ad	10.74	7.71	2.27	2.68	2.57	
bc	.30	~~3.61~~	.19	.075	.30	
bd	3.84	2.60	.89	.96	.87	
cd	4.85	4.08	.80	1.21	1.36	

	P	S	u
ad	2.68	2.57	2.27
ab+bd	2.52	2.30	2.01
ac+cd	2.86	2.66	2.20
ab+bc+cd	2.84	3.09	2.11
	190	262	59
	2.72	2.65	215
	-4	8	12
	-20	35	14
	+14	1	5
	+12	44	4
	.50	88	35
	.12	22	.09

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

1868phae.proj..469P

$x = \frac{1}{4}(2a + b + c - d - e)$ 1.48

$z = \frac{1}{4}(-b + c - d + e + 2f)$ 1.085

$y = \frac{1}{4}(-a + b + 2d + e - f)$ .0125

	O	C	C-O	
x	1.46	1.48	+.02	1.48
x+y	1.47	1.4925	+.0225	
x+y+z	2.62	2.5775	-.0425	
y	.17	.0125	-.1575	.0125
y+z	.92	1.0975	+.1775	
z	1.22	1.085	.135	1.085
			.5550	
			.0925	

Palmer

	O	C		
a	1.56	1.604	+.044	1.60
b	1.65	1.613	-.037	
c	2.68	2.697	+.017	
d	.075	.009	-.066	.01
e	.96	1.093	+.133	
f	1.21	1.084	-.126	1.08
			.423	
			.0705	

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

1868phae.proj..469P

P dl. dom

$3x + 2y + z = a + b + c$.
$2x + 4y + 2z = b + c + d + e$
$x + 2y + 3z = c + e + f$

$6x + 4y + 2z = 2a + 2b + 2c$
$2x + 4y + 6z = 2c + 2e + 2f$

$4x = 2a + b + c - d - e$
$4z = -b + c + d + e + 2f$
$2x + 2z = a + 2c - 2d + 2f$
$4y = a + b + c + d + e - f$

x	z			
2.92	1.47	5.18	2.62	1.47
1.47	2.21	2.68	92	34
2.62	4.09	2.50	2.44	92
7.01	17		5.98	2.73
1.09	92		1.64	2.68
4 | 5.92	2.44		4.34	05
1.48	3,53		1085	

$4y = b + c + d + e - 2a - 2c + 2d - 2f$
$-2a + b - c + 3d + e - 2f$
$2x + 2z = a + c - d + f$
$4y = a + c + d + 2e + f$
$b + c + d + e - a - c + d - f$
$4y \quad -a + b + 2d + e - f$

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

1868phae.proj..469P

θ Orionis

13
9
20
7
8
22
12
11
10
23
14
18
27
13
13
12
12
24
18
23
11
19
9
348 | 23
23 | 15
118

~~13~~

4 | 15
.04

13.
18
12
14
6
14
6 | 77
.128
~~88~~
11 = 8.2 hrs.

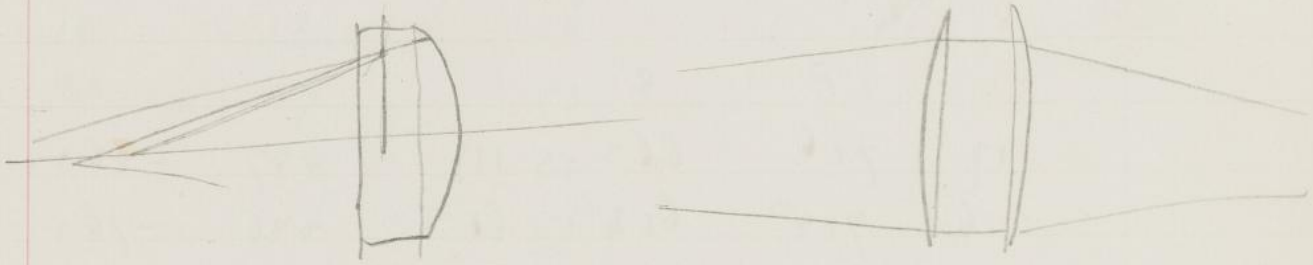
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1868phae.proj..469P

$$3x + 2y + z = 5.55$$
$$2x + 4y + 2z = 5.18$$
$$x + 2y + 3z = 4.76$$

4.44	2.96	1.48
.025	.05	.025
1.085	2.17	3.255
5.550	5.18	4.76

3.12	2.68	1.65
1.65	.96	.15
2.68	2.42	.96
7.45	6.06	2.76
1.035	1.725	2.725
4 | 6.415	4.335	.035
1.60375	1.084	.009



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

1868phae.proj..469P

2ter tiefh.

$$x = a$$
$$x + y = b$$
$$y = c$$

$$2x + y = a + b$$
$$x + 2y = b + c$$
$$2x + 4y = 2b + 2c$$
$$4x + 2y = 2a + 2b$$
$$3x = 2a + b + c \qquad x = \tfrac{1}{3}(2a + b - c)$$
$$3y = -a + b + 2c \qquad y = \tfrac{1}{3}(-a + b + 2c$$

379 .1516
226
605 | 44
44 .135
165
132
230
220

379
364
308 | 68
1050 | 15
168
370
340
350

1050
204
1254 | 8
120 .157
54

308 | 18
18 17
128
128

	P		S			
17	7.26	6.63	.11	+37	-26
6	7.15	6.13	66	+26	-76
52	6.57	6.48	26	-32	-41
22	7.31	7.28	55	+42	+39
9	7.18	6.96	22	+29	+.07
106	47	368	175		
.21	7.094	6.736	.35		

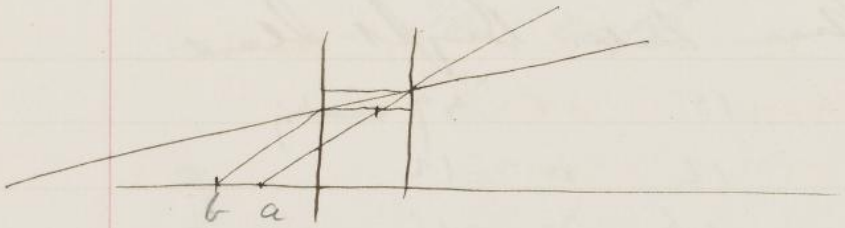
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

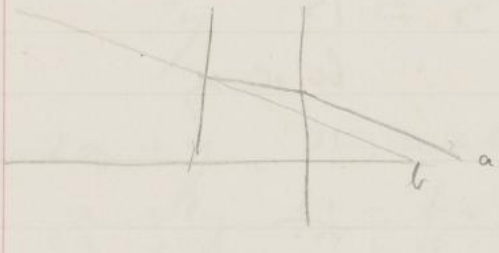
1868phae.proj..469P

Mean Dist.			Bright Stars
24	19	15	39 *Cambridge
12	9	12	12
12	13	36	16
13	5	17	18
13	9	19	60 *Cambridge
9	12	17	10
14	15	14	13
12	9	14	512
24	9	27	
18	14	14	
13	8	12	
9	14	21	
20	6	18	
7	14	16	
8	12	21	
22	18	6	
12	13	18	
11	15	12	
10	12	308 16	
23	29	13	
14	22	21	
18	16	554	
27	26	14	
23	22	19	
11	22	13	
379	363 ~~45~~	~~39~~ 27	
.1516	~~578~~ .1452	12 459	

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

1868phae.proj..469P





18 | 99
.12

+3.95
−3.95
13 | 7.90
61

+2.76
−3.95
219
12
109
19

67 44
69 77
9 16
45 35
61 81
16 10
267 263
263
530 | 12
48 44
50

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

1868phae.proj..469P

Reduction of brightness by Reflection and absorb. .0000

.9542
30 10
.6532

.3468

.867 mag.

Mean Dist. by Stars 7.2

					Dist	Mag.		
γ	Cass.	.55			32	8.9	X	
ι	"	.29	d		2"			Ex
θ	Ret.	.22		2.2		10.9		Ex
γ	Ceti	.24			3"			Ex
η	Tauri	.26			117	~~11~~	X	
ε	Persei	.21			9	8.3		
o²	Eridi	.21		4.6	9	8.5		
σ	Orionis c	7.2				10.3		Ex
ε	Lyr	21		6.		10.5		Ex
β	Orionis	.27		3				
δ	"	29		8				
α	Leon	23		33	4			
κ	Can Maj	60		.6				Ex
β	Del,	36		2		11.0	×	Ex
μ	Cyg	22						
ο	Drac.	27			30		X	
ε	"	23			3			
δ	Cyg	22						
α	Lyr	24						Ex

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

1868phae.proj..469P

A. 23. Lat. Oct 1877 -

65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
							6.7			8.0			7.7		8.6	
							7.4			~~8.8~~			8.2		8.7	
										7.8					9.0	
										7.5					7.0	
										7.5					8.3	
										7.4					~~9.1~~ 9.2	
															7.5	
															7.8	

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

1868phae.proj..469P

8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5
8.0			8.5	8.7	(9.0 9.4)	8.5	9.4	9.2	9.1	8.8	9.5	9.5	9.7
8.5			8.4		8.2	9.4	8.8	9.0	9.0	9.1	9.2	9.5	9.3
			7.8		8.8	8.0	9.0	9.1	9.2	8.7	9.1	9.2	9.4
			8.9			7.8	8.6	9.0	9.1	8.8	9.0	9.2	
			7.8			8.0		9.1					
			8.6			8.7		8.8					
			8.8					8.9					
								9.0					
								9.0					
								9.1					
								9.3					
								9.1					
								8.9					
								9.1					
								6.6					
								7.0					

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

1868phae.proj..469P

Obelen

	Uranus	Regulus	U − R
P	3.46	3.30	+16
4	333	324	+9
U	237	258	−21
S	245	264	−19
I	264	234	+30
U	256	252	+4
P	268	282	−16
			115
			16
			Σ+59
			Σ−56

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

1868phae.proj..469P

Atlantis

	Uranus	Regulus	U-R
P	3.03	3.08	-.05
"	3.80	3.84	-.04
U	3.30	3.12	+.18
S	3.00	3.18	-.18
P	2.76	3.06	-.30
S	2.00	2.40	-.40
U	2.66	2.56	+.10
P	3.34	3.84	-.50
U	2.68	2.70	-.2
P	3.39	3.24	+.15
U	2.16	2.70	-.54

Σ+53

Σ-203

11/256

.23

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

1868phae.proj..469P

Calculations Phot G & I

50605×81

$\frac{\pi}{4}$ 379.5

529
81
529
4152

50605
81
50605
404840
4099005

4.099 113.113.

381
364
2857
2271
1188

4099 | 113113
4095 | 113
339 | 3624 | 81
705 | 324 | 4
678 | 3
270
226
440

3.43

$.3624 \times \left(\frac{235.7}{224.1}\right)^2$

9.55919
2.37273
2.37273
4.304885
4.68918
9.61547

4126

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

1868phae.proj..469P

Constant of E'

45° $\frac{1}{2}(A+B)$ 5.73 $n = 1.55$ d_L .141

C – log.90 – 5.73

9.954 8.758
8.758
1.196

5.73 8.75815
94.27 9.97437 .94874
5.40 8.73252 7.51630
5.09 8.70689
.94874
7.51630
.01672 6.22319
.0000054889 3.73949

248

13.40
6.70 .0005
3.90
0.60 4.0

$\frac{1}{2000}$

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

1868phae.proj..469P

Cortie Sol. Nos.

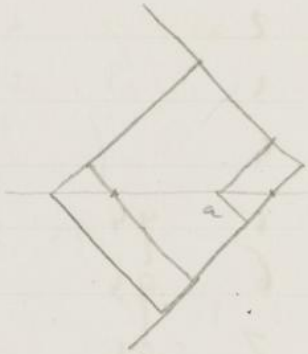
.7.1761	4.3522	5.65
1206	4.2412	5.76
1303	4.2606	5.74
.1987	4.3974	5.60
.0374	4.0748	5.93
.0374	4.0748	5.93
.2810	4.5620	5.44
.3444	4.6888	5.31
.0734	4.1868	5.81
.1171	4.2342	5.77
.1614	4.3228	5.68

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

1868phae.proj..469P

30.044 24.000 17.000

94.296 30.352 0.530



$\sqrt{5}(R-z)$

$\sqrt{5}(R-z+a)$

$$A = c.5\left[(R-z)^2 + a(R-z)\right.$$

$$R^2 - Rz + Ra - Rz - z^2 -$$

$$94.296 = .5c\,(30.044-z)^2 + a(30.044-z)$$
$$30.352 = .5c\,(24-z)^2 + a(24-z)$$
$$\cancel{17.530} = .5c\,(17-z)^2 + a(17-z)$$

$$.5c = \frac{94.296 - a(30.044-z)}{(30.044-z)^2}$$

$$= \frac{30.352 - a(24-z)}{(24-z)^2}$$

$$= \frac{.530 - a(17-z)}{(17-z)^2}$$

14
14
196

14.
96. 32. 50

1

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

1868phae.proj.:469P

	Ids.	Mean					
1	10	32.	3.2	4	3	7	3
2	7	42	4.7	4	6	5	3
3	8	36	4.5	2	5	3	5
4	7	33	4.7	4	2	3	6
		32	4.6				
5	.94	13 52	40	3	5	4	5
6	.93		40	5	9	6	6
7	.91		7 | 17	2	3	5	4
8	.90		.0424	3	3	733	32
9	.90	.30		2	36		
10	.89			3			
11	89			11	32 3.2		.042
12	.88			1			
13	.88			3			
14	875			3			
15	.875			3			
16	.875	.244		4			
17	.871			8			
18	.870			4			
19	.868			5			
20	.867			42			
21	.866						
22	.865						
23	.864						
24	.863						
25	.863	.173					

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

1868phae.proj...469P

Prob. Σ mea = $\frac{.845}{\sqrt{m-1}}$

m	$\log m-1$	$\log\sqrt{m-1}$	.927	
2	000	000	.927	.845
3	302	.151	.776	.597
4	478	.239	688	.488
5	602	301	626	.423
6	~~699~~ 700	350	577	.378
7	778	389	538	.345
8	845	423	504	.319
9	904	452	475	.299
10	954	477	450	.282
11	1.000	500	427	.267
12	1.042	521	406	.255
13	1.080	540	387	.244
14	1.114	557	370	.234
15	146	573	354	.226
16	176	588	339	.218
17	204	602	325	.211
18	230	615	312	.210
19	256	628	299	.199
20	278	639	288	.194
21	302	651	276	.189
22	322	661	266	.184
23	342	671	256	.180
24	362	681	246	.176
25	380	690	.237	.173

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

1868phae.proj..469P

$94.296 = .5c(197.22 + a\ 14044$

211 $\quad 7^{02} \quad 1600$

94.296 / 199.33 $\quad c = .47 \quad a = .15$

9382 / 47 $\quad 94.296 \quad 93.583$

94332 / 2 138531 $\quad 30.352 \quad 30.64$

.47 $\quad 79732 \quad 530 \quad .540$

93.5851

652
47
4564
2608
30.644

1.15
47
805
460
.5405

$A = .47[(R-16.00)^2 + .15(R-16.00)]$

	Obs	C.	C-O
14044	1.1516	1.1576	1.1557 -.0039
082	.656	.6579	.6601 +.0022
28088	.082	.0869	.0861 -.0004
112352			
1.151604			

082
8
656

15.95

$A_p = .082(R-15.95)$

082 | 87
105 | 82
50

$\pi(A_1)^2 = \pi(.082)^2(S-S_0)^2$

$A = \frac{\pi}{4}(.082)^2(S-S_0)^2$

14094
82
28188
112752
1155704

805
82
1610
6440
66010

105
82
210
840
8610

$.082(R-15.94)$ gives C-O as follows: -.0031, +.0030, -.0002, and has been adopted.

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

1868phae.proj..469P

$$A = .5c[R^2 - aR]$$

$$94.296 = .5c[140\mu^2 + a\,140\mu]$$
$$30.352 = .5c[8^2 + a8]$$
$$530 = .5c[1 + a]$$

$$94.296 = \frac{.530}{1-a}[140\mu^2 - a140\mu]$$
$$30.352 = \frac{.53}{1-a}[64 - a8]$$

$$\frac{140\mu^2 - a140\mu}{94.296} = \frac{.530}{1-a} \qquad 140\mu^2 + 2.8088$$
$$8^2 + 1.6$$
$$1 + .2$$

$$\frac{64 - 8a}{30.352} = \frac{.53}{1-a}$$

$$64 - 8a - 64a + 8a^2 = 15.$$

$$120 \overline{)53} \quad 48 \quad .4417$$

$$65.6 \overline{)30.352} \quad 46 \quad 2624 \quad 4112$$

$$65.6 \quad 45 \quad 3280 \quad 2624 \quad 29.520$$

$$41 \quad 45 \quad .54$$

$$(140\mu^2) \quad 197.22 \quad 2.81 \quad 28003 \quad 45 \quad 90.$$

$$41 \quad 41 \quad 164 \quad 1681 \quad 314 \quad 6724 \quad 1681 \quad 5063 \quad 527834$$

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

1868phae.proj..469P

.04 = .096 = .1 mg
.004 = .0093 .01 mg
.08 = .202 .2 "

1.1596 = a 30.044 − b
.6579 = a 24. − b
.0899 = a 17. − b
1.9044 = a 71.044 − 3b

34.839 = ~~41.22~~ 902.64a − 30.044 b
15.790 = 576 a − 24 b
1.477 = 289 a 17 b
52.106 = 1767.64a − 71.044 b
52.106 = 1767.64a −

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

1868phae.proj..469P

1,1596
30044
46384
46384
34488
34.839022 4

6579
4
26316
13158
15789 6

867
17
6083
869
14773

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

1868phae.proj..469P

1	P	7.4	-26		
2	S	20.4		+87	
3	U	72			-53
4	P	-	-10		
5	U	-			+57
6	P	6.3	-34	~~+34~~	
7	S	6.		+45	
8	P	18.8	-1		
9	U	3.0			-61
10	P	11.4	-9		
11	S	24.4		-25	
12	P	14.8	+51		
13	U	21.6			+55
14	P	7.0	-43		
15	U	17.6			-28
16	S	13.8		-13	
17	P	7.6	+10		
			-62	+94	~~254~~
					~~5~~
			-8	+22	+30
					-6

100 77 15 2.00

1873 | 15 — 15 — 125 — 37 — 30 — 7

5.56 — 27.56 | 17 — 17 — 105 — 102 — 36 — 34 — +6 2.1

608 | 17 — 51 — 98 — 85 — 130 — 136 — 35.8

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

1868phae.proj..469P

−18	−18		
		+65	
			−46
−18	−2		
			+63
−42	−26		
		+23	
+7	+7		−56
	−1		
		−47	
	+59		
			−61
	−35		
		−35	−22
	+18		
	166	170	248
	21	42	50
Mean of all		162. ± 36	± 12.
" " P		154 ± 21	± 10
" " S		184 ± 42	± 16
" " 4		156 ± 50	± 12.

125
.423
50 0
2

33.8
211
716
35 8
35 8
7.553 8

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

1868phae.proj..469P

$$\max \left| \frac{\sin^2 b}{(\cos^2 \frac{1}{2} b)^n} \cdot \frac{2 \sin \frac{1}{2} b}{(\cos \frac{1}{2})^{n-1}} \right|$$

$$\sin^2 b = 1 - \cos^2 b = 1 - \cos^2 \tfrac{1}{2} b + \sin^2 \tfrac{1}{2} b^2$$

$$2 - 2\cos^2 \tfrac{1}{2} b$$

$$\lim x (\cos x)^{1-n}$$

$$(\cos x)^{1-n} \cos x \neq \sin^2 x (1-n) \cos x^{-n}$$

$$\frac{\cos x}{\cos x^{n-1}} = \frac{\sin^2 x (1-n)}{\cos x^{+n}}$$

$$\cos x^{n+1} = \sin^2 x (1-n) \cos x^{n-1}$$

$$\cos^2 x = \sin^2 x (1-n)$$

$$\tan x = \sqrt{\frac{1}{1-n}}$$

$$1 - \cos 2$$

$$\cos 2a = 1 - 2 \sin^2 A$$

$$\cos 2A = 1 - 2 \sin^2 A$$

$$\cos 2 = 1 - 2 \sin^2 \tfrac{1}{2} 2$$

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

1868phae.proj..469P

$\lim u \cos^n u$

$-n \lim u \cos^{(n-1)} u \lim u + \cos^n u \cos u$

$-n \lim^2 u \cos^{n-1} u + \cos^{n+1} u$

$-n \lim^2 u + \cos^2 u$

$.0001 = \frac{3d^2}{256 D 10^2}$

$d^2 = \frac{256}{300} \cdot d^2 \qquad \frac{256}{300}$

$.853 \qquad .924$

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

1868phae.proj..469P

Copern. Ven. Inf.

I ÷ phase × (dist ⊙)² ÷ (dia)²

I.



~~Log dist ⊙~~

Data

A Log phase * 1.472

B Log diam. * 1.387

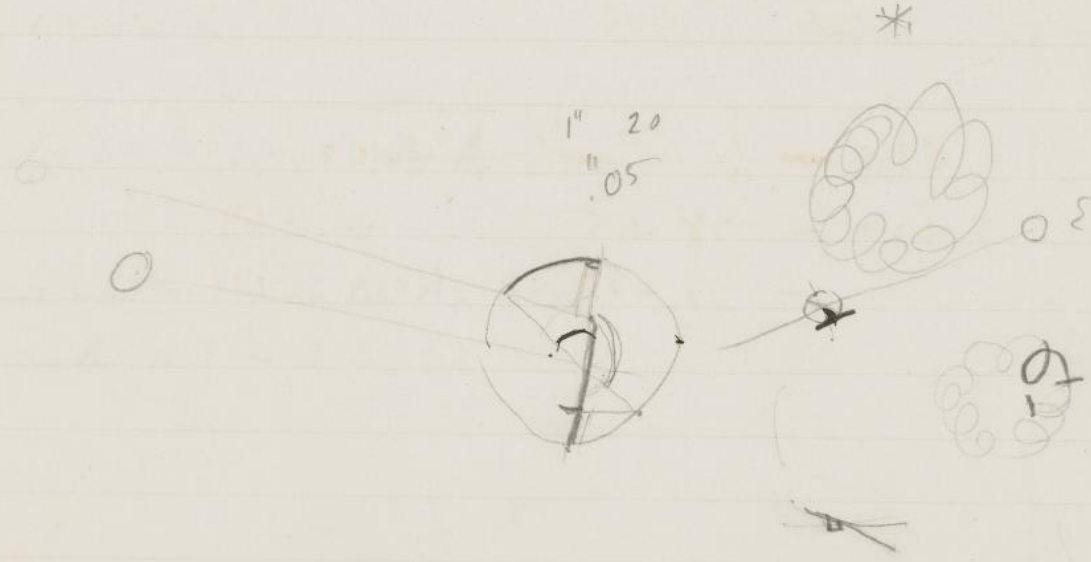
C

Log dist ⊙ * 1.400 Log Rad Vector

2 Log dist ⊙

→ A + B + C = E

D - E



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

1868phae.proj..469P

Ven. Jupiter Oct 28th Nov 7. 17 27
Mean Venus .683 650 612 564

916 51
915 68
847 168
779 -96
683 -115 19
568 -157 +42
411

683
650 33 33 5
612 39 38 (
568 47 42

July 15 945 59
Aug 15 886 15
Sept 15 812 74 12 3
Oct 726 86

$683 + \frac{1}{3}115 + \frac{1}{3}\frac{-2}{3}\frac{1}{2}(42)$

683 − 38 + 5 = .650
− 77 − $\frac{2}{3}\frac{-1}{3}\frac{1}{2}$(42) .611

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

1868phae.proj..469P

.38 $\sqrt{.4}$ .4472

.38 $\sqrt{.4}$ .6325

38

50600

18975

24035

4472
38

35776

13416

17.9936

$I_m = a \cdot \frac{\text{lh dia}^2}{\text{dist}^2}$

$I_s = a$

$\log a_m = \log I_m + C_m$

$\log a_s = \log I_s + C_s$

$\log \frac{a_v}{a_s} =$

$\log a_v - \log$

$\log \frac{a_v}{a_j} = \log I_v - \log I_j + C_v - C_j$

$\log \frac{a_j}{a_v} = \log I_j - \log I_v + C_j - C_v$

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

1868phae.proj..469P

Cy.

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

1868phae.proj..469P

Venus, Jupiter

Date.	Δ R.A.	Δ Dec.					
~~Oct 27~~	~~57 30~~	~~1° 43~~	m.		°	°	
27.0	~~[illegible]~~		57.5	228	13.1	1.7	13.2
28	53 9	1° 51	53.15	228	12.1	1.8	12.2
Nov. 1	35 48	2 20	35.8	227	8.1	2.3	8.4
3	27 09	2 30	27.15	"	6.2	2.5	6.7
4	22 51	2 34	22.85	"	5.2	2.6	5.8
6	14 15	2 39	14.25	"	3.2	2.6	4.1
7	09 58	2 41	10.0	"	2.3	2.7	3.6
9	+ 1 27	2 42	1.45	"	.3	2.7	2.7
13	− 15 23 ~~+ 44 57~~	2 37	15.4	"	3.5	2.6	4.4
17	~~− 31 53 + 24 7~~	2 21	31.9	"	7.2	2.3	7.6
18	− 35 57	2 15	35.95	"	8.2	2.2	8.5

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

1960phae.proj..469P

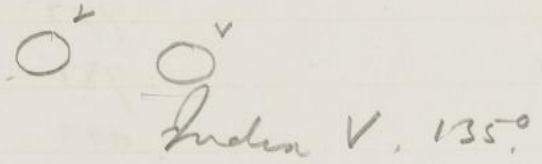
2668

42 Sat.

Cy 25ct.

9.9978

1.4262	1.2695
1.4262	1.2695
.2810	.9846
~~5756~~ 0.1405	
~~9.1566~~	1.9692
2.8502	2.5390
Mar. 7.4308	Sat. 9.4302



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

1868phae.proj..469P

16



Venus			Jupiter		
P	S	u	P	S	u
.124	.978	.997	.092	.228	.134
932	.905	.074	097	.111	.101
.986	.903	.892	.054	.015	.164
.048	.061		.995	.176	.980
.965	.941		.981	.998	
.743			.003		
			.695		

5	6	5	3	6	7	5	4
5.055	5.798	4.788	2.963	6.222	6.917	5.528	4.379
					5.222		
1.011	.966	.958	.988	1.037	.988	1.106	1.095

5	5.055	6.222	6	.985
5	4.788	5.528	5	1.075
3	2.963	4.379	4	1060
13	12.806	16.129 / 15	1.075	28935 / 28 = 1.033
.985	190	15		28
	104	112		93
	66	105		84
		79		75

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

1868phae.proj.469p

139
- 53
1
63
- 20
- 7
- 80
- 82
76
- 44
12
89
- 93
13)659
507

±051

.985±.051 ±

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

1868phae.proj..469P

Eclipses of Jupiter's Satellites

960" | 52
52 | 18 4.6

440
416

240
208

320

369".2 diam Sun.

	Semidur. Eclipse	Dur.	Diam Shad.	Dia ⊙
I	1 7 52	2h 20m	19'49	6' 9"
II	1 25 50	2 56	12 25	"
III	1 46 50	3 43	7 47	"
IV	2 23 25	4 56	4 25	"

2350 | 2693
21384 | ,00880
21160 01
21384
22400

2090 | 4251
17604 | 4917
38960
38259
7010
4251
27590

3430 | 6783
33915 | 5057
3850
33915
45850

19/6
114

2920 | 11928
23856 | 2459
53440 12
47712
5728 0
4771 2
956 40
9

Shad : ⊙ = Dur : x

$$x = \frac{\text{Dur} \times \odot}{\text{Shad}}$$

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

1868phae.proj..469P

Sal + O

4.29

5.44

11.18

16.36

	Diag from Jt at	Shad.	⊙	Dist min	Dist / Shad min	Salut min	⊙
.00 8799	30.2	1189	6.15	140	.118	3.56	.73
.00 4917	16.9	745	6.15	176	236	399	1.45
.00 5057	17.3	467	6.15	223	.477	8.25	2.93
.00 2449	8.5	265	6.15	296	1.117	9.49	6.87

140 | 1189

1189 | .118

2110 30.2

1189 236

9210 354

356

176 | 745

1490 236

2700 16.9

2235 2124

4650 1416

4470 236

180 0984

223 | 467

1868 48

3620

3736 477

1160 17.3

1431

3309

477

6.2521

296 | 265

265 1.117

310 8.5

265

450 5585

265 8936

1850 9.6945

1590

60

1117 | 6.15

5585

1117

6702

6.8955



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

1868phae.proj.469P



Rad of Sun = a

" " Sat = b

m n = x

6 n = y

Area 6 = $dx\, 2\sqrt{b^2 - y^2}$

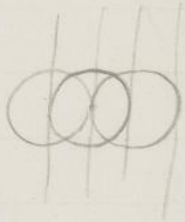
Light on segment of 6 =

$a \sin^{-1} z - z\sqrt{a^2 - z^2}$



$$\text{Light} - 6 = 2\left(a \sin^{-1} z - z\sqrt{a^2 - z^2}\right)\sqrt{b^2 - (x - z)^2}\, dz$$



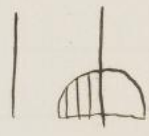


⊙ = 0 or ∞

100.00	0	100.00	100.00	50.00	10	
97.98	2	87.36	74.72		8	
91.65	4	75.	50.48		6	3.14
80.00	6		28.57		4	1.57
60.00	8		10.39		2	
0.00	10	50	.00	100.00	0	







.0
2.8
2.0
2.8
0
7.6
2.53
6.32

1.57

3.14
1.57
6
08

1868phae.proj..469P

Brightness

0	0.0	0.0	0.0	0.0	00	50.0
2	60.0	5.2	3.1	12.4	240.0	37.4
4	80.0	14.3	11.4	22.8	160.0	25.3
6	91.6	25.3	23.2	92.8	366.4	14.3
8	98.0	37.4	36.7	73.4	196.0	5.2
10	100.0	50.0	50.0	200.0	400.0	0.0
12	98.0	62.6	61.4	122.8	196.0	
14	91.6	74.7	68.4	273.6	366.4	
16	80.0	85.7	68.6	137.2	160.0	
18	60.0	94.8	56.9	227.6	240.0	
20	0.0	100.0	0.0	0.0	00	
				1162.6	2324.8	23562
				3 3 4		
				38.7.5	7749	7854
				77.50	15498	15708
						31416

When satellite has left us

0.0
22.44 00
20.24 89.7
13.1 40.5
5.1 52.4
0.0 10.2
00

192.8 3
64.3
1286 | 157
1056 .082
290

192.8 | 2356
18848 82
4320

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

1868phae.proj..469P

~~.12684~~ .23880 .23249 .22686 .23223
.23754
.11853 .12001 .12192 .11949 .11998

.11901 .11879 .11057 .10737 .11225
.1315 .1315 .1290 .1280 .1295

.23880 .24822 .24279
.12074 .12051 .12051
.11806 .12771 .12228
.1312 .1342 .1325

866.4 | 2356
706 8 | 368
15960
14136
18240

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

1960phae.proj..469P

Simpson's Rule $= 85.7 + \frac{2}{3} n \left(0 + 4 \times 94.8 \times 60. \right)$

0
+4 × 5.2 × 60.
+0

0
4 × 5.2 × 6.0
2 × 14.3 80.0
4 ×

0
12.4
11.4
23.8 - 1.3766
11.4 8.0044
92.8 01.01
36.7
164.7 - 2.2167
36.7 8.8445
200.0 09.0
61.4
462.8 - 2.6654
61.4 9.2932
273.6 19.6
68.6
866.4 - 2.9377
98.6 9.5655
227.6 36.8
0.0
1162.6 3.0654
9.6932 49.3

9.37217

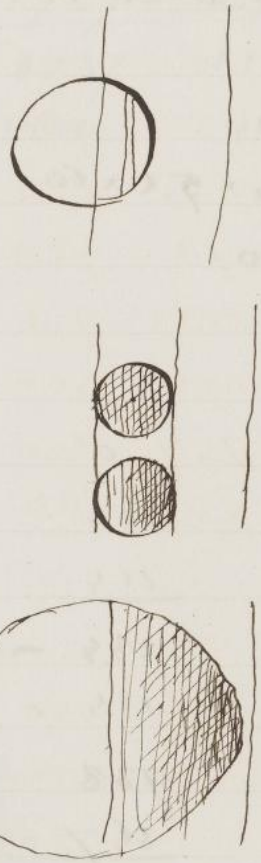
0
0.0
1.0
7.0
19.6
36.8
50.0
63.2
80.4
99.0

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

1868phae.proj..469P

$R = .5$

0



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

1868phae.proj..469P

$R = 1$ $\theta = .2$ ~~.4~~ .6 .8

0.0	800	0.0			0.0
5.2	91.6	4.8	19.6		4.4
14.3	98.0	14.0	28.0	2.8353	13.6
25.3	100.0	25.3	101.2	3.3722	29.0
37.4	98.0	36.7	73.4	9.4631	50.0
50.0	91.6	45.8	183.2	29.05	71.0
62.6	80.0	50.1	100.2		86.4
74.7	60.0	44.8	179.2		95.6
85.7	0.0	0.0			99.0
			684.4		100.0

0.0	98.0	0.0		
5.2	100.0	5.2	20.8	2.5070
14.3	98.0	14.0	28.0	3.3722
25.3	91.6	23.2	92.8	9.1348
37.4	80.0	29.9	59.8	13.64
50.0	60.0	30.0	120.0	
62.6	0.0	0.0		
			321.4	

0.0	98.0	0.0		
5.2	91.6	4.8	19.2	3.3722
14.3	80.0	11.4	22.8	2.0120
25.3	60.0	15.2	60.8	8.6398
37.4	0.0	0.0		~~4.3.6~~
			102.8	4.4

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

1868phae.proj..469P

$P = .5$

0.0

5.2 .80

	Cal.			2.6839
0.0	0.0		0	33722
1.9	60.0	1.44	5.7	9.3117
5.2	80.0	4.16	8.3	20.50
9.4	91.6	8.6	34.4	
14.3	98.0	14.0	28.0	
19.6	100.0	19.6	78.4	
25.3	98.0	24.7	49.4	
31.2	91.6	28.6	114.4	
37.4	80.0	29.92	59.8	
43.6	60.0	26.16	104.6	
50.0	0.0		0.0	
			483.0	2356.2
			6	
			~~241.5~~	5

$0 + 4 \times 5.2 \times .80 + 0$

$\frac{20.8}{16.64}$ | 2356. .6

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

1868phae.proj..469P

$R = 2.0$

0.0	100.0			
5.2	99.5	5.2	20.8	
14.3	98.0	14.0	28.0	2.9503
25.3	95.4	24.1	48.2	3.3722
37.4	91.6	34.3	133.2	9.5781
50.0	86	43.3	86.6	
62.6	80.0	50.1	200.4	~~3.781~~
74.7	71.4	53.3	106.6	1.892
85.7	60.0	51.4	205.6	
94.8	43.6	41.3	82.6	
100.0	0.0		0.0	
			892.0	



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

180
1868phae.proj..469P

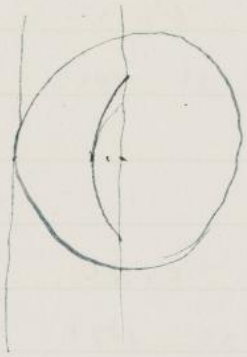
John G. Wolbach Library, Harvard-Smithsonian Center for Astrophysics • Provided by the NASA Astrophysics Data System

1868phae.proj..469P

R=0 a ∞	R=1		R=.5
0.0	0	0.0	.33 20.50
5.2	.1	1.0	
14.3	.2	4.4	
25.3	.3	13.6	R=2.0
37.4	.4	29.0	.33 = 18.92
50.0	.5	50.0	
62.6	.6	71.0	
74.7	.7	86.4	
85.7	.8	95.6	
94.8	.9	99.0	
100.0	1.0	100.0	

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

1868phae.proj..469P







0.0	100.0	0.0	0.0
25.0	96.8		19.6
50.0	86.6	19.6	50.0
75.0	66.1		80.4
100.0	0.0	50.0	100.0

Cos. Sin.

86.6 × 0.0

66.1 × 19.6

0 × 50.0

100.0 × 0.0 = 0.0

96.8 19.6 = 19.0 ×4 = 38.0 76.0

86.6 50.0 = 43.3 ×2 = 173.2 86.6

66.1 80.4 = 53.1 ×4 = 53.1 106.2
106.2

0.0 100.0 = 0.0 375.0

264.3

0.0

346.4

2000.

3464

8928

3750 | 8928

35712

4 8

3 | 71424

23808

420

1868phae.proj..469P

Light	Color
0.0	100.0
14.3	98.0
37.4	91.6
62.6	80.0
85.7	60.0
100.0	0.0

0.0 ×	80
14.3	60
37.4	0

0.0	91.6
14.3	

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

1868phae.proj..469P

Thiemidel Formula.

$$y = y_0 + x D_1 + \frac{x(x-1)}{2} D_2 + \frac{x(x-1)(x-2)}{1.2.3} D_3 + \&$$

y_0
$y_1 - y_0$
y_1 $y_2 - 2y_1 + y_0$
y_2 $y_2 - y_1$ $y_3 - 3y_2 + 3y_1 - y_0$
y_3 $y_3 - y_2$ $y_3 - 2y_2 + y_1$

$$\int y\,dx = y_0 x + \frac{x^2}{2}(y_1 - y_0) + \left(\frac{x^3}{6} - \frac{x^2}{4}\right)(y_2 - 2y_1 + y_0) + \&$$

$y_0 x$
$-\frac{x^2}{2} + \frac{x^2}{2} y_1$
$+\frac{x^3}{6} - \frac{x^3}{3} + \frac{x^3}{6} y_2$
$-\frac{x^2}{4} + \frac{x^2}{2} - \frac{x^2}{4}$

$$A = y^0\left(x - \frac{3x^2}{4} + \frac{x^3}{6}\right) + y'\left(x^2 - \frac{x^3}{3}\right) + y_2\left(\frac{x^3}{6} - \frac{x^2}{4}\right)$$

$$y_0\left(2 - 3 + \frac{4}{3}\right) + y'\left(4 - \frac{8}{3}\right) + y_2\left(\frac{4}{3} - 1\right)$$

$$y_0 \frac{1}{3} + y_1 \frac{4}{3} + \frac{1}{3} y_2$$

$1 + 2 + 3 + 4$

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

1868phae.proj..469P

0 x

1 $x^2 - x$

$x-2$

$x^3 - 2x^2$

$-2x^2 + 2x$

2 $x^3 - 3x^2 + 2x$

$x-3$

$x^4 - 3x^3 + 2x^2$

$-3x^3 + 9x^2 - 6x$

3 $x^4 - 6x^3 + 11x^2 - 6x$

$x-4$

$x^5 - 6x^4 + 11x^3 - 6x^2$

$-4x^4 + 24x^3 - 44x^2 + 24x$

4 $x^5 - 10x^4 + 35x^3 - 50x^2 + 24x$

$x-5$

$x^6 - 10x^5 + 35x^4 - 50x^3 + 24x^2$

$-5x^5 + 50x^4 - 175x^3 + 200x^2 - 120x$

5 $x^6 - 15x^5 + 85x^4 - 225x^3 + 274x^2 - 120x$

$6 \quad 90 \quad 510 \quad 1350x \quad 1344x + 720$

6 $x^7 - 21x^6 + 175x^5 - 735x^4 + 1574x^3 - 1764x^2 + 720x$

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

1868phae.proj..469P

$$\int y\,dx = (y_0)$$
$$+(y_1 - y_0)\ x$$
$$+(y_2 - 2y_1 + y_0)\ \tfrac{1}{2}(x^2 - x)$$
$$+(y_3 - 3y_2 + 3y_1 - y_0)\ \tfrac{1}{6}(x^3 - 3x^2 + 2x)$$
$$(y_4 - 4y_3 + 6y_2 - 4y_1 + y_0)\ \tfrac{1}{24}(x^4 - 6x^3 + 11x^2 - 6x)$$
$$(y_5 - 5y_4 + 10y_3 - 10y_2 + 5y_1 - y_0)\ \tfrac{1}{120}(x^5 - 10x^4 + 35x^3 - 50x^2 + 24x)$$
$$(y_6 - 6y_5 + 15y_4 - 20y_3 + 15y_2 - 6y_1 + y_0)\ \tfrac{1}{720}(x^6 - 15x^5 + 85x^4 - 225x^3 + 274x^2 - 120x)$$
$$(y_7 - 7y_6 + 21y_5 - 35y_4 + 35y_3 - 21y_2 + 7y_1 - y_0)\ \tfrac{1}{5040}(x^7 - 21x^6 + 175x^5 - 735x^4 + 1574x^3 - 1446x^2 + 720x)$$

128/9
1,422

48/9
.533

950/288
864
860
864
40
288
1120
1152
14
33280
.0042

250/288
2304
1960
1728
2320
2304
1600
1440
160
8680455
4340
130207
55
80,8000
1/13,000

5555/868
5208
297
2475
63

.66 + 4.34 5.00
−.00028
+.00028

1868phae.proj..469P

x

$\frac{1}{2}x^2 -$

$\frac{1}{6}x^3 - \frac{1}{4}x^2 + \frac{1}{12}x$ $\qquad \frac{x^2}{12}(2x-3)$

$\frac{1}{24}x^4 - \frac{1}{6}x^3 + \frac{11}{72}x^2 -$ $\qquad \frac{x^2}{24}(x^2-4x+4)$

$\frac{1}{120}x^5 - \frac{1}{16}x^4 + \frac{11}{72}x^3 - \frac{1}{8}x^2$

$\frac{1}{720}x^6 - \frac{1}{60}x^5 + \frac{7}{96}x^4 - \frac{5}{36}x^3 + \frac{1}{10}x^2$

$\frac{1}{5040}x^7 - \frac{1}{288}x^6 + \frac{17}{720}x^5 - \frac{5}{64}x^4 + \frac{14}{135}x^3 - \frac{1}{12}x^2$

$\frac{1}{40320}x^8 - \frac{1}{1680}x^7 + \frac{5}{864}x^6 - \frac{7}{240}x^5 + \frac{787}{10080}x^4 - \frac{361}{3780}x^3 - \frac{1}{14}x^2$

$x =$

1	2	3	4	5	6	7
$\frac{1}{2}$	2	$\frac{9}{2}$	8	$\frac{25}{2}$	18	$\frac{49}{2}$
	$\frac{1}{3}$	$\frac{9}{4}$	$\frac{20}{3}$	$\frac{175}{12}$	27	$\frac{539}{12}$
		$\frac{3}{8}$	$\frac{8}{3}$	$\frac{75}{8}$	24	$\frac{1225}{24}$

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

188

1868phae.proj..469P

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

1868phae.proj - 469P

$x=1$ $\quad A = 1y_0 + \frac{1}{2}(y_1 - y_0) = \frac{1}{2}(y_0 + y_1)$

$x=2$ $\quad A = 2y_0 + 2(y_1 - y_0) + \frac{1}{3}(y_2 - 2y_1 + y_0)$

$= \left(2 - 2 + \frac{1}{3}\right)y_0 + 2y_1 - \frac{2}{3}y_1 + \frac{1}{3}y_2 = \frac{1}{3}y_0 + \frac{4}{3}y_1 + \frac{1}{3}y_2 = \frac{1}{3}(y_0 + 4y_1 + y_2)$

$x=3$ $\quad A = 3y_0 + \frac{9}{2}(y_1 - y_0) + \frac{9}{4}(y_2 - 2y_1 + y_0) + \frac{3}{8}(y_3 - 3y_2 + 3y_1 - y_0)$

$\left(3 - \frac{9}{2} + \frac{9}{4} - \frac{3}{8}\right)y_0 + \left(\frac{9}{2} - \frac{9}{4} + \frac{9}{8}\right)y_1 + \left(+\frac{9}{4} - \frac{9}{8}\right)y_2 + \frac{3}{8}y_3$

$= \frac{3}{8}y_0 + \frac{9}{8}y_1 + \frac{9}{8}y_2 + \frac{3}{8}y_3 = \frac{3}{8}(y_0 + 3y_1 + 3y_2 + y_3)$

$x=4$ $\quad A$

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

1868phae.proj..469P

Mechanical Quadratures.

$$A = \tfrac{1}{2}(y_0 + y_1)$$
$$= \tfrac{1}{3}(y_0 + 4y_1 + y_2)$$
$$= \tfrac{3}{8}(y_0 + 3y_1 + 3y_2 + y_3$$
$$= \tfrac{2}{45}(7y_0 + 32y_1 + 12y_2 + 32y_3 + 7y_4$$
$$= \tfrac{5}{288}(19y_0 + 75y_1 + 50y_2 + 50y_3 + 75y_4 + 19y_5$$

.5

.333 1.333

.375 1.125

.311 1.422 .533

.32986 1.30207 .86805

.33 1.302 .868

$$.33\,(y_0 + y_5) + .868\left(\tfrac{3}{2}(y_1 + y_4) + y_2 + y_3\right)$$

$-.00014$ $+.000055$

If y_1, y_2, y_3, y_4 are 0 the result will be too great by .00042 or less than a twentieth of one per cent.

If y_0, y_5 are 0 the result will be too small by .000063 or less than one one hundred and sixtieth of one per cent.

If $y_0 - y_5$ are equal the result will be exact.

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

1868phae.proj.469P

Jubilate Lectius

1.208	.164
1.196	.155
1.208	.164
1.142	.115
1.216	.170
1.180	.144
	312
	4.152

29 13 37
27 21 52
2 11 45

$-166''.4$ $-3''.5$ $-36''$ -1

125
416
II
208"

I
$-3(''$ 172" short. Jun 2 get 1878

30 12 25 II at $\Sigma_{c.}$ $-40''$
23 18 49
6 59 36

26
37

91" III at $\Sigma_{c.II} = -114''$
1/2
23
114"

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

1868phae.proj..469P

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

1868phae..proj..469P

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

1868phae.proj..469P

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

1868phae.proj..400p

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

1868phae.proj..469P

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

1868phae.proj..469P

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

1868phae.proj..469P

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