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169

No. 9.

LATITUDE AND LONGITUDE

AREQUIPA STATION.

W. Upton.

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I

Arequipa Observatory.

Observations and Calculations
relating to

Time, Latitude & Longitude.

under supervision of
Winslow Upton.

(All observations by W.U. except otherwise specified.)

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Instrumental Notes

The Sextant used in following observations is by Troughton & Sims, belonging to Arequipa Observatory. The telescope magnifies 4 times. A higher power could have been used to advantage. Sperm oil was used for the artificial horizon. It worked well, but it was necessary to use other sun shades in determining Index Correction than those used in the observations. The Index Correction was used only in the latitude observations, Time by Equal Altitudes not requiring it.

Base weighs 30lbs

The Draper Transit is by Stackpole, objective 52 m.m. aperture, diagonal eyepiece magnifies 40 diameters. It is lightly built. Striding level has no partition and full length of bubble must always be used. A higher magnifying power and more sensitive level could be used. The reticle is 7 spider threads placed in an inner tube which can be adjusted for verticality or focus only by removing eye end of tube. Collimation screws are on outside of tube.

Tot. tel. 32lbs

The Rogers Transit is an incompleted instrument designed by Prof. W. A. Rogers to repeat the prime vertical observations for latitude made at Harvard Observatory when it was first established. The tube axis and mounting are very heavy and pivots large. A duplicate mounting is furnished for use in the prime vertical. The aperture is 76 m.m. and the single eyepiece furnished is a diagonal magnifying 76 times.

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The striding level is placed in a heavy iron frame. The reticle furnished consisted of three groups of five heavily ruled double lines (see p. 89) on glass. It was attached to the frame in a micrometer moved by a screw having 80 rev. to the inch, the head graduated to 60ths.

The level trier was made as follows: a board about 24" × 8" was supplied with three legs, two made of heavy nails on which a screw thread had been turned. The third leg was the micrometer screw of the 18" equatorial. The screw was necessarily made stationary, as so made in the micrometer, and the head which became the leg of the level trier turned. A new index arm was supplied the regular index not answering for this purpose. After use the micrometer screw was replaced in the micrometer of the equatorial, and the rest of the apparatus put on the instrument shelves. It can be readily put together if desired. It proved a serviceable instrument.

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Chron 1131

1896			11^m s	Rate
July 31	app. noon	+	14.2	constant
Aug 3	"		9.4	−1.6
6	"		1.6	−2.6 −3.0
10	"		57.2 56.8	−1.8 −2
13	"		54.9	−0.8
17	"		52.2	−0.7
22	"		53.1	+0.2
25	"		48.2	−1.6 −1.4 −1.7
28	"		50.5	+0.8
31	"		51.6	+0.4
Sept 3	"		50.8	−0.3
7	"		50.1	−0.2
11	"		48.7	−0.4
14	"		49.1	+0.1
17	"		47.0	−0.7
18	Chron. time 8.31 pm		45.6	Draper transit
19	7.56 "		45.9	+0.3 " "
22	8.00 "		45.3	−0.2 " "
23	7.57 "		44.6	−0.7 Rogers "
24	7.50 "		44.9	+0.3 Draper "
28	7.57 "		44.0	−0.2 " "
Oct. 1	8.06 "		43.8	−0.1 " "
6	8.36 "		43.6	0.0 " "
17	8.57 "		44.0	−3.1 " " S.I.B. Obs.
19	10.07 "		42.8	" " "
20	10.50 "		42.7	" " "
21	11.33 "		42.7	" " "
31	8.44 "		44.6	−1.7 " "
Nov. 6	8.36 "		49.0	+0.4 " "

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Chron 1131

1896	Chron. Time	Correction	Rate	
Nov. 6	8 36 p.m.	+10m 49.5		Draper Transit.
12	8 9 "	51.3	+0.4	" "
20	7 52 "	55.0	+0.5	Rogers "
25	8 36 "	11 1.8	+1.3	" "
27	8 5 "	4.5	+1.4	" "
30	10 36 "	8.6	+1.3	" "
Dec. 2	10 0 "	10.6	+1.0	" "
22	7 56 a.m.	32.8	+1.1	" "
28	12 0 p.m.	40.7	+1.2	" "
1897 Jan. 8	7 00 a.m.	56.0	+1.5	"
8	8 30 p.m.	57.2	+1.5	" "
15	9 00 p.m.	12 ~~49.4~~ 6.1	+1.3	" "
21	11 00 p.m.	12 14.6	+1.4	" "
22	11.00 p.m.	16.0	+1.4	" "
23	8.00 p.m.	17.2	+1.3	" "
26	8.00 p.m.	21.4	+1.4	" "
Feb. 1	8.00 p.m.	27.2	+1.0	" "
4	8.00 p.m.	30.5	+1.1	" "
23	8.00 p.m.	50.1	+1.0	" "
Mar. 17	8.00 p.m.	13 24.3	+1.6	" "
23	8.30 p.m.	28.4	+0.7	Draper "
30	11.30 p.m.	35.4	+1.0	" "
Apr. 5	8.50 p.m.	39.7	+0.7	" "
6	8.00 p.m.	40.2	+0.5	" "
7	11.20 p.m.	41.2	+0.9	" "

Instrument taken to Arica.

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Time by Sextant

Equal altitudes

July 31/96

a.m.

Before

		Chron.	Arc.
		49	65 20
App	☉	37.5	40
		48 30	66 0
		8 47 38.8	65 40
		Reversed ends	
		11	66 0
Sep.	☉	1	20
		8 52 53.5	40
		8 52 1.8	66 20

		Off	On
App		359 38 40	0 41 20
Sep.		20	41 30
		359 38 30	0 41 25
		0 9 57.5	

After

	38 20	0 41 50
	20	41 30
	359 38 20	0 41 40
	0 10 0	

Mean 0 9 58.8

Reduction Doolittle p. 231

	☉	☉
T' East	8 47 38.8	8 52 1.8
T" West	3 2 16.5	2 57 54.5
Δ	6 14 37.8	6 5 52.7
½ Δ = t	3 7 18.8	3 2 56.4
	46° 50'	45° 44'
	3.122	3.049
½ (T' + T")	11 54 57.6	11 54 58.2
δt	+ 5.6	+ 5.6
Eq. of t.	+ 6 6.5	+ 6 6.5
Clock time mean noon	11 48 45.5	11 48 46.1
ΔT	+ 11m 14.s2	

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July 31/96
p.m.

Before

	Chron.	Arc.	Off	On
Obs ☉	3	66 40	359 38 30	0 41 30
	54.5	20	20	41 50
	2 58 46	0	359 38 25	0 41 40
	2 57 54.5	66 20	0 10 2	

After

Sep. ☉	1	26.5	66 0	359	38 30	0 41 10
	2	16	65 40		20	41 30
3	3	7	20	359	38 25	0 41 20
3	2	16.5	65 40		0 9	52.5
				Mean	0 9	57.2

Reduction.

$$\delta t = \left[\frac{\tan\varphi}{\sin t} - \frac{\tan\delta}{\tan t}\right] t + \frac{\Delta\delta}{15}$$

$\varphi = -16^\circ\ 24'$

$L = -0^h\ 22^m\ 42^s$

$\delta = +18^\circ\ 3'$

$\Delta\delta = -87.''73$

log tan δ	9.51306	9.51306
: tan t	0.02781 ~~9.86295~~	0.01112
	9.48525	9.50194
Δ	~~9.54087~~	~~9.52418~~
N_{σ_2}	.3057	.3176
$N_{\sigma_1} - N_{\sigma_2}$	-.7092	-.7286

log tan φ	9.46881n	9.46881n
" sin t	9.86295	9.85497
	0.60586	9.61384
Δ	~~9.33176n~~	~~9.32378n~~
N_{σ_1}	-.4035	-.4110

log $N_{\sigma_1} - N_{\sigma_2}$		
" t	9.~~85~~077n	9.86249n
	0.49443	0.48416
" $\Delta\delta$	1.57669n	1.57669n
" $\frac{1}{15}$	8.82391	8.82391
ε	0.74580	0.74725
δt	5.57	5.59

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July 31/96 Lat by circummer alt

	Reading		Chron		t-g	m	n
⊙	III	27 0	II	39 10	15 48	490.0	0.6
		31 0		40 22	14 36	418.4	0.4
Aff		33 10		41 27	13 31	358.6	0.3
		35 20		42 34	12 24	301.8	0.2
	III	31 37.5				392.2	0.4
	II	37 0		43 40	11 18	250.7	
⊙		38 30		44 37	10 21	210.3	
Aff		39 30		45 32	9 26	174.7	
		42 10		46 25	8 33	143.5	
	II	39 17.5	Chr. corr			194.8	
		42 30		47 47	7 11	101.3	
Sep ⊙		45 20		48 50	6 8	73.9	
		47 40		50 25	4 33	40.6	
		48 40		51 32	3 26	23.1	
	II	46 2.5				59.7	
	III	52 50		53 18	1 40	5.4	
		52 0		54 19	0 39	0.8	
Sep ⊙		52 0		55 20	0 22	0.3	
		52 0		56 20	1 22	3.7	
	III	52 12.5				2.6	
	III	50 40		57 43	2 45	359 39	0 41 20
		50 30		58 45	3 47	39 0	41 30
Mak ⊙		48 30		0 44	5 46	36 40	41 50
		47 10		1 48	6 50	38 10	41 50
		49 12.5				359 38 42	0 41 38

m	Index Corr.
14.8	
28.1	
65.3	
91.7	
50.0	

m Aff Dec

Aff
Sep.

0° 10' 10"

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Reduction Eanó' Method Doolittle p 247.

φ −16 24	φ −16 24.0	log cos 9.98196	log A^2 0.41506
L −0 22 42	δ 18 2.7	" cos 9.97809	" cot z_0 0.16376
ΔT + 11 14.2	z_0 34 26.7	" sin ~~9.75252~~ correc 0.24748	" B 0.57882
δ +18 2 43.0		" A 0.20753	B 3.8
$\Delta\delta$ −37.″73		A	
E. +6 6.5	Const. log 9.40594	log γ 0.77510n	
δ 15 48.0	" $\Delta\delta$ 1.57669n	γ	6.0 s
	" $\frac{1}{A}$ 9.79247	Chron app noon 11 54 52.3	
		" max alt. 11 54 58	

log m	2.59351	2.28959	1.77597	0.41497	1.69897
" Am	2.80104	2.49712	1.98350	0.62250	1.90650
N_0	682.5	314.1	96.3	4.2	80.6
+Bn	1.5				
(S+2+p+½I)	−21 21	+10 15	+10 15	−21 21	−21 21
Am − Bn	+10 31.0	+5 14.1	+1 36.3	+4.2	+1 20.6
App alt.	55 45 48.8	19 38.8	23 1.2	56 6.2	54 36.2
S	−15 48.0	+15 48.0	+15 48.0	−15 48.0	−15 48.0
2	− 32	− 32	− 32	− 32	− 32
p	+ 4	+ 4	+ 4	+ 4	+ 4
½ I	− 5 5	− 5 5	− 5 5	− 5 5	− 5 5
Cor'd h	55 34 59	34 8	34 52	34 49	34 36
Mean h		55 34 53			
z		34 25 7			
δ		18 2 43	−16 22 18		
φ		−16 22 24			

	v	vv
"	6	36
9	15	225
25	1	1
28	4	16
41	17	289
24	20	567

28.4

$\sqrt{}$ = 5.3
1.8

N_0 = 3.5

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Time by Sextant

Equal altitudes

Aug 3/96

Before

	Chron		Arc.		off				On		
Aff. ⊙	43	43	65	0	359	38	50	0	41	20	Aff.
	44	32		20		38	30		41	30	Sep.
Ref: B towards observer.	45	22		40		38	40		41	25	
8	46	11	66	0				0	10	2.5	
8	44	57.0									

Rev. ref.

	48	50.5	66	0							
Sep. ⊙	49	41		20							
Ref: A towards observer.	50	31.5		40							
8	51	23	67	0							
8	50	6.5									

After

359	38	30		41	20	Aff.
	38	0		41	20	Sep.
	38	15		41	20	
9	47.5					

Reduction equal altitudes

	⊙			⊙		
T'	8	44	57.0	8	50	6.5
T''	3	4	44.0	2	59	31.9
Δ	6	19	47.0	6	9	25.4
$\frac{1}{2}\Delta = t$	3	9	53.5	3	4	42.7
	47°	28′		46°	11′	
	3.165			3.078		

$\frac{1}{2}(T'+T'')$	11	54	50.5	11	54	49.2
δt			+ 5.8			+ 5.8
Eq. of t		+ 5	53.4		+ 5	53.4
Ch. t: mean hom	11	48	51.3	11	48	50.0
ΔT			$+11^m\ 9^s.4$			

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P. M.

	Chron		Arc.	Before Off			Du		
~~2~~	~~57~~	~~2~~	~~66~~ 0	359	38	40	0	41	30
Aff. ⊙ 2	58	18.5	67 0		38	0		41	30
Ref: B	59	8	66 40	359	38	20	0	41	30
towards observer.	59	59.5	20		0	9	55		
3	0	51.5	66 0						
2	59	31.9							
				After					
Sef. ⊙	3	28	66 0	359	38	30	0	41	30
	4	18.5	40		38	20		41	40
Ref: A	5	10	20	359	38	25	0	41	35
towards observer.	5	59.5	65 0		0	10	0		
3	4	44.0							

φ	−16	22′
L	− 0	22 42
δ	+17	16
Δδ	−39.90	

log tan φ	9.46788n	9.46788n
" sin t	9.86740	9.85827
Δ	9.60048n	9.60961n
N_{0_1}	−.3985	−.4070

log tan δ	9.49252	9.49252
" tan t	0.03744	0.01794
Δ	9.45508	9.47458
N_{0_2}	.2852	.2982
$N_{0_1} - N_{0_2}$	−.6837	−.7052
" (")	9.83487n	9.84831n
" t	0.50037	0.48827
" Δδ	1.60097n	1.60097n
" 1/15	8.82391	8.82391
Σ	0.86012	0.76146
δt	~~7~~ 5.8	5.8

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Latitude by circummeridian altitudes.

Aug. 3

	chron	Arc	t	m	n	359 38 40
⊙ [⊙]	11 44 14	112 10 40	−10 30	216.44	.12	40
Ref. B to ⊙ observed	45 22	12 0	9 22	172.24	.07	359 38 40
aff	46 10	14 30	8 34	144.08	.05	41 50
	47 10	16 20	7 34	112.41	.03	50
	11 45 44	112 13 17.5	−9 0	161.29	.07	41 50
					0	10 15

⊙ [⊙]	49 4	113 21 40	5 40	63.05	
aff	50 33	23 30	4 11	34.36	
	51 23	24 0	3 21	22.03	
	52 25	24 0	2 19	10.54	
		113 23 17.5	−3 53	32.50	
		Reversed Ref.			
Ref. A to ⊙ observed	53 35	24 40	1 9	2.60	
⊙ [⊙]	54 32	24 40	− 0 12	.08	
aff	55 22	24 50	+ 0 38	.79	
	56 13	24 50	1 29	4.32	
		24 45.0	+ 0 12	1.95	

	58 10	112 20 40	3 26	23.14	359 38 40
⊙ [⊙]	59 9	20 20	4 25	38.30	40
	0 6	19 10	5 22	56.55	359 38 40
	1 16	18 0	+ 6 32	83.81	0 41 20
		112 19 32.5	4 56	50.45	41 40
					0 41 30
					0 10 5

Mean t. aff. now	12 5 53.4	log cos φ	9.98202		
chron. clock	11 9.4	" cos δ	9.97997	log A²	~~0.08328~~ 0.17694
" t aff. now	11 54 44	" csc ½,	~~0.07989~~ .25663	" cot ½,	.43716
φ −16 22.4	δE −5.3	" k'	0.00006	" B	0.~~26022~~ 61410
δ +17 15.9	δT +1.6	" A	0.~~04164~~ .21858	B	4.1
½, 33 38.3	δT−δE +6.9				

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Reduction – Delambre's Method Chauv. I, 238

2alt	112	13	37.5	113	23	17.5	113	34	45.0	112	19	32.5
Index		−10	10		10	10		10	10		10	10
	112	3	27.5	113	13	7.5	113	14	35.0	112	9	22.5
alt	56	1	43.8	56	36	33.8	56	87	17.5	56	4	41.2
r		−30			−30			−30			−30	
p		+5			+5			+5			+5	
S		+15	48		+15	48		+15	48		+15	48
h	56	17 ~~45~~	7 ~~31~~		20 ~~51~~	21 ~~57~~		21 ~~82~~	4 ~~40~~		20 ~~48~~	4 ~~38~~
ζ	33	42 ~~14~~	53 ~~29~~		39 8	39 3		38 X	56 ~~20~~		39 ~~11~~	56 ~~32~~
log m		2.20760			1.51188			0.29003			1.70286	
" Am		2.42618			1.73046			0.50861			1.92144	
Am		266.8			53.8			3.2			83.5	
Bm		0.3										
ζ	33	38 ~~10~~	26 ~~2~~		38 ~~7~~	45 9		38 ~~7~~	53 ~~17~~		38 ~~10~~	32 ~~8~~
δ	17	16 ~~15~~	14 ~~59~~		16 ~~15~~	11 ~~56~~		16 ~~15~~	8 ~~53~~		16 ~~15~~	5 ~~50~~
φ	−16	22	12 ~~27~~		22	34 ~~49~~		22 ~~23~~	45 ~~0~~		22	27 ~~42~~

Mean −16 22 ~~11~~ 30

v	vv
18	324
4	16
15	225
3	9
12	574

47.83 $\sqrt{} = 6.9$ (2.3)

$r_0 = 4.6$

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Time - Sextant
Equal Altitudes

Aug 6/96

		chron		zone	am		Before			After	
☉ aff.	9	4	50	7	4	20	359	38	40	0	41 20
									20		20
Prof B tide observer		5	40.5			40	Partly cloudy	38	30		41 15
		6	33	7	5	0			0	9	52
	9 -	7 -	26			20					
		6	7.4								

							After				
☉ aff.		9	18	7	5	0	359	38	50	0	41 40
Prof A tide observer		10	10			20			30		30
		11	35			40		38	40		41 35
	9	11	57	7	6	0				10	8
		10	37.1								

Reduction

	☉			☉		
T'	9	6	7.4	9	10	37.1
T''	2	43	10.5	2	38	42.8
Δ	5	37	3.1	5	38	5.7
½Δ=t	2	48	31.6	2	49	2.8
	42°	7.9		42°	15.7	
	2.809			2.818		

½(T'+T'')	11	54	39.0	11	54	40.0
δt			6.0			6.0
chron Aff Noon	11	54	33.0	11	54	34.0
Mean " "	12	5	35.½	12	5	35.½
chron clear		11	2.½		11	1.1 / ~~2.0~~

11m 56

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p. m.

⊙ app		37	23.5	76	0			
Roof. B		38	16.5	75	40			
tvds obs.		39	10		20			
Σ		40	1.0		0			
2		38	42.8					
						After		
						359	380	0 42 0
⊙ refs.		42?	53.5	75	20		30	41 50
Roof: A		43?	45		0		30	40
tvds obs.		44?	35.5	74	40		40	40
		45?	28		20			
	[43]	44	10.5					

φ	−16	22.5
δ	+16	26.7
Δδ	−41.95	

log tan φ	9.46812n	9.46812n	Cog(Nb' − Nb²)	9.88326n	9.88178n
" cni t	9.82662	9.82771	" t	0.44855	0.44994
Δ	9.64150n	9.64041n	" Δδ	1.62273n	1.62273n
Nb'	−.4380	−.4369	" 1/15	8.82391	8.82391
			Σ	0.77845	0.77836
" tan δ	9.47008	9.47008	δt	6.0	6.0
" tan t	9.95645	9.95842			
Δ	9.51363	9.51166			
Nb²	.3263	.3248			
Nb' − Nb²	−.7643	−.7617			

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Lat. Circumm. Alt.

Aug. 6/96

			t	m	n
⊙	48 18	114 58 0	−6 15.5	76.90	
	49 21	58 50	5 12.5	53.36	
Ref: B tide	50 16	59 30	4 17.5	36.16	
observer	51 4	114 0 40	3 29.5	23.94	
		113 59. 15.0	−5	47.56	
⊙	52 58	115 3 20	1 35.5	4.98	
	53 32	3 10	1 1.5	2.06	
	18	3 40	−0 15.5	0.13	
	55 17	3 20	+0 43.5	1.04	
Reversed ref's		115 3 22.5	−0	2.05	
Ref A tide	56 5	4 10	1 31.5	4.57	
observer	57 46	2 40	3 12.5	20.22	
	58 44	2 20	4 10.5	34.22	
	59 41	1 30	5 7.5	51.87	
		115 2 40.0	+3	27.64	
⊙	12 1 8	113 55 50	6 34.5	84.88	0.02
	2 15	54 10	7 41.5	116.15	.03
	3 12	52 50	8 38.5	146.61	.05
	4 15	50 40	9 41.5	184.40	.08
		53. 22.5	+8	133.01	.045

359 39 0	0 41 40	
39 0	50	
38 50	40	
38 30	30	
359 38 50	0 41 38	
0 10 14		

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1896phae.proj.11711

Reduction – Delambre's Method. Chauv. I, 238

Mean t app. noon	12 5 35.0						
Chron. slow	11 1.5	log cos φ	9.98202				
" app noon	11 54 33.5	" cos δ	9.98186	log A^2	.46000		
φ	−16 22.4	δE	−7.0	" cosec ζ,	0.26602	" cot ζ,	0.19051
δ	+16 26.7	δT	+2.6	" k'	.00010	" B	0.65051
ζ,	32 49.1	δT−δE	+9.6	" A	0.23000	B	4.5

2 Alt	113 59 16.0	115 3 22.5	115 2 40.0	113 53 22.5
Index Corr.	−10 14.			
	113 49 1	114 53 8.5	114 52 26	113 43 8.5
Alt	56 54 30.5	57 26 34.2	57 26 13	56 51 34.2
r	−29	−29	−29	−29
p	+5	+5	+5	+5
S	+15 49	−15 49	−15 49	+15 49
h	57 9 55.5	10 21.2	10 0	6 59.2
ζ	32 50 4.5	49 38.8	50 0.0	53 0.8
log m	1.67724	0.31175	1.44154	2.12388
. Am	1.90724	0.54175	1.67154	2.35388
B″m / Bm	80.77	3.5	46.9	225.9
ζ	32 48 44	49 35	49 13	49 15
δ	16 27 3	27 0	26 58	26 54
φ	−16 21 41	22 35	22 15	22 21

16 22 13

Results

					1/wt	wt	v	vv
July 31	−16 22 24	±	~~5.3~~ 3.5		12.25	82	22	484
Aug. 3	22 30	±	~~6.9~~ 4.6		21.16	47	2	4
Aug. 6	22 13	±	~~10.1~~ 7.0		~~102.01~~ 49.00	20	8	64
					~~135.42~~ 82.41		12	~~1516~~ 1336
Weighted Mean	−16 22 28 4/	±	2″.5					~~131.33~~ 111.33

$\sqrt{\frac{10.5}{3.5}} = \frac{\sqrt{15.2}}{3.5}$ = 7.0

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Time by Equal Altitudes

Aug 10/96 a.m.

☉ app		46	3.5	68	20	35.9	38	30	0	41	40
Roof		46	52		40		20			30	
B tide observer		47	43	69	0		38	25		41	35
	8	48	32.5	69	20		0	10	0		
	8	47	17.8								
☉ ref.		50	20	69	0						
Roof		51	8.5		20						
A tide observer.		51	57		40	35.9	38	30	0	41	30
	8	52	46.5	70	0		10			40	
	8	51	33.0				38	20		41	35
							0	9	58		

Reduction

T'	8	47	17.8	8	51	33.0
T''	3	1	4.8	2	56	50.1
Δ	6	13	47.0	6	5	17.1
$\frac{1}{2}\Delta = t$	3	6	53.5	3	2	38.6
	47	43.4		45	39.6	
	3.115			3.044		

$\frac{1}{2}(T'+T'')$	11	54	~~16.5~~ 11.3	11	54	11.5
δt			6.0			6.4
Chron. app noon	11	54	6.3	11	54	6.4
Mean t " "	12	5	2.~~4~~ 5	5	2.~~3~~ 5	
			57.2		57.1	
	10		~~56.9~~	10	~~56.8~~	
	10		~~56.8~~ 57.2			

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	55 35.5	70 0	359 38 30	0 41 50	
⊙ aff	56 25	69 40	38	50	
Roof B	57 15	20	359 38 30	41 50	
Add 86.	2 58 5	0	0 10 10		
	2 56 60.1				

		69 20			
⊙ refl		0			
Roof A	1 29.5	68 40			
Add 86.	48.5				
	2 18	20			
	50.5				
	3 8.5	0	359 38 30	1 41 40	
	48.5				
	3 3 57 49.2	67 40	20	50	
	2 43.2		359 38 25	0 41 45	
	1 3 8 4	Red. ℓ 68° 50′	0 10 5		
	1 4.8				

δ +15 17.5 $\Delta\delta$ −44.51

log tan ϕ	9.46812n	9.46812n	log $Sv_1 - Sv_2$	9.81003n	9.83129n
" sin ℓ	9.86917	9.86443	" ℓ	0.49346	0.48344
Δ	9.59895n	9.61369n	" $\Delta\delta$	1.64846n	1.64846n
Sv_1	−.3971	−.4109	" $\frac{1}{15}$	8.82391	8.82391
			Σ	0.77586	0.78710
" tan δ	9.43682	9.43682	δt	6.0	6.1
" tan ℓ	0.04135	0.01005			
Δ	9.39547	9.42677			
Sv_2	.2486	.2672			
$Sv_1 - Sv_2$	−.6457	−.6781			

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Aug. 12/96

12.30 pm.

Level Trier on bed plate of Bruce telescope
Trier carefully adjusted with Rogers level

Rogers level

Micr.	S	N		S	N	Mean	1 div. =
0.07	2.8	14.0	0.70 =	49.4	49.2	49.3	0.0142
0.37	52.2	63.2					log 8.15229
							log 1 div 0.13742
0.35	53.6	64.7	0.70 =	49.6	49.5	49.55	0.0143
1.05	4.0	15.2					8.14922
							0.13435
1.05	3.3	14.6	0.70 =	~~50.7~~ 49.1	49.1	49.1	0.0143
0.35	52.4	63.7					8.15534
	trier tapped with pencil						0.14047
0.35	57.6	69.0	0.70 =	51.8	51.7	51.75	0.0135
1.05	5.8	17.3					8.13033
							0.11546
0.95	11.2	22.8	0.50 =	34.8	34.7	34.75	0.0144
0.45	46.0	57.5					8.15836
							0.14349
0.45	45.8	57.3	0.50 =	35.0	35.0	35.00	0.0143
0.95	10.8	22.3					8.15534
							0.14047
							0.01413
							8.15014
							0.13527
							1.365+

log 1 rev = 1.98513

1 div =
1.372
1.363
1.382
1.305
1.392
1.382

1.366 = 0.091

1.15 pm.

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Draper level 1.20 feet

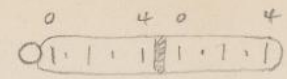
Micr	S	N		S	N	Mean	1 div. =
1.00	−4.0	25.4	0.75 =	16.1	16.2	16.15	0.0464
0.25	12.1	41.6				log	8.66652
						log 1 div	0.65165
0.20	14.7	44.1	0.80 =	18.7	18.8	18.75	0.0427
1.00	−4.0	25.3					8.63043
							0.61556
1.00	−4.1	25.2	0.80 =	17.4	17.5	17.45	0.0458
0.20	13.3	42.7					8.66087
							0.64600
0.20	14.0	43.2	0.80 =	18.1	18.1	18.1	0.0442
1.00	−4.1	25.1					8.64542
							0.63055
1.00	−4.3	25.1	0.80 =	17.1	16.9	17.0	0.0471
0.20	12.8	42.0					8.67302
							0.65815
0.20	13.3	42.5	0.80 =	17.6	17.6	17.6	0.0455
1.00	−4.3 ✓	24.9 ✓					8.65801
							0.64314
							0.04453
							8.65610
							1.35 feet
							0.64123

1 div = 4.″484
4.126
4.426
4.271
4.551
4.397
4.376 = 2.″292

4.378

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1896phae.proj.1171U



Draper Setting Level - Longer one

	S	N		1 div. =	1.35 μm
2.05	−0.1	−0.3	1.60 = 4.4	0.364	
0.45	4.3	4.1			
0.45	4.4	4.1	1.60 = 4.4	.364	
2.05	−0.1	−0.2			
2.05	−0.1	−0.2	1.60 = 4.4	.364	
0.45	4.4	4.1		=	
				.364	1.45 μm

1 div = 35."2

Draper Setting Level - Shorter one



0.20	0.3	0.0	1.20 = 3.1	0.387	
0.00	3.3	3.2			
0.00	3.5	3.3	1.20 = 3.2	0.375	
1.20	0.4	0.0			
1.20	0.3	0.0	1.20 = 3.3	0.367	
0.00	3.6	3.3			
				0.376	

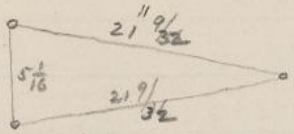
1 div = 36."3

1.50 μm

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Level Trier



2 pcs.

$21\frac{9}{32} = 21.''281$ log = 1.32799 2 log = 2.65598 452.878

$5\frac{1}{16} = 5.0625$ ~~2 log~~ = 6.407

$\frac{1}{2} \cdot 5\frac{1}{16} = 2.5312$ " " 0.40332 0.80664 ↗

△ ~~1.844934~~ 446.471

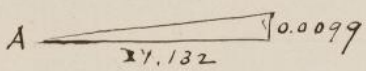
log △ = ~~0.92467~~ 2.64979

R = 21.130 ½ log △ 1.32490

check log hyp 1.32799 log sin angle 9.99695

" base 0.40332 " R 1.32494

" sine angle 0.92467 R 21.132 adopt



101 rev. to inch. 1 rev. = 0."0099

log 0.0099 = 7.99564

" 21.132 = 1.32494

" tan A = 6.67070

" tan 1" = 4.68557

" A" = 1.98513

A" = 96.634

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Time. Equal altitudes

a.m. Before

Aug. 13/96

⊙ aft.	8	53	13 [3]	72	20		359	39	0	0	41	40
Refl		53	51		40			38	40			50
A tide Obs		54	40.5		0			38	50		41	45
		55	30	73	20				0	10	18	
		54	16.1									

After

⊙ aft.		57	17	73	0						
Refl		58	6		20						
B tide Obs		58	56.0		40		359	38	40	0	41	30
	8	59	46.5	74	0			38	10			30
		58	31.6					38	25		41	30
									0	9	58	

Reduction

T'	8	54	16.1	8	58	31.6		
T''	2	53	9.6	2	48	~~56.0~~ ~~58.6~~		
Δ	5	58	53.5	5	50	~~24.4~~ ~~27.0~~		
$\frac{1}{2}\Delta = t$	2	59	26.8	2	55	~~12.2~~ ~~13.5~~		
	44	51.7		43	48.~~4~~ 0			
	2.991			2.920				

$\frac{1}{2}(T'+T'')$	11	53	42.8	11	56	~~43.8~~ ~~45.1~~		
δt			43.3 6.2					

Chron. app. noon 11 53 37.1

Mean " " 12 4 32.0

10 54.9

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jun.

⊙ afp
Rwf Atrds Hb.

	48	31.5	73 40	
	49	20.5 (49.0)	20	
	50	10 (49.5)	0	
2	58	59 (49.)	72 40	
	49	45.8	Rel t 73 30	
	48	−49.2 ~~56.6~~ 56.0		
	51	55	73 20	
	52	45.5	73 0	
	53	34.5	72 40	
2	54	23.5	72 20	
	53	9.6		

⊙ aep.
Rwf Btrds Hb

After

307	38 40	0 41	40
	40	41	30
	40	41	30
	30	42	0
	38 38	41	40
	0 10	9	

δ 14° 23".3 Δδ −46.28

log tan φ	9.46812 n	9.46812 n	log $N_1 - N_2$	9.82886 n	9.84001
" cos t	9.84843	9.84020	" t	0.47582	0.46538
Δ	9.61969	9.62792	" Δδ	1.66539	1.66539
N_{01}	−.4166	−.4245	" $\frac{1}{15}$	8.82391	8.82391
			Σ	0.79397	0.79469
" tan δ	9.40916	9.40916	δt	6.2	6.2
" tan t	9.99812	9.98180			
Δ	9.41104	9.42736			
N_{02}	.2577	.2675			
$N_{01} - N_{02}$	−.6743	−.6920			

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1896phae.proj.1171U

Aug 13/96

12.20 pm.

Level trier on horizontal base of Bruce mounting between two piers, same place as yesterday.
Leveled E+W by Rogers level

Rogers level

Micr.	S	N		S	N	Mean	1 div =
0.90	0.6	13.2	0.75 =	52.6	52.4	52.5	R 0.0143
0.15	53.2	65.6					log 8.15534
							" div 0.13999
0.15	53.8	66.0	0.75 =	52.8	52.9	52.85	.0142
0.90	1.0	13.1					8.15229
							0.13694
0.90	0.3	12.3	0.75 =	53.0	52.9	52.95	.0142
0.15	53.3	65.2					8.15229
							0.13694
0.15	53.6	65.3	0.75 =	53.2	53.1	53.15	.0141
0.90	0.4	12.2					8.14922
							0.13387
0.75	10.7	22.3	0.50 =	34.5	34.6	34.55	.0145
0.25	45.2	56.9					8.16137
							0.14602
0.25	45.8	57.3	0.50 =	35.2	35.2	35.2	.0142
0.75	10.6	22.1					.01425
							8.15381
							0.13846
							1.376
							1.05 pm

1 div = 1.380
1.371
1.371
1.361
1.400
1.371

Mean 1.376 = 0.092

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1896phae.proj.11710

Draper level

1.10 pm

Micr.	S	N	S	N	Mean	1 div =
1.00	−4.6	24.8	0.85 =	18.3	18.2	18.25
0.15	[13.7] 12.7	43.0				
0.15	14.0	43.2	0.85 =	18.4	18.5	18.45
1.00	−4.4	24.7				
0.75	0.3	29.4	0.40 =	8.4	8.4	8.4
0.35	8.7	37.8				
0.35	8.7	37.8	0.40 =	8.4	8.4	8.45
0.75	0.3	29.3				

1 div. = 4.498, 4.450 } 4.474

4.595, 4.566 } 4.580 ½ weight

4.509 = 0.300

0.04466
8.66539
0.65304

0.0461
8.66370
0.64835

0.0476
8.67761
0.66226

.0473
8.67486
0.65951

.0469
8.67117
0.65582
4.527

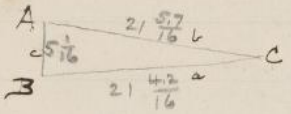
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Aug. 13/96 1.30 pm.

Level tree

Dimensions determined by placing it upon paper and noting marks made by legs.



$$\tan \tfrac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$$

$a = 21.2625$	$\log(s-b)$	0.39520	$s-a$	0.41130	
$b = 21.3563$	" $(s-c)$	~~1~~ 1.27368		1.27368	
$c = 5.06\frac{25}{33}$	" $\left(\frac{1}{s-a}\right)$	9.58870	$s-b$	9.60480	
$2s = 47.6813$	" $\frac{1}{s}$	8.62268		8.62268	
$s = 23.8406$	Σ	9.88026		9.91246	
$s-a = 2.5781$	" $\tan \frac{1}{2}A$	9.94013		9.95623	
$s-b = 2.4843$	$\frac{1}{2}A$	41 $3.\frac{80}{32}$	$\frac{1}{2}B$	42 7.04	
$s-c = 18.7781$	A	82 7.6	B	84 14.1	
	" $\sin A$	9.99589	" $\sin B$	9.99780	
	" b	1.32953	a	1.32761	
	" R	1.32542		1.32541	
	R	21.155		21.155	

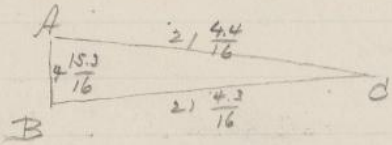
log 0.0099	7.99564
" R	1.32542
" $\tan A$	6.67022
" " 1"	4.~~55687~~ 68557
" 1 rev	1.98465
1 rev	96.528

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1896phae.proj.11710

Sept. 4/96

Level tries



a	21.2688	log (s-b)	0.39358	s-a	0.39466
b	21.2750	" (s-c)	1.27402		1.27402
c	4.9562	" $\frac{1}{s-a}$	9.60534	s-b	9.60642
2s	47.5000	" $\frac{1}{s}$	8.62434		8.62434
s	23.7500	Σ	9.89728		9.89944
s-a	2.4812	" tan $\frac{1}{2}$A	9.94864		9.94972
s-b	2.4750	$\frac{1}{2}$A	41 37.~~333~~ 200	$\frac{1}{2}$B	41 41.44
s-c	18.7938	A	83 14.4	B	83 22.88
		" sin A	9.99697	sin B	9.99710
		" b	1.32787	a	1.32775
		" R	1,32484		1,32485
		R	21.127		21.128

log	0.0099	7.99564
"	R	1.32484
"	tan A	6.67080
"	" Ist	4.68557
"	I^{rev}	1.98623
	I^{rev}	96.656

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52

Aug. 17/96

⊙ App.	8	55	27	75	0					359	38	0		0	42	0	
Roof		56	16.5	48.5							30				42	0	
A tridolabserv		57	5	48.5						38	15			42	0		
		57	54	49	76	0				0	10	8					
	8	56	40.6														

⊙ Left	8	59	39.5	50	75	40					75	39	0				
Roof B tridol		0	29.5	47.5								10	6				
observ		1	17	51							75	19	54				
	9	2	8		76	40					37	39	57		Alt.		
	9	0	53.5									15	50.7		Semi-d.		
													56.6		Refr.		
													23.3		Par.		
													7.0		h		
											37	23	17		ζ		
											52	36.7			φ−δ		
											29	49.3			ζ+(φ−δ)		
											82	26.0			ζ−(φ−δ)		
											22	47.4			½(ζ+(φ−δ)		
											41	13.0			½(ζ−(φ−δ)		
											11	23.7			log sin ½(")		
											9.81882				" sin ½(")		
											9.29575				" sec φ		
											0.01798				" sec δ		
											0.01207				" sin² ½t		
											9.14462				" sin² ½t		
											9.57231				½ t		
											21	55.97			t		
											43°	51.94			(27.6)		
											2h	55m.46					
											12	3	43.7				
											9	8	16.1				

Reduced by single altitudes next page

T′	8	56	40.6							9	0	53.5					
T″	2	49	14.1							2	44	54.5	?				
T′−T″	5	52	33.5							5	44	1.0					
½(")	2	56	16.8							2	52	0.5					
	44°	4.2								43°	0′						
	2.938									2.867							
½(T′+T″)	11	52	57.4							11	52	54.0	rej.				
δt			6.3														
Chron app noon	11	52	51.1							φ	−16	22.5					
Mean " "	12	3	43.7							δ	+13	26.8					
Chron corr.	+10	52.6								φ−δ	−29	49.3					
⊙ ave single alt. (next page)			51.3	½ wt													
	+10	52.2	adopts							9	8	16.1					
										8	56	40.6					
										11	35.5						

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56.5	43	43	76 40	
53	44	28.5	reject	Shadow partly across
54.5	45	22.5		mercury horizon on last two
	46	17.5	75 40	readings. Use first two.

2	48	1	76 0	
	48	50 (49)		
	49	38.5 (48.5)		
	50	27 (48.5)	75 0	
2	49	14.1		

359 38 30 0 41 57
20 40
38 25 41 45
0 10 5

,808
54
1616
40 40

2 57 35 = 12 55 55

δ +13 ~~26.8~~ 7.5 Δδ − ~~47.92~~ 48.45

log tan φ	9.46812n
" sin t	9.84232
Δ	9.62580
N_{o_1}	−.4225
" tan δ	9.~~98690~~ 36766
" tan t	9.98590
Δ	9.~~39267~~ 38376
N_{o_2}	.24~~09~~9
$N_{o_1} - N_{o_2}$	−.66~~705~~ 34
" "	9.82~~576~~ 178
" t	0.46805
" Δδ	1.68~~052~~ 529
" $\frac{1}{15}$	8.82391
Σ	0.79~~823~~ 903
~~Δt~~	6.3

76 10 0	δ noon 13 7 30
−10 6	Red 2h 52m 1 36.9 42.0
75 59 54	δ 13 9 49
37 59 57	log sin ½(+) 9.81381
+15 50.7	" " ½(−) 9.28474
− 56.6	" sec φ 0.01798
+ 7.0	" sec δ 0.01156
38 14 58	h " sin ½t 9.12809
−16 22 25	φ " sin ½t 9.56404
13 9 49	δ ½t 21 29.~~97~~ 88
51 45	2
29 32 14	φ−δ t 42 59.76
~~81 17~~ ~~67 47~~	~~16~~ ~~12~~ ½(+) t^h 2 5~~7~~1 ~~98~~ 58.~~8~~ 5
22 12 48	½(−) Sun 12 3 43.7
40 38 38	½(+) 9 11 44.9
11 6 24	½(−) Chm 9 0 53.5
	10m 5s 1.4
	Red to noon −.1
	W 51.3

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Mine - Sextant
Equal altitudes

Aug. 22/96 am.

		54	49.5	77	0
⊙ aff	8	55	37		
		56	25		
Ref: I this Obs.		57	14.5	78	0
⊙ eff		58	59.5	77	40
		59	47.5		
Ref: I this Obs		0	36.5		
	9	1	24.5	78	40

359 39 0 0 41 30
38 30 50

chron	Sid. clock
9 11 31.5	= 7 29 15
9 23 20 Watch	9 13 30 chron

T'	8	56	1.5	9	0	12.0
T''	2	~~43~~ 47	~~+8.4~~ 28.1	2	43	18.4
Δ	5	51	26.6	5	43	6.4
½ Δ	2	55	43.3	2	51	33.2
		43°	50.'8	42°		53.'3
		2.929		2.859		
½ (T'+T'')	11	51.	44.8	11	51.	45.2
δt			6.3			6.3
Chron aff mean	11	51	38.5	11	51	38.9
Mean . . .	12	2	31.8	12	2	31.8
		10	53.3		10	52.9
			10 53.1			

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p.m.

⊙ app	2	42 7.5	78 40	
		42 54		359 39 0 0 42 0
Ref: B tride		43 41.5		38 40 42 0
6a		44 30.5	77 40	
⊙ ref.		46 16	78.0	
Ref: A tride		47 4.5		
6a.		47 51.5		
		48 40.5	77 0	

	δ ★ 11 28.1	Δδ −50.87
Log tan φ	9.46812 n	9.46812 n
" sin t	9.84056	9.83287
Δ	9.62756 n	9.63525 n
N_{0_1}	−.4242	−.4318
" tan δ	9.30723	9.30723
" tan t	9.98251	9.96796
Δ	9.32472	9.33927
N_{0_2}	.2112	.2184
$N_{0_1} - N_{0_2}$	−.6354	−.6502
" "	9.80305 n	9.81305 n
" t	0.46672	0.45621
" Δδ	1.70646 n	1.70646 n
" $\frac{1}{15}$	8.82391	8.82391
E	0.80014	0.79963
δt	6.3	6.3

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Zenic – Sextant

Aug. 25/96 am.

Images poor today

⊙ app.

Refl: A tide hb.

8	54	42.5	11	78	20	
	55	31.5	13		40	78 50
	56	18.5	11		0	
	57	7.5		79	20	
8	55	55.0				

12.1
47.8
23.9
11.8

⊙ app.

Refl: B tide hb.

4.3	58	52.5	11.5	79	0	
4.9	59	41			20	79 30
5.2	0	~~25~~ 25 *	12		40	
9	1	17		80	0	
9	0	4.8				

* Images suddenly blurred. Zenic uncertain Refl.

359 38 40 0 41 50
20 42 0

								Mean	79 0	Mean	78 20
									79 20		78 40
											79 0
8	55	55.0		9	0	4.8		8	59 16.8	8	55 30.8
2	4~~6~~	4.~~8~~ 5		2	42	~~4.8~~ 0.3		2	42 48.2	2	46 28.7

							2.6		
11	50	59.8	11	51	~~3.3~~	11	51	2.5	11 50 59.8
		11 51	1.~~6~~ 2						
			6.3						
		11 50	~~55.3~~ 54.9						
		12 1	43.3						
		10	48.~~0~~ 4						

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⊙ app

Roof A trids Hb.

2	42	24.5		79	20
	43	12	12.5		0
	44	6	12.5	78	40
	44	48	12		20
	43	36.1			
	−1	35.8	Red. ⊏	79	30

78 50

⊙ app

Roof B trids Hb.

	45	41.5		79	0
	46	28 5	13		40
	47	16	12.5		20
2	48	3.5	12.5	78	0
	46	52.4			
		−47.9	Red. ⊏	78	50

78 30

359 38 40 0 42 0

20 42 0

3 3 9.5 = 3 14 0

4 56 13 35 30

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Aug. 28/96 a.m.

Images blurred

⊙	8	40	28		40							
		41	15.5		0							
B		42	1.5									
	[42]	43	46.5	74	40							
⊙		44	27	74	20							
		45	14									
A		46	1									
		46	47	75	20							
⊙		48	12.5	77	0							
		48	59									
		49	45.5									
		50	32	78	0							
B		52	13	77	40							
⊙		53	1									
		53	46.5			359	38	40	0	41	50	
		54	34	78	40			30		42	0	

T'	8	41	37.9	45	37.2	49	22.2	53	23.6	Mean	
T''		58	36.5	54	35.2	50	53.2	46	51.1		
	2	~~46~~	~~51.1~~	~~60~~	~~53.2~~	~~54~~	~~35.2~~	~~58~~	~~36.5~~		
Mean	11	~~50~~ 44	7.2 ~~44.5~~	50	6.2	50	7.7	50	7.4	11 50	7.1
											−6.3
										11 50.	0.8
										12 0	51.3
										10	50.5

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Jan.

⊙	2	45	40.5	78	40
A		46	27.5		
		47	14		
		48	2.5	77	40
B		49	44?	78	0
⊙		50	30		
		51	16		
		52	3	77	0
⊙		53	25.5	75	20
		54	12.5		
		54	58		
		55	45	74	20
⊙		57	27	74	40
A		58	13.5		
		58	59.5		
	2	59	46	73	40

59 38 30 0 41 50
10 42 20

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Time equal altitudes.

Aug 31/96 am.

☉ app.		55	37	81	40				
	8	56	22	52	0				
Roof: B trds obs.		57	9.5						
		57	56.5		40				
☉ ref.		59	40	82	20	9	8	18 = 8	1 40
Roof: A trds obs.		0	26.5			9	17.3 - 9	20	0
		1	13.5						
		2	0	43	20				

T'	8	56	46.2	9	0	50.0	
T''	2	41	34.6	2	37	32.6	
Δ	5	~~5~~ 4	48.4	5	36	42.6	
$\frac{1}{2}\Delta$	2	52	24.2	2	48	21.3	
		43	6.0		42	5.3	
		2.873			2.806		
$\frac{1}{2}(T'+T'')$	11	49	10.~~8~~ 4	11	49	11.3	
		11	49	10.8			
δt				6.1			
Chron app noon		11	49	4.7			
Mean " "		11	59	56.3			
Chron Corr.		+ 10	51.6				

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Jun.

	36	24	83	20
	37	8		
B	37	56.5		
	38	42	82	20
	40	24.5	82	40
A	41	11		
	41	58		
2	42	45	81	40

δ +8° 18′.3 $\Delta\delta$ −54.44

log tan φ	9.46812n	9.46812n
" cos t	9.83459	9.82625
Δ	9.63353n	9.64187n
Sh_1	−.4306	−.4384
" tan δ	9.16427	9.16427
" tan t	9.97118	9.95579
Δ	9.19309	9.20848
Sh_2	.1560	.1616
$Sh_1 - Sh_2$	−.5861	−.6000
" "	9.76797n	9.77815n
" t	0.45834	0.44809
" $\Delta\delta$	1.73592n	1.73592n
" $\frac{1}{15}$	8.82391	8.82391
Σ	0.78614	0.78607
δt	6.1	6.1

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Sept. 3/96 a.m.

☉ aff	8	38	27.5	75 40 est
Ref: B			attend trees	
bdr thr.		41	27	77 0
		42	13	
		42	58	
		43	43.5	78 0

☉ occ		45	25.5	77 40
Ref: A	bdr	46	9	
	thr.	46	54	
		47	39.5	78 40

12 16 46 = 11 22 30
17 26.5 = 12 28 0
10 50.8
28 17.3

T'	8	42	35.4	8	46	32.0
T''	2	53	50.4	2	49	55.0
Δ	6	11	15.0	6	3	23.0
½ Δ	3	5	37.5	3	1	41.5
		46	24.4		45	25.4
		3.094			3.028	

½(T'+T'')	11	48	12.9	11	48	13.5
		11	48	13.2		
δt				6.0		
Chron aff. mean		11	48	7.2		
Mean t. " "		11	58	58.0		
Chron corr.			10	50.8		

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1896phae.proj.1171U

p.m.

⊙ app	2	48	46	78 40
B		49	32.5	
		50	18	
		51	3.5	77 40
		52	43	78 0
		53	27.5	
⊙ esp.		54	13	
A		54	58	77 0

δ 7 12.4 $\Delta\delta$ −55.40

log tan ϕ	9.46812n	9.46812n
" cos t	9.85989	9.85267
Δ	9.60823n	9.61545n
No_1	−.4057	−.4125
" tan δ	9.10191	9.10191
" tan t	0.02133	0.00642
Δ	9.08058	9.09549
No_2	.1204	.1246
$No_1 - No_2$	−.5261	−.5371
"	9.72107n	9.73006n
" t	0.49052	0.48116
" $\Delta\delta$	1.74351n	1.74351n
" $\frac{1}{15}$	8.82391	8.82391
Σ	0.77901	0.77864
δt	6.0	6.0

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1896phae.proj.11711

Sept. 4/96

Level trier on horizontal base of Bruce mounting. Set at different part of micrometer screw from that used Aug. 12 and 13.

Rogers level 11.55 am.

Micr.	S	N		S	N	Mean	1 div =
.80	18.1	4.5					
			0.75 =	52.9	53.0	52.95	0.0142
1.55	71.0	57.5					
1.50	67.0	53.8					
			0.75 =	52.2	52.1	52.15	.0144
.75	14.8	1.7					log = 8.15836
							0.14359
.80	18.7	5.6					
			0.70 =	49.2	49.3	49.25	.0142
1.50	67.9	54.9					8.15229
							0.13752
1.50	68.0	55.2					
			0.70 =	49.5	49.4	49.45	.0142
.80	18.5	5.8					

.01425

log 1 rev = 1.98623 p. 51

12.15 p.m.

8.15381

0.13904

1.377

1 div. = 1.373
1.392
1.373
1.373
1.378 = 0.092

Summary.

Aug. 12	0.091
13	.092
Sept. 4	.092

Mean 0.092 = 1.38

See Next book p. 143

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Draper level

Micr.	S	N		
1.61	44.3	15.0	0.86 = 19.1	19.1
0.75	25.2	−4.1		
0.75	25.2	−4.1	0.85 = 18.9	18.9
1.60	44.1	14.8		
1.60	44.7	15.3	0.85 = 19.3	19.2
0.75	25.4	−3.9		
0.75	25.4	−3.9	0.85 = 19.3	19.3
1.60	44.7	15.4		

12.15 feet

1 div. = log

$\overset{2}{0.0450}$ 8.65321

log div. 0.63844

0.0450

0.0442 8.64542

0.63065

0.0440 8.64345

0.62868

0.04455 8.64885

0.63408

12.25 feet.

4.306

1 div. = $4.\overset{11}{\cancel{4}}50$

$4.\overset{3}{\cancel{4}}50$

4.272

4.253

4.306 = $\overset{s}{0.287}$

Summary

Aug. 12	$\overset{s}{0.292}$
13	0.300
Sept. 4	0.287

Mean $\overset{s}{0.293}$

See Next book p. 142

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1896phae.proj.1174U

Calculation of Transit Coefficients A B C.

Assume $\varphi = -16^\circ\ 22'.4$

(Additional values calculated on p. 68)

δ	−80	−72	−64	−56	−48	−40
$\varphi - \delta$	+63 37.6	+55 37.6	+47 37.6	+39 37.6	+31 37.6	+23 37.6
log sin (")	9.95227	9.91665	9.86851	9.80467	9.71965	9.60290
" sec δ	0.76033	0.51002	0.35816	0.25244	0.17449	0.11575
" cos (")	9.64759	9.75173	9.82864	9.88661	9.93017	9.96198
" A	0.71260	0.42667	0.22667	0.05711	9.89414	9.71865
" B	0.40792	0.26175	0.18680	0.13905	0.10466	0.07773
A	5.159	2.671	1.685	1.141	0.784	0.523
B	2.558	1.827	1.537	1.377	1.272	1.196
C	~~5.160~~ 5.159	3.236	2.281	1.788	1.494	1.305
$\varphi - \delta$)	−32	−24	−16	−8	0	+8
log sin (")	+15 37.6	+7 37.6	−0 22.4	−8 22.4	−16 22.4	−24 22.4
" sec δ	9.43035	9.12293	7.81397n	9.16323n	9.45009n	9.61561n
	0.07158	0.03927	0.01716	0.00425	0.00000	0.00425
" cos (")	9.98364	9.99614	9.99999	9.99534	9.98202	9.95946
" A	9.50193	9.16220	7.83113n	9.16748n	9.45009n	9.61986n
" B	0.05522	0.03541	0.01715	9.99959	9.98202	9.96371
A	0.318	0.145	−0.~~018~~ 007	−0.147	−0.282	−0.417
B	1.136	1.085	1.040	0.999	0.959	0.920
C	1.179	1.095	1.040	1.010	1.000	1.010
$\varphi - \delta$)	+16	+24	+32	+40	+48	+56
log sin (")	−32 22.4	−40 22.4	−48 22.4	−56 22.4	−64 22.4	−72 22.4
" sec δ	9.72871n	9.81142n	9.87360n	9.92041n	9.95503n	9.97912n
	0.01716	0.03927	0.07158	0.11575	0.17449	0.25244
" cos (")	9.92664	9.88187	9.82234	9.74333	9.63599	9.48117
" A	9.74587n	9.85069n	9.94518n	0.03616n	0.12952n	0.23156n
" B	9.94380	9.92114	9.89392	9.85908	9.81048	9.73361
A	−0.557	−0.709	−0.881	−1.087	−1.347	−1.704
B	0.879	0.834	0.783	0.723	0.646	0.542
C	1.040	1.095	1.179	1.305	1.494	1.788

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Differences & Interpolation

A			B			C
−2.488			−0.206	20	−0.731	−0.060	−2.523
			217		23		
			229	−54		−17	
			243		31		
−0.986			−0.260	−43	−0.290	36 −0.077	−0.955
			278		40	41	
			300	−97		−27	
			325		57		
−0.544			−0.357		−0.160	47 −0.104	−0.493
						57 [52]	
	+187				+55		+199
				58		165	
−0.357		−91		11	−0.105	−26	36 −0.294	−94
	+96	See f. 69		47			129	
				6		+29 +13	24	+105 +52
				41			105	
−0.261		−40		6	−0.076	−13	21 −0.189	−42
244				35			84	
229	+56			4		+16 +6	15 14	+63 +21
216		24		31			69	
−0.205		−24		2	−0.060	−7	12 14 −0.126	−21
195				29			5657	
187	+32			3		9 +3	16	42 +8
180		14		26			46	
−0.173		−11		1	−0.051	−3	8 −0.084	−13
167				25			38	
161	+21			2		6		29 39 +9
156		9		23			7	
−0.152		−9		1	−0.045		31	5
148				22			7 −0.045	−4
145	+12			1		4	24	
143		5		21			6	25 −1
−0.140		−7		1	−0.041		18	
138				20			6 −0.030	25 −5
137	+5					1	12	
136		2		20			5	20
−0.135		−5			−0.040		7	
134		+1		20			4 −0.010	
134	0					+1	3	
134		−1		20			0	20
−0.135		−5			−0.039		3	
136		2		19			4 7 +0.010	
137	−5					−2		
138		3		20				
−0.140		−7			−0.041			
142		5		21				
145	−12					4		
148		7		22				
−0.152		−8			−0.045			
156		9		23				
161	−20					6		
166		11		25				
−0.172		−14			−0.051			
179		15		26				
187	−34					9		
196		19		28				
−0.206		−20			−0.060			
				32				

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Additional

δ	−79	−78	−77	−76	−75	−74
φ−δ	+62 37.6	+61 37.6	+60 37.6	+59 37.6	+58 37.6	+57 37.6
log sin (")	9.94843	9.94442	9.94024	9.93588	9.93135	9.92664
" sec δ	0.71940	0.68212	0.64791	0.61632	0.58700	0.55966
" cos (")	9.66256	9.67689	9.69064	9.70383	9.71651	9.72871
" A	0.66783	0.62654	0.58815	0.55220	0.51835	0.48630
" B	0.38196	0.35901	0.33855	0.32015	0.30351	0.28837
A	4.654	4.232	3.874	3.566	3.299	3.064
B	2.410	2.286	2.180	2.090	2.011	1.943
C	5.241	4.810	4.445	4.134	3.864	3.628

δ	−73	−71	−70	−68	−66	−62
(φ−δ)	+56 37.6	+54 37.6	+53 37.6	+51 37.6	+49 37.6	+45 37.6
" sin (")	9.92174	9.91137	9.90588	9.89431	9.88187	9.85418
" sec δ	0.53406	0.48736	0.46595	0.42642	0.39069	0.32839
" cos (")	9.74044	9.76260	9.77309	9.79294	9.81142	9.84468
" A	0.45580	0.39873	0.37183	0.32073	0.27256	0.18257
" B	0.27450	0.24996	0.23904	0.21936	0.20211	0.17307
A	2.856	2.505	2.354	2.093	1.873	1.523
B	1.881	1.778	1.734	1.657	1.598	1.490
C	3.420	3.072	2.924	2.669	2.459	2.130

δ	−60	−58	−54	−52	−50	−46
φ−δ	+43 37.6	+41 37.6	+37 37.6	+35 37.6	+33 37.6	+29 37.6
log sin (")	9.83882	9.82234	9.78570	9.76530	9.74333	9.69403
" sec δ	0.30103	0.27579	0.23078	0.21066	0.19193	0.15823
" cos (")	9.85965	9.87360	9.89873	9.91000	9.92047	9.93915
" A	0.13985	0.09813	0.01648	9.97596	9.93526	9.85226
" B	0.16068	0.14939	0.12951	0.12066	0.11240	0.09738
A	1.380	1.254	1.039	0.946	0.862	0.712
B	1.448	1.411	1.347	1.320	1.295	1.251
C	2.000	1.887	1.701	1.624	1.556	1.440

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Interpolation of A.

	I	II	III	IV			
+58	−0.544						
−74 22.4		+.187					
9.98364n	.357		−91				
0.27579		96		+51			72
					−139		69
9.43035	.261		40			+17	63
					122		59
0.25943n		56		16		14	56
					108		52
9.70614	.205		24			11	50
					97		47
−1.817		32		13		7	46
					90		44
0.508	.173		11			7	42
					83		41
		21		2		5	40
					78		38
+60	.152		9			4	37
					74		37
−76 22.4		12		2		3	36
					71		35
9.98760n	.140		7			2	35
					69		34
0.30103		+5				1	34
					68		34
9.37216	.135		5			1	34
					67		33
0.28863n		0				+0	33
					67		34
9.67319	.135		5			−1	34
					68		34
−1.944		−5				1	34
					69		35
0.471	.140		7			2	35
					71		36
		12				3	37
					74		37
	.152		8			4	38
					78		40
		20				5	41
					83		42
	.172		14			6	44
					89		45
		34				9~~8~~	48
					9~~8~~		50
	.206		20			10	53
					10~~8~~		55
		54		−23		13	59
					121		62
	.260		−43			18	67
					139		72
		−97		−50		2~~1~~	7~~8~~ 77
					1~~6~~1 162		8~~3~~ 85
	−.357		[−93]			3~~3~~	9~~0~~ 92
		[190]			−1~~8~~5 195		9~~6~~ 103

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A is considered ± for stars N/S of zenith

Time coefficients. Declination

δ	A	B	C	δ	A	B	C
−80	− 5.159	2.558	5.759	−55	− 1.089	1.362	1.743
	505	148	518		50	15	42
79	− 4.654	2.410	5.241	54	− 1.039	1.347	1.701
	422	124	431		48	14	40
78	− 4.232	2.286	4.810	53	− 0.991	1.333	1.661
	358	106	365		45	13	37
77	− 3.874	2.180	4.445	52	− 0.946	1.320	1.624
	308	90	311		43	13	35
76	− 3.566	2.090	4.134	51	− 0.903	1.307	1.589
	267	79	270		41	12	33
75	− 3.299	2.011	3.864	50	− 0.862	1.295	1.556
	235	68	236		40	12	32
74	− 3.064	1.943	3.628	49	− 0.822	1.283	1.524
	208	62	208		38	11	29
73	− 2.856	1.881	3.420	48	− 0.784	1.272	1.495
	185	54	184		37	11	29
72	− 2.671	1.827	3.236	47	− 0.747	1.261	1.466
	166	49	164		35	10	26
71	− 2.505	1.778	3.072	46	− 0.712	1.251	1.440
	151	44	148		34	10	26
70	− 2.354	1.734	2.924	45	− 0.678	1.241	1.414
	136	40	134		33	10	24
69	− 2.218	1.694	2.790	44	− 0.645	1.231	1.390
	125	37	121		32	9	23
68	− 2.093	1.657	2.669	43	− 0.613	1.222	1.367
	115	33	110		31	9	22
67	− 1.978	1.624	2.559	42	− 0.582	1.213	1.345
	105	31	100		30	9	20
66	− 1.873	1.593	2.459	41	− 0.552	1.204	1.325
	98	29	93		29	8	20
65	− 1.775	1.564	2.366	40	− 0.523	1.196	1.305
	90	27	85		28	8	19
64	− 1.685	1.537	2.281	39	− 0.495	1.188	1.286
	84	24	78		28	8	18
63	− 1.601	1.513	2.203	38	− 0.467	1.180	1.268
	78	23	73		26	8	16
62	− 1.523	1.490	2.130	37	− 0.441	1.172	1.252
	74	22	67		26	7	16
61	− 1.449	1.468	2.063	36	− 0.415	1.165	1.236
	69	20	63		25	8	15
60	− 1.380	1.448	2.000	35	− 0.390	1.157	1.221
	65	19	58		25	7	15
59	− 1.315	1.429	1.942	34	− 0.365	1.150	1.206
	61	18	55		24	7	14
58	− 1.254	1.411	1.887	33	− 0.341	1.143	1.192
	58	17	51		23	7	13
57	− 1.196	1.394	1.836	32	− 0.318	1.136	1.179
	55	17	48		23	7	12
56	− 1.141	1.377	1.788	31	− 0.295	1.129	1.167
	52	15	45		23	6	12
−55	− 1.089	1.362	1.743	−30	− 0.272	1.123	1.155

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−80° to 0°

δ		A		B		C	δ		A		B		C
−30	−	0.272		1.123		1.135	−10	+	0.113		1.009		1.015
29	−	0.250	.22	1.116	7	1.144	11	9	+	0.130	17	1.004	5	1.012	3
28	−	0.228	.22	1.110	6	1.133	11	8	+	0.147	17	0.999	5	1.010	2
27	−	0.207	.21	1.103	7	1.123	10	7	+	0.164	17	0.994	5	1.008	2
26	−	0.186	.21	1.097	6	1.113	10	6	+	0.181	17	0.989	5	1.006	2
25	−	0.165	.21	1.091	6	1.104	9	5	+	0.198	17	0.984	5	1.004	2
24	−	0.145	.20	1.085	6	1.095	9	4	+	0.215	17	0.979	5	1.003	1
23	−	0.125	.20	1.079	6	1.087	8	3	+	0.232	17	0.974	5	1.002	1
22	−	0.105	.20	1.073	6	1.079	8	2	+	0.249	17	0.969	5	1.001	1
21	−	0.086	.19	1.067	5	1.071	7	1	+	0.266	17	0.964	5	1.000	0
20	−	0.067	.19	1.062	6	1.064	7	0	+	0.282	17	0.959	5	1.000	0
19	−	0.048	.19	1.056	5	1.057	6								
18	−	0.030	.18	1.051	6	1.051	6								
17	∓	0.011	.19	1.045	5	1.045	5								
16	+	0.007	.18	1.040	6	1.040	5								
15	+	0.025	.18	1.034	5	1.035	5								
14	+	0.043	.18	1.029	5	1.030	4								
13	+	0.061	17	1.024	5	1.026	4								
12	+	0.078	18	1.019	5	1.022	4								
−11	+	0.096	17	1.014	5	1.018	3								
10	+	0.113		1.009		1.015									

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Time Coefficients — Declination 0° to +60°

δ	A	B	C	δ	A	B	C
0	+0.282	0.959	1.000	+30	+0.836	0.796	1.155
+ 1	+ .298 (16)	.954 (5)	1.000 (0)	31	+ .858 (22)	.790 (6)	1.167 (12)
2	+ .315 (17)	0.949 (5)	1.001 (1)	32	+0.881 (23)	0.783 (7)	1.179 (12)
3	+ .332 (17)	.944 (5)	1.002 (1)	33	+ .905 (24)	.776 (7)	1.192 (13)
4	+ .348 (17)	0.939 (5)	1.003 (1)	34	+ .929 (24)	0.769 (7)	1.206 (14)
5	+ .366 (17)	.934 (5)	1.004 (1)	35	+ .954 (25)	.762 (7)	1.221 (15)
6	+ .383 (17)	0.929 (5)	1.006 (2)	36	+ .979 (25)	0.755 (7)	1.236 (15)
7	+ .400 (17)	.925 (4)	1.008 (2)	37	+1.005 (26)	.748 (7)	1.252 (16)
8	+0.417 (17)	0.920 (5)	1.010 (2)	38	+1.032 (27)	0.740 (8)	1.268 (16)
9	+ .434 (17)	.915 (5)	1.012 (2)	39	+1.059 (27)	.732 (8)	1.286 (18)
10	+ .451 (17)	0.910 (5)	1.015 (3)	40	+1.087 (28)	0.723 (9)	1.305 (19)
11	+ .468 (17)	.905 (5)	1.018 (3)	41	+1.116 (29)	.715 (8)	1.325 (20)
12	+ .486 (18)	0.900 (5)	1.022 (4)	42	+1.146 (30)	0.706 (9)	1.345 (20)
13	+ .503 (17)	.895 (5)	1.026 (4)	43	+1.177 (31)	.697 (9)	1.367 (22)
14	+ .521 (18)	0.890 (5)	1.030 (5)	44	+1.208 (31)	0.687 (10)	1.390 (23)
15	+ .539 (18)	.885 (5)	1.035 (5)	45	+1.241 (33)	.677 (10)	1.414 (24)
16	+0.557 (18)	0.879 (6)	1.040 (5)	46	+1.275 (34)	0.667 (10)	1.440 (26)
17	+ .575 (18)	.874 (5)	1.045 (6)	47	+1.310 (35)	.657 (10)	1.466 (26)
18	+ .594 (19)	0.868 (6)	1.051 (6)	48	+1.347 (37)	0.646 (11)	1.495 (29)
19	+ .612 (18)	.863 (5)	1.057 (6)	49	+1.385 (38)	.635 (11)	1.524 (29)
20	+ .632 (19)	0.857 (6)	1.064 (7)	50	+1.425 (39)	0.623 (12)	1.556 (32)
21	+ .650 (19)	.852 (5)	1.071 (7)	51	+1.466 (42)	.611 (12)	1.589 (33)
22	+ .669 (19)	0.846 (6)	1.079 (8)	52	+1.508 (43)	0.599 (12)	1.624 (35)
23	+ .689 (20)	.840 (6)	1.087 (8)	53	+1.554 (45)	.586 (13)	1.661 (37)
24	+0.709 (20)	0.834 (6)	1.095 (8)	54	+1.601 (47)	0.572 (14)	1.701 (40)
25	+ .729 (20)	.828 (6)	1.104 (9)	55	+1.651 (50)	.557 (15)	1.743 (42)
26	+ .750 (21)	0.822 (6)	1.113 (9)	56	+1.704 (53)	0.542 (15)	1.788 (45)
27	+ .771 (21)	.816 (6)	1.123 (10)	57	+1.759 (55)	.525 (17)	1.836 (48)
28	+ .792 (21)	0.809 (7)	1.133 (10)	58	+1.817 (58)	0.508 (17)	1.887 (51)
29	+ .814 (22)	.803 (6)	1.144 (11)	59	+1.878 (61)	.490 (18)	1.942 (55)
+ 30	+0.836	0.796 (7)	1.155 (11)	+60	+1.944 (66)	0.471 (19)	2.000 (58)

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Special South Stars.

	δ Octantis	ρ Octantis	σ Octantis	υ Octantis
δ	−83 11.7	−84 7.3	−89 15.5	−86 29.4
φ	−16 22.5			
	66 49.2	67 44.8	72 53.0	70 6.9
	9.96344	9.96639	9.98032	9.97330
	0.92632	0.98963	1.88793	1.21309
	9.59508	9.57830	9.46882	9.53164
	0.88976	0.95602	1.86825	1.18639
	0.52140	0.56793	1.35675	0.74473
	−7.76	−9.04	−73.83	−15.36
	3.32	3.70	22.74	5.56
	8.44	9.76	77.26	16.33

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Sept. 7/96 am.

⊙ app.	8	36	22.5	76	40	
B		37	8			
		37	52.5			
		38	36.5	77	40	
☉ dep.		40	14.5	77	20	
A		40	59.5			
		41	44			8 46 54.5 = 8.7.20
	8	42	29	78	20	48 35.5 = 8.59.0
	8	37	29.9	8	41	21.8
	2	56	19.4	2	52	28.2
Mean	11	46	54.6	11	46	55.0
		11	46	54.8		
				−6.0		
Chron app. noon		11	46	48.8		
Mean. " "		11	57	38.9		
			10	50.1		

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Jan.

2	51	20	78	20
	52	6		
A	52	51.5		
	53	35.5	77	20
	55	11.5	77	40
	55	56.5		
A	56	42		
	57	27.5	76	40

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Sept. 11/96 am

⊙ app.	8	38	4.5	79	20
Roof: A		38	48.5		
tricks obs.		39	33		
		40	17.5	80	20
⊙ sep.		41	55	81	0
Roof: B		42	39		
tricks obs.		43	22.5		
		44	7.5	81	0

8-49-18 = 8 25 30

50-46.5-9 1 0

T'	8	39	10.9	8	43	1.0
T''	2	51	55.5	2	48	5.1
T''-T'	6	12	44.6	6	5	4.1
½(")	3	6	22.3	3	2	32.0
		46	35.6		45	38.0
			3.106			3.042
½ (T'+T'')	11	45	33.2	11	45	33.0
		11	45	33.1		
δt				5.6		
clinom. ~~sep~~ mean		11	45	27.5		
Mean " "		11	56	16.~~2~~		
		10	48.~~8~~ 7			

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p.m.

⊙ aff Roof. A	2	46	58	81	0
		47	43		
		48	28		
		49	11.5	80	0
⊙ aff. Roof. B		50	48.5	80	20
		51	33.5		
		52	17.5		
		53	2.5	79	20

	Δ +4° 11.'8	Δδ −57.32
log tan φ	9.46812 n	9.46812 n
" sin t	9.86123	9.85423
Δ	9.60689 n	9.61389 n
No$_1$	−.4045	−.4110
" tan δ	8.86556	8.86556
" tan t	0.02417	0.00960
Δ	8.84139	8.85596
No$_2$	.0694	.0718
No$_1$ − No$_2$	−.4739	−.4828
" "	9.67569 n	9.68377 n
" t	0.49220	0.48316
" Δδ	1.75831 n	1.75831 n
" $\frac{1}{15}$	8.82391	8.82391
Σ	0.75011	9.75435
δt	5.6	5.7

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Sept. 14/96 a.m.

	9	14	22.5	97	0
A		15	6.5		20
		15	53		40
		16	38.5	98	0
		15	30.1		

	18	19		97	40					
B	19	5.5		98	0	9	23	40.5	= 9 − 11 − 50	
	19	50.5			20		24	53.5	35	0
	20	37		98	40		28	12.8	39	0
	19	28.0								

Reduction by single altitudes.

	☉			☉			☉			☉		
Reading	97	30	0	98	10	0	93	50	0	93	10	0
Index Corr.		− 10	15									
Corr'd Reading	97	19	45	97	59	45	93	39	45	92	59	45
App. Alt.	48	39	52.5	48	59	52.5	46	49	52.5	46	29	52.5
Semi-diam		− 15	57.0		+ 15	57.0		+ 15	57.1		− 15	57.1
Refr.		−	38.4		−	38.0		−	41.0		−	41.5
Par.		+	5.8		+	5.8		+	6.0		+	6.0
h	48	23	22.6	49	15	17.3	47	5	14.6	46	13	19.9
ζ	41	36	37.4	40	44	42.7	42	54	45.4	43	46	40.1
φ − δ	− 19	27	32	− 19	27	28	− 19	22	38	− 19	22	35
ζ + (φ − δ)	22	9	5	21	17	15	23	32	7	24	24	5
ζ − (φ − δ)	61	4	9	60	12	11	62	17	23	63	9	15
½(+)	11	4	32	10	38	38	11	46	4	12	12	2
½(−)	30	32	4	30	6	6	31	8	42	31	34	38

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jun.

	2	18	16.5	94	20		
		19	3.	94	0		
A		19	48	93	40		
		20	34	93	20		
		19	25.4				

					359	38	30	0 42 0 } aff
	22	12.5	93	40			30	0 }
B	22	58		20			30	0 } sup
	23	43.5	93	0			30	0 }
	24	27	92	40	359	38	30	0 42 0
	23	20.2					0	10 15

Refr.	Sea-level	51.2	50.6	54.6	55.3
	1/4	12.8	12.6	13.6	13.8
	3/4	38.4	38.0	41.0	41.5
h.a.		2 50	2,43		
		~~2.66~~	~~2.60~~	2.57	2.63
$\Delta\delta$		2′ 24″.5	20″.5	28″.5	32″.0

δ affp. none +3 2 42 h.m. 57″.80
Meant. " " 11 55 13.0
chron " " 11 45 27

δ + 3° 5′ 6.″5 / 3° 5′ 2.″5 / 3° 0′ 13.″5 10.″0

φ − 16 22 25

log sin ½(+)	9.28354	9.26647	9.30952	9.32497
" " ½(−)	9.70591	9.70030	9.71867	9.71904
" sec φ	0.01798	0.01798	0.01798	0.01798
" sec δ	0.00063	0.00063	0.00060	0.00060
" sin² ½t	9.00806	8.98538	9.04177	9.06259
" sin ½t	9.50403	9.49269	9.52088	9.53130
½t	18 36.78	18 7.00	19 22.69	19 52.11
t°	37° 13′.56 (33″.4)	36 14.00 (0″)	38 45.38 (22″.5)	39 44.22 (13″.2)
t^h	2 28 54.2	2 24 56.0	2 35 1.5	2 38 56.9
Meant aff noon	11 55 13.0			
Chron. t	9 15 30.1	9 19 28.0	2 19 25.4	2 23 20.2
Calc. t. ~~Corr.~~	9 26 18.8	9 30 17.0	2 30 14.5	2 34 9.9
Corr.	10 48.7	49.0	49.1	49.7

Mean 10^m 49.^s1

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Sept. 17/96 am.

	8	43	28	84	40
		44	12		
A		44	55.5		
		45	40.	85	40

		47.	15.5	85	20	8 54 21.5 = 54 15
B		48	0.5			clouds 55 42.8 = 9 7 0
		48	44			
		49	29.	86	20	

T'	8	44	33.9	8	48	22.2
T''	2	42	21.4	2	38	33.1
T''−T'	5	57	47.5	5	50	10.9
½ (")	2	58	53.8	2	55	5.4
		44	43.4		43	46.4
			2.982			2.918

½(T'+T'')	11	43	27.6	11	43	27.6
δt			5.2			
	11	43	22.4			
chron. app. noon	11	54	9.4			
Mean " "						
Chron Corr.		10	47.0			

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	2 37	27	86	20
A	38	10.5		
	38	55.5		
	39	39.5	85	20
B	41	15.5	85	40
	41	59		
	42	44		
	43	27	84	40

δ 1′ 53.′1 $\Delta\delta$ −58.″15

log tan ϕ	9.46812 n	9.46812 n
" cot t	9.84738	9.83998
Δ_1	9.62074 n	9.62814 n
" tan δ	8.51734	8.51734
" tan t	9.99580	9.98140
Δ_2	8.52154	8.53594
$\log_1$	−.4176	−.4248
$\log_2$	.0832	.0844
Δ	−.4508	−.4592
" Δ	9.65398 n	9.66200 n
" t	0.47451	0.46509
" $\Delta\delta$	1.76455 n	1.76455 n
" $\frac{1}{15}$	8.82391	8.82391
Σ	0.71695	0.71555
δt	5.2	5.2

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Sept. 18/96

Draper Transit

ε Parvis chron calc. 7 44 15

W ε az. adjusted

								−.05
								−.2
								−.12
327	1.5	+34.2						
1.6	32.8	−34.4		32.5	0.9	+33.4	$b = -^s.036$	
		−.2		1.2	33.0	−34.2		
		−.05				−0.8		
						−.2		

dl ε,

δ	−12 52	−57 4	−18 33	+10 57
	λ^2 Capric	α Parvis	π Capric	ε Delph
	—	11 35.8	5.5	58.1
	—	12 4.7	22.2	14.2
	34.7	12 32.3	38.1	29.2
	49.8	12 59.7	54	44.4
	5.2	13 27	9.4	59.3
	20.1	13 53.6	24.5	14.3
	8 35.2	14 21.2	17 40.4	24 29.6
Mean		12 59.19	16 53.44	23 44.16
Red. to sid. time [8h 31m]		− 2.96	− 2.32	− 1.19
T		12 56.23	16 51.12	23 42.97
α	20 12 20.98	17 31.95	21 26.26	28 18.11
T − α		− 4 35.72	−4 35.14	− 4 35.14
Bb		−.05	−.04	−.03
T − α + Bb				
A	−.06	− 1.20	− .04	+ .47
B	1.02	1.40	1.05	.91
C	1.02	1.84	1.05	1.02

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	Cl W	W i	Σ			33.0	1.0	+34.0
			+35.2					−33.0
			−34.0			0.6	32.4	+ 1.0
			+ 1.2					+ .25
			+ .3					+ .3
δ	−66 35	33.4	1.8	−9 22	+40 46			
	β Pav.	1.0	33.0 Σ Cygni	μ Aq.	ν Cygni			Mean +.28
	29. 17		—	44.6	42.2			+.084
	29 54.5		—	59.9	3.6			
	30 31		—	14.7	23			
	31 8.3		27.2	29.8	42.6			At 8.31 Chron.
	31 45.5		44.7	44.8	2.2			ΔT + 4m 35.1s
	32 23.5		2.7	0	22.3			on sid. time
	33 3	38	21.7	43 15.7	49 42.7			M.T. 8 42 1 25.8
	3½ 8.97			42 29.93	48 42.94			Sid. 8 43 25.8
	+.19			+1.89	+2.83			Norm 11 52 23.8
	3½ 9.16			42 31.82	48 45.77			S.T. 20 35 49.6
	35 43.19	42	3.25	47 6.64	53 20.70			Chron 20 31 14.5
T−α	−4 34.03			−4 34.82	−4 34.93			Chron. 20 31 0
								4 35.1
Bk	+.13			+.08	+.06			Sidt 20 35 35.1
								" Norm 11 52 23.8
T−α+Bk								" Sid. 8 43 11.3
								1 25.7
A	−1.94			+.12	+1.11			Mean 41 45.6
B	1.61			1.01	.72			31 0
C	2.52			1.01	1.32			+ 10 45.6
								Chron Corr. on Mean time

Equations.

		Cc	ΔT	
1	0 = −4 35.77 + ΔT − 1.20a − 1.84c	+1.38	+4 34.39	
2	35.18 − .04 − 1.05	+.79	.39	34.40
3	35.17 +.47 − 1.02	+.76	.41	
4	~~34.98~~ 33.0 −1.94	+2.52	−1.89	35.85 79
5	34.74 +.12	+1.01	−.76	.50
6	34.87 +1.11	+1.32	−.99	.86
				35.07
3−1	0 = 0.60 + 1.67a + 0.82c	a = .00		
4−6	= 0.97 − 3.05a + 1.20c	c = −.76		
½(3−1)	0.90 + 2.50a + 1.22c	−.74		

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Rogers Transit

1 Pegasi

26.2	Azimuth adjusted by ~~λ Ophiuchi~~
—	β and α Centauri Sept. 18 in
—	daylight.
48.2	
55.5	Collimation adjusted on
17.3	distant N. horizon.
28.2	
39	Central thread of reticle
50.2	when head of screw is towards W
1.2	is near 6th notch at left of
22.8	0 of comb scale, telescope pointed
30.5	N. [The comb scale cannot be
37.8	seen with only eyepiece of
45	the instrument]
13 52.3	

(not used)



Draper & Rogers transits read <u>altitude</u>.
To obtain setting use formulæ

N of Zenith	S of Zenith
$A = 90 - [\delta - \phi]$	$A = 90 + \delta - \phi$
$= 90 + \phi - \delta$	$= 90 - \phi + \delta$
$\phi = -16^\circ 22'$ $[73^\circ 38']$	$106^\circ 22'$
or	As δ is always − S of zenith
Subtract algebraically	subtract it numerically
δ from $73^\circ 38'$	from $106^\circ 22'$

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Draper Transit.

a at end of reticle towards lamp.

Thread Intervals. Sept. 18

	−57 4 sec δ = 1.84 ε Par. Mean Int.	Sid.	Eq. Int. s	−66 35 sec. δ = 2.52 β Par. Mean Int.	Sid.	Eq. Int. s
a to Mean	83.4	83.6	45.4	114.0	114.3	45.4
b	54.5	54.6	29.7	74.5	74.7	29.6
c	26.9	27.0 ~~30.0~~	14.7 ~~16.3~~	36.5	36.6	14.5
d	− 0.5	0.5	.3	− 0.7	0.7	.3
e	27.8	27.9	15.2	38.0	38.1	15.1
f	54.4	54.5	29.6	74.5	74.7	29.6
g	82.0	82.2	44.7	112.0	112.3	44.6

Sept. 19

	ε Parmis sec δ = 3.46			β Parmis sec δ = 2.52		
a	156.6	157.0	45.4	114.4	114.7	45.5
b	102.6	102.9	29.7	74.4	74.6	29.6
c	50.6	50.7	14.7	36.9	37.0	14.7
d	− 0.9	0.9	.3	− 0.9	0.9	.4
e	52.4	52.5	15.2	38.1	38.2	15.2
f	102.4	102.7	29.7	74.6	74.8	29.7
g	153.9	154.3	44.6	112.1	112.4	44.6

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Draper Transit

b = −.12 +.09

W [3] E
3.0 24.3 −37.3 Sept. 19/96
33.7 2.2 +35.9 −1.4 −.4
+ 8.6
+ 2.15

0.9 32.3 −33.4
33.2 1.6 −73 11 +34.8 + 1.2 + 0.3

δ		Clw.		+17 14	+10 22		
		+27 44	−7 16	Sept.			
		β Cygni	K Aq.	β Aq.	γ Aq	ε Pav.	
		24.3	—	17.7	14.6	47.5	
		41.3	—	33.4	30	39	
		57.7	45.8	48.4	44.7	29	
	18	14.4	0.8	4.3	59.7	40 20.5	
		31.3	15.8	19.8	15	12	
		48.3	31	35.6	30.2	4	
	19	6	23 46.8	28 51.8	33 46.3	42 58	
		18 14.76		28 4.43	32 60.09	40 21.43	
Red to (7^h 56^m)		− 6.20	− 5.42	− 4.59	− 3.78	− 2.57	
T		18 8.56		27 59.84	32 56.31	40 18.86	
α	19	26 34.35	31 21.33	~~41 22.12~~ 36 25.70	41 22.12	48 42.79	
T − α	− 8	25.79		25.86	25.81	23.93	
Bk		− .10		−.05	.00	+ .17	
T − α + Bk							
A		.79		.58	.46	− 2.90	
B		.81		.87	.91	1.89	
C		1.13		1.05	1.02	3.46	

Equations

0 = − 8 25.89 + ΔT + .79 a + 1.13 c
25.91 + .58 + 1.05
25.81 + .46 + 1.02
} 0 = −25.87 + ΔT + .61 a + 1.07 c

24.10 −2.90 + 3.46
26.00 + .06 − 1.03
26.22 −1.20 − 1.84
26.21 + .47 − 1.02
27.48 −1.94 − 2.52
26.30 + .92 − 1.20
} 0 = −26.26 + ΔT + .70 a − 1.11 c

Neglecting .09 a
c = − .18

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$b = +.36$
$+.03$
$-.06$

cl ε

−0.8 31.0 −30.2 +34.9 + 4.7 + 1.2
33.2 1.7 −12 52

1.2 32.9 33.2 1.3 −57 4

−34.1 +34.5 + .1 +10 57

1.5 33.3 32.9 0.9 −66 35

−34.8 +33.8 −1.0 +33 35

+6 59 α Aq.	α^2 Capric.	α Pav.	ε Delph.	β Pav. ~~α Delph.~~	ε Cygni
55.9	7.3	3.4 40	1.8	18.3	36.4
11.7	23.3.	10.? rej.	17.7	58	55.2
—	38.4	3.4 36.5	33.2	35.5	13.3
~~56.8~~	54	3.5 9 4	48.2	13.3	31
56.8	9	3.7 31.5	3.3	50.5	49
11.5	24	3.6 58	18.2	27	6.5
51 26.5	4. 39.2	3.5 10 25.5	20 33.4	29 4.5	34 24.4
	3 53.60	3.52	19 47.97	27 12.44	33 30.83
	+ 1.30	+ 2.15	+ 3.91	+ 3.16	+ 6.16
~~59 6.98~~	3 54.90	5.67	19 51.88	27 15.60	33 36.99
59 6.98	12 20.96	17 31.93	28 18.10	35 43.16	42 3.24
— 8	26.06	26.26	26.22	27.46	26.25
	[+.36 rej.]	+.04	+.01	−.02	−.05
	[26.00]				
	.06	−1.20	.47	−1.94	.92
	1.02	1.40	.91	1.61	.77
	1.03	1.84	1.02	2.52	1.20

	Aa	Cc	Σ	ΔT		
$0 = 1.77 - 3.51a + 2.39c$						Adopt +8 26.0
$= 0.04 - 1.90a' - 0.73c$	+ .31	− .20	+.11	+8 25.78		19 56 0
$= 1.22 + 2.64a' + 1.41c$	+ .22	− .19	+.03	.88	25.83	Sid.t. 20 4 26.0
$3.51a = +1.37$	+ .17	− .18	−.01	.82		mm 11 56 20.1
$a = +.39$	− 1.12	− .62	−1.74	.84]		Int. 8 8 5.9
$1.90a' = +.17$	− .02	+ .19	+.17	25.83		Red 1 20.0
$a' = +.09$	+ .44	+ .33	+.77	25.45]		Mean 8 6 45.9
$2.64a' = -.97$	− .17	+ .18	+.01	26.20	26.15	chron 7 56 0
$a' = -.37$ adopt	+ .72	+ .45	+1.17	26.31]		Chron Corr. 10 45.9
	− .34	+ .22	−.12	26.42		

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Sept. 19/96

Cl. W. Rogers transit $\delta = -83\ 12.0$ Thread Interval

* prec. λ' Octantis	λ' Octantes	Mean Int.	Sid. Int.	Log
8 59 1	16 54.5	582.6	584.2	2.76656
59 59	17 52	525.1	526.5	2.72140
0 55.5	18 49.5	467.6	468.9	2.67108
1 54.5	19 50	407.1	408.2	2.61087
2 51.5	20 47	350.1	351.1	2.54543
5 44	23 42.5	174.6	174.9	2.24279
7 10.5	25 10	87.1	87.3	1.94101
8 38	[26] 27 38	− 0.9	0.9	9.95024
10 4	28 4.5	87.4	87.6	1.94250
11 32	29 32.5	175.4	175.7	2.24477
14 23	32 26	348.9	349.9	2.54394
15 22	33 26	408.9	410.0	2.61278
16 20.5	34 23.5	466.4	467.7	2.66997
—	35 21.5	524.4	525.8	2.72082
—	36 19.5	582.4	584.0	2.76641
	26 37.1			

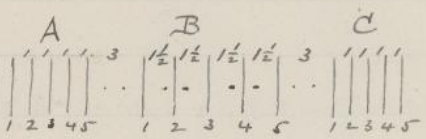
log sec δ 0.92663

" cos δ 9.07337 .118

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log i	i				Mean	Results	
1.83993	69.17						
		6.83					
1.79477	62.34					A_1 or C_5	69.2
		6.82					
1.74445	55.52				6.90	$\frac{A}{B_2}$ or C_4	62.3
		7.19					
1.68424	48.33					$\frac{A}{B_3}$ or C_3	55.4
		6.76					
1.61880	41.57					$\frac{A}{B_4}$ or C_2	48.4
			20.86		6.95		
						$\frac{A}{B_5}$ or C_1	41.5
1.31616	20.71						
				10.37			
1.01488	10.34					B_1 or B_5	20.8
				10.45			
9.02361	.11				$\frac{2}{3}$|10.38	B_2 or B_4	10.4
				10.26			
1.01587	10.37				6.92	B_3	—
				10.43			
1.31814	20.80						
			20.63		6.88		
1.61731	41.43						
		7.12					
1.68615	48.55						
		6.83					
1.74384	55.38				6.93		
		6.88					
1.79419	62.26						
		6.89					
1.83978	69.15						



Σ 138.32 | 20

6.^{8}916

Small Intervals in A + C groups 6.^{8}92

" " " B group 10.38

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+33.8 −34.0 −.05 33.0 0.8 1.7 33.7 −35.4 +33.4 −2.0 −.5 b = −.02 −.15

Sept. 22/96 1.0 33.0 32.7 0.7

		−73 11 ε Par	19 13 γ Leo.	−12 52 α² Cap.	+39 55 γ Cyg	+10 57 ε Delph
α ε	7	25 56	—	20.2	17.3	14.7
		50	28	36.2	38	30.6
		42	44	51.5	57.5	46
		28 33.5	59.5	6.5	17	1.2
		25	15.2	21.7	36.4	16.2
		15.5	34 30.7	36.8	55.2	31.2
		31 7	—	52 52.4	59 14.7	8 46.2
	7	28 32.71	33 59.48	52 6.47	58 16.59	8 0.87
Red to 8.00		−5.17	−4.27	−1.30	−0.28	+1.32
	7	28 27.54	33 54.21	52 5.17	58 16.31	8 2.19
	19	48 42.63	54 10.95	12 20.92	18 32.53	28 18.07
T − α		20 15.09	20 16.74	15.75	16.22	15.88
Bb		− .04	− .04	− .08	− .07	− .13
T − α + Bb						
A		−2.90	.62	.06	1.08	.47
B		1.89	.86	1.02	.72	.91
C		3.46	1.06	1.03	1.30	1.02

				I Aa	Cc	Σ	ΔT	II Aa	Cc	Σ	ΔT
1	0 = −20	15.13	+ΔT −2.90a −3.46c	−.64	−.34	−.98	16.11	−1.28	+.86	−.42	15.55
2		15.78	+ .62 −1.06	+.14	−.11	+.03	15.75	+.27	+.26	+.53	.25
3		15.83	+ .06 −1.03	+.01	−.10	−.09	15.92	+.03	+.26	+.29	.54
4		16.29	+1.08 −1.30	+.24	−.13	+.11	16.18	+.46	+.32	+.78	.51
5		16.01	+ .47 −1.02	+.10	−.10	.00	16.01	+.20	+.26	+.46	.55
6		15.91 (14)	−1.94 +2.52	−.42	+.25	−.17	15.08	−.12	−.63	−.75	.66
7		15.54 (4)	+ .92 +1.20	+.20	+.12	+.32	15.12	+.06	−.30	−.24	.68
8		15.36 (27)	+ .12 +1.01	+.03	+.10	+.13	15.14	+.01	−.25	−.24	.51
9		15.47 (39)	+1.11 +1.32	+.24	+.13	+.37	15.02	+.07	−.33	−.26	.65
							15.99				15.48
							15.09				.62
							15.54			+20	15.55

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0.7330 −33.7
+34.6
+ .9
+ .2
333 1.3

0.7 33.0 −33.7
33.5 1.2 +34.7
+ 1.0
+ .25

b = +.06
+.07

clw

	−66 35	+33 35	−9 22	+40 46			
	β Pav.	ε Cyg	μ Sg.	ν Cyg			
18	33.2	50.4	1.7	0.8	20	0	0
	49	8.5	16.7	20.7		20	15.5
	47.5	26	31.5	39.8	20	20	15.5
	24.5	43.7	46.7	59.3	12	8	9.7
	2.3	1.8	1.7	19.2	8	12	05.8
	40.3	19.7	17	39		−1	20.6
17	19.7	2238.5	32.7	3359.7	8	10	45.3
15	25.50	21 44.13	26 46.86	32 59.79	Chron Corr	10	45.3 m. Meant.
	+ 2.54	+ 3.57	+ 4.40	+ 5.42			
15	28.04	21 47.70	26 51.26	33 5.21			
35	43.05	42 3.19	47 6.59	53 20.64			
20	15.01	15.49	15.33	15.43			
	+ .10	+ .05	+ .06	+ .04			
	−1.94	.92	.12	1.11			
	1.61	.77	1.01	.72			
	2.52	1.20	1.01	1.32			

Note: These observations were made without clamping the telescope, it being suspected that disturbance or reversal noted Sept. 18 & 19 might be due to a strain on the frame, as the clamp and slow motion are attached to it quite high up by a strong spring. This suspicion does not seem to be warranted by tonight's observations as the same disturbance appears.

I

$0 = -16.15 + \Delta T + 0.78a - 1.16c$

$-15.42 + \Delta T + 1.02a + 1.26c$

$0 = 1.02 - 3.68a - 2.30c$

5/4 $0.51 - 2.96a + 1.26c$

$0.64 - 3.70a + 1.58c$

$0 = 0.38 - 3.88c \quad c = +.10$

$a = +.22$

II

From 3 & 8 $c = -.28$

5 & 7/8 $= -.32$

4 & 7/8 $= -.33$

Adopt $= -\frac{25}{88}$

$a = +.43$

$a' = +.06$

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92

Sept. 22/96

Rogers transit. Micrometer Screw

Transits over C_3 as star was entering field

8	59	15	
		58	43] req'.
		34	36
		9	35
		46	37
		18.5	32.5
		58.5	* 40
3		35.5	37
		8.5	33
		48	39.5
		24	36
6		0.5	36.5
		37.5	37
		14	36.5
		50	36
		27	37
		25	35.5
		39	36.5
10		15.5	36.5
		52.5	37
		28.5	36
		5.5	37
		35.5	30
			* 42.5
13		18	
		54.5	36.5
			36
* 14		30.5	36.5
15		7.	

1590

Mean 36.36

14	30.5
	7
	—

Transits over A_3 as star was leaving field.

19		16	
		—	
		—	
21		3.5	
		41.5	38
		18.5	37
		54.5	36
		30.5	36
		8	37.5
		43.5	35.5
25		20	36.5
		56.5	36.5
		33.5	37
		10	36.5
		46.5	36.5
		22.5	36 36.58
		57 ?	34.5
29		35.5	38.5

$\log 36^s.43 = 1.56146$

" 15 1.17609

" $\cos\delta$ 9.07337

Σ 1.81092

$1^{rev} = 64''.70$

check $\Delta = \frac{15}{14}\ 9^s = 909^s = 25^{rev.}$

$36^s.36 = 1^{rev.}$

$\frac{36.58}{36^s.43} = 1^{rev}\ \frac{1}{2}\text{ wt.}$

$36^s.43$ = Mean by wts.

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In above observations, micrometer head was at West end. The screw was set at its extreme the reticle thus being at east of field, C_1 near edge of field. The transits were taken over C_3 the screw turned back 1 rev between each transit. As the spring opposing the screw is not strong enough to overcome friction the screw head was tapped each time to bring the thread to a bearing. The records marked * are probably in error by several seconds because the thread was not quite in position. A stronger spring will be necessary if screw is ever to be turned backward.

After the screw had run out, it was moved back again and transits taken over A_5 until the star left the field.

Results

1 rev = 64."70 The screw has 25 revolutions

The extreme length of the field is more than this. It is about 25 rev. of screw plus A_1 to C_3 on reticle, or by second estimate is A_1 to C_5 + A_5 to C_2

	First Estimate	Second estimate
25 rev	= 1618"	20 div
A_1 to C_3	= 1868 = (18 div p.89)	13 "
Sum	= 3486" = 58'	(p.89) 33 " = 3425" = 57'

∴ for zenith telescope work, by using different threads of reticle an extreme length of over 50' is possible.

The diameter of single field, the eyepiece stationary is about $B_1 - C_1$ = 9 div p.89 = 935" = 16'

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43.8 15.0 +58.8
248 54.8 −79.6
−20.8
−5.2

+59.2 45.1 14.1
−86.7 27.7 59.0
−27.5
−6.9 t = −6.0 = −0.55

Sept 23/96

Rogers Transit

Cl W	y 10 22 Eq.	Σ Par.	D Eq	31 Cyg 46 26	y Cygni
	6.5				
	20.5	22 7.5	9	44	51.3
	34.5	23 19.5	29.5	59.2	9.2
	55.5	55	50.2	14.2	27.2
	16.7	24 31	10.8	29	54.4
	37.5	6	42 31.4	46 43.8	7.8
	57.5	42.5			54 21.4
	12.7	54			34.5
18	26.7				48.2
7 17	16.57	24 30.79	41 50.18	46 14.04	14.8 54 21.16
Red. to 7 57	−6.52	−5.34	−2.49	−1.77	33 −0.43
7 17	10.05	24 25.45	41 47.69	46 12.27	55 51 54 20.73
19 41	22.06	48 42.57	5 59.81	10 23.81	18 32.51
11 35	47.99	42.88	47.88	48.46	48.22
Bk	−.50	−1.04	−.53	−.36	−.40
A	.46	−2.90	.26	1.29	1.08
B	.91	1.89	.97	.66	.72
C	1.02	3.46	1.00	1.45	1.30

				Aa	Cc	Σ	ΔT	
0 = +11h 35m	47.49	+ΔT	+.46 a	+1.02 c	−.29	+1.58	+1.29	−11 35	48.78
	41.84		−2.90	+3.46	+1.83	+5.36	+7.19		49.03
	47.35		+.26	+1.00	−.16	+1.55	+1.39		48.74
	48.10		+1.29	+1.45	−.81	+2.25	+1.44		49.54 ✓
	47.82		+1.08	+1.30	−.68	+2.02	+1.34		49.16
	50.82		+.47	−1.02	−.30	∓1.58	−1.88		48.94
	51.72		−1.94	−2.52	+1.22	∓3.91	−2.69		49.03
	50.64		+.12	−1.01	−.08	∓1.57	−1.65		48.99
	51.88		+1.11	−1.32	−.70	∓2.05	−2.75		49.13
	51.74		+1.04	−1.28	−.66	∓1.98	−2.64		49.10
									49.04

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4.8 35.7 −40.5 +106.7 +66.2 +16.6
69.0 37.7

7.8 39.8 −47.6 +106.1 +58.7 +14.7 b = +15.6 = 1.44
69.0 37.1

38 14

cl ε	ε Delph	β Pavonis	μ Aq	γ Cyg	61 Cygni
	24.3	46	41.5		
	45.2	38	55.5	11.5	53 4
	56	4.3	9.7	38.8	50.8
	6.4	11 30	30.5	52.5	8.5
	17.1	56	22 51.5	6	34.7
	27.5	22	12.5	20	48
4	48.2	13 14	33.5	38.5	38 1.2
			47.5	30 1	14.5
			24 1.5		27.7
	39				
4	6.45	11 30.04	22 51.52	29 6.19	54 38 1.23
	+1.17	+2.38	+4.25	+5.27	11.7 +6.74
8	4 7.56	11 32.42	22 55.77	29 11.46	39 29 38 7.97
	28 18.05	35 43.02	47 6.58	53 20.62	2 17.30
	49.51	49.40	49.19	50.84	50.67
	+1.31	+2.32	+1.45	+1.04	+1.07
	.47	−1.94	.12	1.11	1.04
	.91	1.61	1.01	.72	.74
	1.02	2.52	1.01	1.32	1.28

$0 = 47.69 + \Delta T + .77a + 1.19c$

$= 51.27 + \Delta T + .68a - 1.16c$

$0 = 5.85 + 3.67a - 2.27c$

(1.4) $0.45 - 2.62a - 1.36c$

$0.63 - 3.67a - 1.90c$

$0 = 6.48 - 4.17c \quad c = +1.55$

$3.67a = -2.33 \quad a = -.63$

$2.62a = -1.66$

7 57 0

−11 35 49.04

20 21 10.96

12 12 6.28

8 9 4.68

1 20.12

8 7 44.56

Chron. Cor 10 44.56

8 44 4 = 21 9 80

10 44.6

8 54 48.6

1 27.9

12 12 6.3

21 8 22.8

1 7.2 Sidereal Clock fast

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1.3 33.1 −34.4
32.3 0.7 +33.0 / −0.4 b = +.03 / −.12

Sept. 24/96 Draper transit with higher mag. power

1.0 32.7 −33.7
33.0 1.0 +34.0 / +0.1

d w	γ Aq	ε Cor.	γ Sag.	α² Cap.	γ Cyg.
	36.2	18 7	21.2	29.6	28
	51.4	59	36.9	45	47.5
	6.2	48.7	52.4	54.8	67
	20.7 +.5 = 21.2	20 40.5	8.2	15.1	25.7
	36.5	[3]2	23.9	30.4	45.1
	51.7	24	39.7	45.7	4.7
	14 7.5	23 18.3	27 56.4	45 1.8	51 25.1
7	13 21.53	20 41.36	27 8.39	44 15.34	50 26.11
Red. to 7 50	−6.02	−4.82	−3.76	−0.94	+.07
7	13 15.51	20 36.54	27 4.63	44 14.40	50 26.18
19	41 22.04	48 42.51	54 10.91	12 20.90	18 32.49
11	31 53.47	54.03	53.72	53.50	53.69
	+.03	+.05	.00	−.05	−.09
A	.46	−2.90	.62	.06	1.08
B	.91	1.89	.86	1.02	.72
C	1.02	3.46	1.06	1.03	1.30

				Aa	Cc	Σ	ΔT		
0 =	31 53.50	+ΔT	+.46 a	+1.02 c	+.01	−.15	−.14	−11 31 53.36	
	54.08		−2.90	+3.46	−.09	−.52	−.61	.47	
	53.72		+.62	+1.06	+.02	−.16	−.14	.58	
	53.45		+.06	+1.03	+.00	−.15	−.15	.30	53.43
	53.60		+1.08	+1.30	+.03	−.20	−.17	.43	
	53.03		+.47	−1.02	−.10	+.15	+.05	.08	
	52.45		−1.94	−2.52	+.41	+.38	+.79	.24	
	53.25		+.92	−1.20	−.19	+.18	−.01	.24	53.25
	53.21		+.12	−1.01	−.03	+.15	+.12	.33	
	53.41		+1.11	−1.32	−.23	+.20	−.03	.38	
									53.34

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1896phae.proj.11710

$b = -.09$
$-.24$

32.7 0.8 +33.5
1.5 33.3 −34.8
−0.3

32.2 0.2 +32.4
1.7 33.7 −35.4
−0.8

dE	ε Delph.	β Pav.	ε Cyg.	μ Aq.	ν Cygni
	23.3	38.7	58	9	8.4
	39.2	17.8	16.7	25	29
	54.4	55.7	35	40.2	49.2
	9.7	7 33.5	53	55.4	8.7
	25	10.7	10.7	10.4	28.3
	39.5	47.3	28.2	25.3	47.3
	6 54 9	9 24 5	14 46	19 40.3	26 7.2
	0 9.43	7 32.60	13 52.51	18 55.09	25 8.30
	+1.67	+2.88	+3.92	+4.75	+5.77
	0 11.10	7 35.48	13 56.43	18 59.84	25 14.07
	28 18.04	35 42.98	42 3.15	47 6.57	53 20.60
	53.06	52.50	53.28	53.27	53.47
	−.03	−.05	−.03	−.06	−.06
	.47	−1.94	.92	.12	1.11
	.91	1.61	.77	1.01	.72
	1.02	2.52	1.20	1.01	1.32

$0 = 53.61 + \Delta T + .72a + 1.13c$
$53.23 + \Delta T + .83a - 1.18c$
$0 = 0.47 - 3.62a + 2.33c$
$= 0.78 + 2.77a' + 1.34c$

$c = -.12$ 4 5 8
$-.23$ 1 + 6
$-.16$ eq. alm
Adopt $-.15$

$3.62a = +.12$
$a = +.03$
$2.77a' = -.58$
$a' = -.21$

7 50 0
−11 31 53.3
20 18 6.7
12 16 2.8
8 2 3.9
1 19.0
8 0 44.9
Chron Corr. 10 44.9

8 30 57 = 21 0 15
10 44.9
8 41 41.9
1 25.7
12 16 2.8
20 59 10.4
1 4.6 Clock fast

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1896phae.proj.1174U

2.0 34.0 −36.0 Delft. 28/96 Draper transit b = −.22
32.3 0.3 +32.6 −34.0 −.7
−3.4 +31.3
−.8 0.9 33.1 −18 33
31.7 −0.4

α ε	Tag.	α² Cafmic.	α Par.	π Cap.	ε Delft.
	35.2	46.1	—	—	41.1
	51.2	2	40.7 46.2	4.9 36.3	57.2
	6.2	7.4	40.9 14	20.5 36.0	12.4
15	21.2	328	41.0 41.5	36.3 35.9	27.5
	36.2	48	40.7 8.5	52 35.9	42.7
	50.7	2.8	41.3 35.7	7.3 35.9	57.3
16	5.7	29 18.2	41.0 35 3	38 23.2 35.9	45 12.6
7 15	20.91	28 32.47	33 40.93	37 35.98	44 27.26
Red. to 7h 57		−6.84	−4.68	−3.83	−3.19	−2.06
T	7 15	14.07	28 27.79	33 37.10	37 32.79	44 25.20
α	19 59	6.85	12 20.84	17 31.69	21 26.12	28 17.98
T−α	11 16	7.22	6.95	5.41	6.67	7.22
Bh		−.20	−.22	−.31	−.23	−.20
A		.40		−1.20	−.04	
B		.92	1.02	1.40	1.05	.91
C		1.01		1.84	1.06	

					Aa	Cc	ε	ΔT
0 =	11 16	7.02	+.40a	−1.01c +ΔT	−.44	+.15	−.29	6.73
		6.73	+.06	−1.03	−.07	+.15	+.08	.81
		5.10	−1.20	−1.84	+1.32	+.28	+1.60	.70]
		6.44	−.04	−1.06	+.04	+.16	+.20	.64
		7.02	+.47	−1.02	−.52	+.15	−.37	.65
		5.97	+1.94	+2.52	+1.29	−.38	+.91	.88]
		7.52	+.92	+1.20	−.61	−.18	−.79	.73
		7.06	+.12	+1.01	−.08	−.15	−.23	.83
		7.78	+1.11	+1.32	−.74	−.20	−.94	6.84
		7.97	+1.04	+1.28	−.69	−.19	−.88	7.09
								− 11 16 6.79

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1896phae.proj.11710

1.5 33.7 −35.2 −.9
32.0 −0.3 +31.7

1.7 34.0 −35.7 −1.0 $b = -.28$
32.1 −0.3 +34.8

	β Per.	ε Cyg	μ Aq	ν Cyg	61 Cyg	
Cl W	58.2	17	27.7	27.7	25	8 23 41
	35.5	35.2	42.9	47.3	44.2	21 8 40
	12	52.3	57.5	64	2.7	
	49.5	10.4	12.5	26	21.5	24 25.5
	27	28.3	27.7	45.8	40.7	8 35 30
	4.5	46.3	43	5.7	59.7	
	53 44	59 5.	3 58.7	10 26.3	19 19.5	
	51 50.10	58 10.64	3 12.86	9 26.46	18 21.90	
	− 0.85	+0.19	+1.02	+2.04	+3.51	
	51 49.25	58 10.83	3 13.88	9 28.50	18 25.41	
	35 42.83	42 3.09	47 6.53	53 20.52	2 17.23	
	6.42	7.74	7.35	7.98	8.18	
	−.45	−.22	−.29	−.20	−.21	
	1.61	.77	1.01	.72	.74	

$0 = 7.02 + \Delta T + .44a - 1.02c$

$7.76 + \Delta T + 1.02a + 1.27c$

$0 = 1.92 + 1.64a + 0.82c$

$= 1.79 + 2.96a' - 1.25c$

$c = -.15$

$1.64a = -1.80 \quad a = -1.10$

$2.96a' = -1.98 \quad a' = -.67$

7 57 0
−11 16. 6.79
20 40 53.21
~~+9~~ ~~+3~~ ~~6.79~~
12 31 49.05
8 9 4.16
~~6~~ ~~44~~ ~~17.74~~
1 20.12
8 7 44.04
Chron slow 10 44.04

8 23 41
10 44.0
8 34 25.0
1 24.5
12 31 49.0
21 7 38.5
8 40
1 1.5 Clock fast

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100

Oct. 1/96 Draper transit

		31.7	-0.6	+31.1	32.2	0.0	+32.0	$b = -.25$	
Cl W		1.7	32.6	−34.3	1.7	33.7	−35.4		
				− 0.8			− 0.8		
	ε Delph	β Pav.		ε Cyg.	μ Aq.				
	54.2	11.3		28.8	40				
	9.3	49		47	55.4		10 14 17		
	24.2	26		4.3	10		23 11 20		
	39.3	40 2.5		22	25				
	54.5	40.3		40	40.2		10 15 38		
	9.8	18.5		58	55.3		10 27 0		
7	33 25.7	57.7		47 17	52 11.2				
	32 39.57	40 3.61		46 22.44	51 25.30				
Red. to 6	−5.48	−4.26		−3.27	−2.40				
	32 34.09	39 59.35		46 19.22	51 22.90				
	28 17.94	35 42.71		42 3.03	47 6.49				
	4 16.15	16.64		16.19	16.41				
B C	−.23	− .40		− .19	− .25				
B	.91	1.61		.77	1.01				

				Aa	Cc	E	ΔT		
0 = 11 4	15.92	$+\Delta T + .47a + 1.02c$		+.01	−.15	−.14	11 4	15.78	
	16.24	−1.94	+2.52	−.04	−.38	−.42		15.82]	
	16.00	+.92	+1.20	+.02	−.18	−.16		15.84	15.88
	16.16	+.12	+1.01	+.00	−.15	−.15		16.01	
	16.28	+1.11	−1.32	−.55	+.20	−.35		15.93	
	16.20	+1.04	−1.28	−.51	+.19	−.32		15.88	
	16.13	+.83	−1.15	−.41	+.17	−.24		15.89	15.83
	15.40	−.12	−1.08	+.06	+.16	+.22		15.62	
	10.85	−7.76	−8.44	+3.80	+1.27	+5.07		15.92]	
									15.86

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1896phae.proj.11710

$b = -.30$
$-.36$
$-.45$

E	W		W	E			
34.2	2.2	−36.4	31.7	−0.9	+30.8	1.7 342	−35.9
0.0	32.2	+32.2 / −1.0	1.8	34.0	−35.8 / −1.2	31.3	−1.3 +30.0 / −1.5
			+29.48		−23.52	−8.3 11.8	

d.E	v Cyg.	61 Cyg.	ζ Cyg	ζ Cap.	λ Ursae		
	38.4	35.7	56.5	11.7	33 1.5	δ	−83 11.8
	59	55.8	14.7	28.7	35 13.5	φ	−16 22.4
	19.2	14.8	32.2	44.8	37 20	φ−δ	−66 49.4
	38.7	34	49.2	1.2	39 25.5	log sin(..)	9.96345n
	58.4	52.5	63	17	41 30	.. sec δ	0.92642n
	17.4	11.3	23.2	33	43 34	.. cos(..)	9.59502
	57 37.2	7 30.6	13 40.3	25 49.2	45 41	.. A	0.88987
	57 38.33	6 33.53	12 48.91	25 0.80	39 23.64	.. B	0.52144n
	−1.37	+.09	+1.12	+3.12	+5.49		
	57 36.96	6 33.62	12 50.03	25 3.92	39 29.13		
	53 20.46	2 17.18	8 33.62	20 48.13	35 16.79		
	4 16.50	16.44	16.41	15.79	12.34		
	−.22	−.24	−.28	−.39	−1.49		
A			.83	−.12	−7.760		
B	.72	.74	.80	1.08	3.322		
C			1.15	1.08	8.442		

$0 = 15.96 + \Delta T + .70a + 1.11c$
$= 16.20 + \Delta T + .99a' - 1.25c.$

$0 = 0.28 + 2.64a + 1.41c$
$= 5.35 + 8.75a' + 7.19c$

If $c = -.15$ (as before)
$a = +.02$
$a' = -.49$

If $c = +.05\ 73\ +7$
$-.37\ 54\ +8$
$-.16$
as above

10	14	17		10	14 17
−11	4	15.86			10 43.83
	10	1.14		10	25 0.83
23	18	32.86			1 42.68
12	43	38.71		12	43 38.71
8	6	0		23	10 22.22
−11	4	15.86			11 20
21	1	44.14		0	57.78
12	43	38.71			
8	18	5.43			
	1	21.60			
	16	43.83			

Chron Corr. + 10 43.83

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1896phae.proj.11711U

Oct. 1/96

Approx. value of Micr. Screw of 13" attached to Rogers Transit

$\delta = -81\ 55.6$
(3 Octantis

Mean T. Chron.

rev				
22.0	9	34	40	
				122
27		36	42	
				117
32		38	39	
				123.5
37		40	42.5	
				123
42		42	45.5	
				119
47		44	44.5	
				118
52		46	42.5	
				119
57		48	41.5	
62		–		240.5
67		[52]	42	120.22
72			37	rej. screw beginning to bind

Star focussed and thread adjusted for verticality on this star in first half of its transit. Times taken over last half of field only.

$45^{rev} = 18^{m}\ 2^{s} = 1082^{s}$

$1^{rev} = 24^{s}.044$ M.T. $= 24^{s}.11$ Sid. T.

log 24.11	1.38220	Observations made to
" 15	1.17609	aid in setting micrometer.
" cos δ	9.14750	Not to be used in rigid
" i	1.70579	determination of value of
i	$50''.79$	screw, as adjustment of thread was made on moving * as above stated.

Complete field is about 90^{rev}. Can use 80^{rev} to advantage with single thread = about 70', – a large range for zenith telescope, but value of 1^{rev} must be very accurately known to use such a large interval.

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Oct. 2/96 Transits γ α Centauri

0	1	30	0.2	
				68.8
10		31	9	
				85
20		32	34	
Middle Thr.		33	26.5	
				68.7
30		33	42.7	
				68.8
40		34	51.5	
				50.3
50			41.8	
				69.7
30		36	51.5	
				68.7
10		38	0.2	

Reject. Mic. Screw goes irregularly, as spring is not strong enough to offset screw.

Remove this difficulty.

Observation for Lat. by Zen. Tel.

Oct. 2/96

	micr.	N	S	
β Pav.	28.607	52.8	28.0 + 80.8 dim in clouds.	
ε Cyg.	13.055	14.5	40.0 54.5 jarred telescope in reversing.	
	15.552		+26.3	
	7.776		+ 6.4 =	
α Lyrae	23.948	21.7	48.2	69.9
α Peg.	27.717	49.0	20.8	69.8
	3.769			.1
	1.884			.00

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Red. to App. Place

	β Parnis	ε Cygni	γ Centauri	α Indi	α Delphini
	Oct. 2/96	Oct 2/96	Oct. 3/96	Oct 3/96	Oct 3/96
q	337 53	337 53	337 52	337 51	337 51
α°	308 54	310 30	188 56	307 34	308 42
H	78 46	78 46	78 3	77 42	77 42
$q+\alpha^\circ$	286 47	288 23	166 48	285 25	286 33
$H+\alpha^\circ$	27 40	29 16	266.59	25 16	26 24
δ_0	− 66 34.6	+ 33 34.8			
log g	1.3150	1.3150	1.3156	1.3158	1.3158
" cos$(q+\alpha^\circ)$	9.4695	9.4988	9.98884 n	9.4246	9.4546
Σ_1	0.7755	0.8138	1.3040 n	0.7404	0.7764
" L	1.2745	1.2745	1.2746	1.2748	1.2748
" cos$(H+\alpha^\circ)$	9.9473	9.9407	8.7212 n	9.9563	9.9522
" sin δ°	9.9627 n	9.7428	9.8736 n	9.8687 n	9.4281
Σ_2	1.1845 n	0.9580	9.8694	1.0998 n	0.6551
" i°	0.9035	0.9035	0.9026	0.9021	0.9021
" cos δ°	9.5994	9.9207	9.8224	9.8284	9.9838
Σ_3	0.5029	0.8242	0.7250	0.7305	0.8859
N_1	+ ~~59.63~~ 5.96	+ 6.51	− 20.14	+ 6.50	+ 5.89
N_2	− 15.29	+ 9.08	+ 0.74	− 12.55 ~~26~~	+ 4.52
N_3	+ 3.18	+ 6.67	+ 5.31	+ 5.38	+ 7.69
Σ	− 6.15 ~~+ 47.82~~	+ 22.26	− 14.09	− 1.70	18.10
δ_0	−66 34 35.39	33 34 50.15	−48 23 18 66 ~~9.25~~	−47 39 14.43	+15 32 42.54
δ	~~−66 38 47.8 22.91~~	33 35 12.41	−48 23 32.75	−47 39 16.13	15 33 0.64
	−66 34 41.54				

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1896phae.proj.11711

Oct. 2

	β Pavonis	α Gruis
	ε Cygni	α Pegasi
δ'	+33 35 12.4	+14 39 10.5
δ	−66 34 41.5	−47 27 43.2
$\frac{1}{2}(\delta'+\delta')$	−16 29 44.6	−16 24 16.35
$\frac{1}{2}(m-m')$	[not reduced	+ 1 35.76
$\frac{1}{2}(l+l')$	on account of	.00
$\frac{1}{2}(i-i')$	jarring of telescope]	+ .03
φ		16 22 40.6

Rule for calculating level correction when level is graduated end to end continuously.

Mark readings increasing S to N +, N to S −. Add algebraically. $\frac{1}{4}$ sum $= \frac{1}{2}(l+l')$

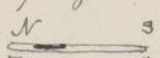
Proof (not in books)

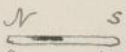
l, l' = corr. for S & N star resp. + when N end is higher

Let n, s; n', s', be readings of north & south ends of bubble, the ′ when readings increase N to S.

m_0 = reading of middle of bubble when level is horizontal

Then





S star. $l = \frac{n+s}{2} - m_0$ or $m_0 - \frac{n'+s'}{2}$

N " $l' = m_0 - \frac{n'+s'}{2}$ $\frac{n+s}{2} - m_0$

$\frac{1}{2}(l+l') = \frac{n+s-(n'+s')}{4}$ or $\frac{n+s-(n'+s')}{4}$

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Oct 3/96 am

		N	S	
(β Leonis	8.617	39.2	25.7	+64.9 Struck end of damp screen
γ Cent.	2.974	25.2	45.2	-70.4 Wire reversing
	35.643			-5.5
	17.822			-1.4

pm

α Indi	9.467	43.0	24.8	+67.8 Direct seen
α Delph	23.567	24.3	44.2	-68.8 thro' clouds
	45.900			-.7
	22.950			-.2

	β Leonis γ Centauri	α Indi α Delph.	α Indi α Delphini
δ'	+15 8 59.9	+15 33 0.64	+15 33 0.64
δ	-48 23 32.75	-47 39 16.13	-47 39 16.13
½(δ'+δ)	-16 37 46.42	-16 3 7.74	-16 3 7.74
½(m-m')	*		-19 26.55
½(l+l')	*not to be reduced for		-.28
½(z-z')	reasons above given.		-.35
			-16 22 34.9

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1896phae.proj.1171U

Oct. 6/96

		N	S		chronometer
ε Aq	26.957	23.7	50.2		7 27 14 late
μ Aq	21.255	23.6	50.2		Wire a little inclined to motion of stars
4 Cap.	27.800	53.8	21.8		
α Eq.	17.482	49.8	17.0	+66.8	Corrected partly inclination of wire.
α Peg.	22.065	16.3	49.4	−65.7	
				1.3	
	4.583			+ .3	
	2.292				

	ε Aquarii	μ Aquarii	α Equi
	4 Capricorni	4 Capricorni	α Pegasi
δ′			+14 39 10.9
δ		−9 22 12.8	−47 27 43.9
½(δ′+δ)			−16 24 16.5
½(m−m′)			
½(l+l′)			
½ r−r′			

Not to be reduced, as wire was evidently inclined
Cause of disturbance of instrument is not known but probably is due to clamp screw at micrometer not being firmly tightened. It cannot be tightened readily as there is not room for thumb and finger.

A slot was later cut in the head that a screw driver may be used, and above trouble will not happen again.

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Oct. 6/96 Draper Transit

Cl E. 2.7 34.7 −37.4 −.14 −.42 (b_s) 2.2 34.0 −36.2 −.10 −.30 (b_s)
32.2 0.0 +32.0 32.2 0.2 +32.4

	ζ Cygni	ε Cyg.	1 Peg	λ' Octantis
	28.5	53.4 30.4 (7)	14.7	11 37.5 18 0.7
	46.3	12.4 30.8 (9)	31.3	13 50.5 0.3
	3.8	31 30.6	47.3	15 57.5 1.6
53	21.2	49.8 30.8 (6)	3.2	—
	38.2	8.2 30.9 (9)	19	20 8.5 0.2
	55	56 27.3 31.1 (4)	34.2	22 12 2.2
	R 2		2 50	24 17.5 1.1
7	53 20.74	55 30.80	2 2.81	18 0.58 1.02
Red to 8 36	− 7.01	−6.65	−5.58	2.96 −2.96
7	53 13.73	24.15	1 57.23	17 58.06
21	8 33.54	10 41.23	17 19.83	35 16.14
10	44 40.19	42.92	37.40	42 41.92
Bl	−.34	−.30	−.30	−1.00
A		1.02	.62	
B	.80	.74	.86	3.32
C		1.26	1.06	

			Aa	Cc	E	ΔT	
0 = 44	39.85	+ΔT +.83a −1.15c	− 11.90	− .64	−12.54	−10 44	27.31
	42.62	+1.02 −1.26	− 14.63	− .72	−15.35		27.27
44	37.10	+.62 −1.06	− 8.99	− .59	− 9.58		27.52
42	40.92	−7.76 −8.44	+111.28	− 4.73	+106.55		24.47] 27.37
44	29.21	+ .04 + 1.03	− .57	+ .58	+ .01		29.22
	30.93	+ .14 + 1.01	− 2.01	+ .57	− 1.44		29.49
	32.96	+ .30 + 1.00	− 4.30	+ .56	− 3.74		29.22 29.35
44	30.19	+ .09 + 1.02	− 1.29	+ .57	− .72		29.47
42	51.96	−6.48 +7.12	+ 92.92	+ 3.99	+96.91		28.87]
						−10 44	28.36

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1896phae.proj.1171U

Cl W

1.7 33.8 −35.5 −.10 −5.30 +31.6 +0 51

31.8 −0.2 −8 18 −11 13

−14.2

μ Cap. | Q Ag. | π Ag | σ Ag. | β Octantis

Very faint
not timber in the way

μ Cap.	Q Ag.	π Ag	σ Ag.	β Octantis
25.7	7.7	45.8	52.2	13 17 9 32 51
41.5	22.8	0.8	7.7	15 5 22 49 25
56.3	37.5	15.3	22.3	16 37
11.7	52.5	30.2	37.3	18 24 9 34 13.2
27.2	7.7	45.3	52.5	20 9 9 45 0
42.7	22.7	0.2	8	21 56 9 44 57
32 58.7	56 38.5	5 15.5	10 24	23 48.5
32 11.83	55 52.77	4 30.44	9 37.71	18 28.07
−0.62	+3.27	+4.68	+5.52	+6.98
32 11.21	55 56.04	4 35.12	9 43.23	18 35.05
21 47 41.69	11 24.81	20 1.86	25 12.72	35 42.03
44 29.52	31.23	33.26	30.51	42 53.02
−.31	−.30	−.30	−.32	
.04	.14	.30	.09	6.48
1.03	1.00	.95	1.02	2.95
1.03	1.01	1.00	1.02	7.12

32.0 0.0 +32.0
−37.0
2.5 34.5 − 1.2
−81 56 − 5.36

10 43.6

3 5 feet

−1.06
−81 55.6
−16 −22.4

6.48 65 33.2
2.95 9.95921
7.12 0.85250

$0 = 44\ 39.86 + \Delta T + .82a - 1.16c$ — 8 36 0 — 9 32 51 — 9.61684

$44\ 30.82 + \Delta T + .14a + 1.02c$ — −10 44 28.4 — 10 43.6 — log A 0.81171

$0 = 118.94 + 8.58a + 7.28c$ — 21 51 31.6 — 9 43 34.6 — " B 0.46934

37

$98.86 + 6.62a - 7.10c$ (1.98, .13, .14) — 13 3 21.5 — 1 35.9

$100.84 + 6.75a - 7.24c$ — 8 48 10.1 — 13 3 21.5

$0 = 219.78 + 15.33a + .04c$ — 1 26.5 — 22 48 32.0

.35 $a = -14.34$ — 8 46 43.6 — 49 25

$c = +.56$ — 10 43.6 — 53.0

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Oct. 7/96 1 div micr. Screw

β Pavonis

20	12 37.7	41.3	
15	13 19		
10	14 2.7	43.7	
5	14 45	42.3	
0	15 27.4	42.4	
25	16 10	42.6	
20	16 52.3	42.3	
15	17 35.2	42.9	
10	18 18.1	42.9	
5	19 0.5	42.4	
0	19 43.4	42.9	
25	25.7	42.3	.002 beyond 25
20	21 8	42.3	
15	7 21 49.5	41.5	
		42.45 ✓	

λ₁ Octantis

8	2 59		
	5 20	141	
	7 48	148	
	10 9	141	
	12 30	141	
	14 54.5	144.5	
	17 15	140.5	
	19 42.5	147.5	
	22 5.5	143	
	24 28	142.5	
	26 52	144	
	29 15.5	143.5	
	31 37.5	142	143.21 ✓
	33 54	136.5 reg.	Screw not by friction

Approx. red.

$65^{rev} = 9^{m}\ 11^{s}.8 = 551.8$

$5^{rev} = 42.45$ ✓

$1^{rev} = 8^{s}.489$

$60^{rev} = 28^{m}\ 38^{s}.5 = 1718^{s}.5$

$5^{rev} = 143.21$ ✓

$1^{rev} = 28^{s}.642$

In above observations screw was moved backward

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Reduction

	β Pavonis	λ, Octantis
Transit	20 35 42.5	21 35 16.0
Sid. mean	13 7 18.0	13 7 18.0
" Int.	7 28 24.5	8 27 58.0
Corr.	1 13.5	1 23.2
Mean t	7 27 11	8 26 34.8
Chron t	7 16 28	8 15 51

δ = −66 34.7 ~~8~~

β Pavonis

log 8.489	0.92886
" cos δ	9.59933
" 15	1.17609
" 1 rev	1.70428
1 rev	50.61

Correc. t times See Doolittle pp 293, 491

		Corr'd Times ~~Interval~~	λ, Octantis
20	Inappreciable	0.4	8 2 59.4
15		0.2	5 20.2
10		0.1	7 48.1
5			
0			
25			
20			
15			
10			
5		0.1	24 27.9
0		0.2	26 51.8
25		0.4	29 15.1
20		0.8	31 36.7
15			

δ −83 12.0

log 28.622	1.45670
" cos δ	9.~~73263~~ 07337
" 15	1.17609
" 1 rev	1.7~~6543~~ 9616
1 rev.	50.83

60 rev. = 28 m 37.s 3 = 1717.s 3

1 rev = 28.622

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1896phae.proj.1171W

Instr. adj. for eq. on β + d_2 Centauri in early p.m.

Oct. 15/96 Observer J.F.B.

Clamp E or W

Level W E

20.9 35.0 −37.9 −2.1 b = 0.63 | for practice before Moon Culminations
+29.5

cl. w. 30.9 −1.4

Name of Star | Transits

16 Pegasi Adopt

	h	m	s	
1	7	56	39.5	39.5
2			57.5	57.5
3		57	7.3	—
4			8.3	28.3
5			45.0	45.0
6		58	1.4	1.4
7			18.3	18.3

T − α

57 29.6 10 9 6.6

21 48 23 −.5 Bf

cl w

+ Ursae

1	8	9	43.5
2		10	5.5
3			27.0
4			49.3
5		11	10.5
6			33.0
7			56.5

8 10 49.33

22 1 46.01

T − α

10 9 3.3

−.7

cl w

5 octantis

1			
2			
3	8	17	8.
4		21	16.
5		25	18.5
6			
7			

8 21 14.2

22 12 16.1

T − α

10 8 58.1

cl w Sun

W E

30.3 −1.7 +28.6 −2.0

−36.9

34.5

1896phae.proj.1171U

A B C

clamp ε

Lwl w ε

16 leg. +25° 26′ .74 .83 1.11

α Ursæ −47 27 .76 1.27 1.48

29 35.0 −37.9

30.0 −2.2 +27.8 −2.5

β Octantis. 0=10 9 6.1 +ΔT +.74a −1.11c

1 6.3 2.6 −.74a −1.48c

2

3 Not seen. If c=0 ΔT = 10 9 44

4 Perhaps cut off by timbers c=−.15 46

5

6 Adopt 10 9 45

7 8 0 0

24 50 55.5

cl ε d Aquarii 13 38 50.5

1 8 12 5

2 1 20 6

3 N.S. 8 10 44.4

4 as above. alph. pointed

5 at one of the timbers. Chron Corr. + 10m 4s approx

6

7

cl 3 Lwl w ε

30.4 −1.8 +28.6

2.4 34.6 −37.0 −2.1

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1896phae.proj.11711

Moon Culmination – Draper Transit.

Oct 16. 1896 Obs. D.T.B.

Clamps. E
Level. W E

32.2 0.8 +33.0
1.8 33.3 −35.1

W E
−35.2 1.8 33.4
+32.0
31.9 0.1

Name of Star	ε Cygni	ι Pegasi	ν Octantis	μ Capric.	36 Aqua.
Transits	1. 7h 15m 59.	1. 7 27 46.	1. 7 33 58.5	1. 7 52 ?.5	1. 8'
	2. 15 19.	2. 22 2.5	2. 36 11.0	2. 20.5	2. Very Dr Mist Stars with Illumination
	3. 38	3. 18.5	3. 38 18.5	3. 36.0	3.
	4. 57.	4. 34.5	4. 40 24.5	4. 51.5	4.
	5. 16 15.5	5. 50.0	5. 42 30.5	5. 53 7.0	5.
	6. 33.5	6. 23 5.5	6. 44 34.0	6. 21.0	6.
	7. 52.5	7. 21.0	7. 46 40.0	7. 36.5	7.
Mean T	7 15 56.4	22 34.00	40 22.4	52 51.00	
α	21 10 41.0	17 19.7	35 14.7	47 41.6	
T − α	10 5 15.4	5 14.3	5 7.7	5 9.4	

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1896phae.proj.11711U

5:00 P.M. East bearing towards so that ~~bb~~ level bubble moved 2 div. to w.

Level

	☉ Aqua.	Moon.	♂ Aqua.	β Ostanbi	♃ Aqua.	♀ Pegasi	τ Pegasi
1.	8 15- 44.5 - 8	2	1	1	1	1	1
2.	16 0.5 - 2	Mixed moon.	2	2	2	2	2
3.	15.5 - 3	Perhaps	3	3	3	3	3
4.	30.5 - 4	long of. li	4	4	4	4	4
5.	46.0 5	limb -	5	5	5	6	5
6.	17 0 6	under cutting	6	6	6	6	6
7.	16.0 7	a bit.	7	7	7	7	7

16 30.4
11 24.7
5 5.7

(not used.)

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1896phae.proj.11710

Moon Culmination – Draper Transit

Oct 17 – 1896 Obs. S.F.B.

$b = +1^d.4 = 5^s.42$

clamp E

Level W. E W. E

35.0 1.7 +36.7 34.8 1.4 +36.2

−1.0 32.2 −31.2 −1.1 32.2 −31.1

+1.4 +1.3

32 40 −8 18 +0 51 −11 13 −84 56

Name of Star. π Virginis θ Aquarii π Aquarii τ Aquarii β Octantis

Transits

1.	1	8	5.	42.1	1	8	11	49.3	1	8	20	21.5	1	8	25	34.5	1	8	–	–
2.	6	1.	5.		12	4.	5		40.	5	2.		51.	2	36	43.833	13			
3.		17.8	3.			20.0	3		55.	5	3		26	6.	5	44.035	0			
4.		36.5	4.			35.0	4	21	10.	5	4.		21.	5	4	44.536	46.5			
5.		54.0	5.			50.1	5.		26.	0	5.		36.	0	5.	44.338	32.5			
6.	7	11.2	6.		13	4.	6		40.	2	6.		50.	5	6.	44.240	15.			
7.		29.3	7.			19.5	7.		55.	5	7.	27	5.	5	7.	43.442	1.			
	6	36.11			12	34.69		21	10.53			26	20.79			36	44.03			
Red. to	8.57		−8.28			−7.30			−5.88				−5.04				−3.32			
	8	6	27.83		12	27.39		21	4.65			26	15.75			36	40.71			
	22	5	25.29		11	24.70		20	1.76			25	12.62			35	40.95			
	10	1	2.54			2.69			2.89				3.13			0	59.76			
BL			+.33			+.42			+.40				+.42				+1.24			
B			.78			1.00			.96				1.01				2.95			

Reversed C. W.

1	8	5.0	11.0															
2			26.0															
3			40.5															
4			55.0															
5		5	10.0															
6			25.0															
7			40.5															
		50	55.43															
			−1.00															
		50	54.43															
		49	51.42															
			3.01															
			+.45															
			.99															

					Aa	Cc	E	ΔT			
0 = 10 0	62.87	+ΔT	+.90	a − 1.19c	− .39	− .18	− .69	−.57	61.54	62.30	
	62.27	3.11	+.14	− 1.01	− .06	− .15	− .19	−.21	62.08	62.90	
62.32	62.49	3.29	+.29	− 1.00	− .18	− .15	− .28	−.27	62.20	63.02	62.90
	62.71	3.55	+.09	− 1.02	− .04	− .15	− .18	−.19	62.55	63.36	
	58.52	61.00	− 6.48	− 7.12	+ 2.79	− 1.07	+ 3.38	+1.72	61.89	62.72	
	62.56	3.46	+.19	+ 1.00	+ .10	+ .15	+ .11	+.25	62.67	63.61	
63.44	62.67	3.57	+.19	+ 1.00	+ .19	+ .15	+ .17	+.25	.78	63.82	
½ wt	62.39	3.29	+.17	+ 1.01	+ .08	+ .15	+ .11	+.23 ½ wt.	.50	½ wt 63.52	63.77
	62.67	3.37	+.69	+ 1.09	+ .34	+ .16	+ .13	+.58	.94	63.87	63.84
	62.80	3.64	+.38	+ 1.01	+ .19	+ .15	+ .11	+.34	.91	63.98	
	63.35		+.37	+ 1.00	+ .18	+ .15	+ .11	+.33	.62	63.68	
	63.35		− 7.10	+ 7.94	− 1.78	+ 1.16	+ .87	+1.64	.10	63.96	
				7.16	3.55			2.39			

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5:00 P.M. East bearing lowered raising level 1 div. on west side -

$b = +1.5 = 5.45$

	W	E			W	E	
	−1.6	31.9	−30.3	+1.4	−30.4	−1.6	32.0
	34.7	1.3	+36.0		+36.6	1.5	35.1
					+ 1.6		

	−5 16		−6 36		23 10		+5 48		+5 4		−82 36	
	8017	Moon	☌ Aq.		T Psc.		θ Psc		ι Psc		γ Octantis	
1	8h 57½	31.2	9 15.5	1.5	9 −	1	9 15	44.5	9 22	59.5	34 52.0	9 41 24.5
2	(17)	48.8		16.5	−	2	16	1.0	23	14.5	35 7.0	43 23.5
3	57½	0.5		31.5	−	3	16	16.5		29.5	21.5	45 18.0
4		18.8		46.5	[10] 5	1.0	1.3	32.5		44.0	36.5	47 10.0
5		30.5	6	1.5		16.0	1.3	48.5		59.0	51.5	49 6.5
6	(8)	45.5		17.0		30.5	0.6	17 5.0	6	24 14.0	36 6.5	51 3.0
7	57½	1.5		33.0		47.0	1.0	22.3	7	[2] 39.8	22.0	53 2.5
	57	15.83	5	46.79	10	1.05	16	32.90	23	44.33 45.76	35 36.71	47 12.14
	+	.04		1.44		2.14		3.21		4.39	6.34	8.25
	57	15.87	5	48.23	10	3.19	16	36.11	23	48.72	35 43.05	47 20.39
	56	12.75			9	0.35	15	33.12	22	45.50	34 40.12	46 15.45
		3.12				2.84		2.99		3.22	2.93	4.94
		+.45				+.45		+.38		+.39 42	+.39 42	+1.41
		.99		.99		.99		.84		.93	.93	3.13

Equations

$0 = 63.09 + \Delta T + .44a - 1.07c$

61.00 58.52

$= 63.09 - 6.48a - 7.12c$

45.45

$= 63.09 + .48a + 1.03c$

$= 66.35 - 7.10a + 7.76c$

$0 = 2.09\ 3.80 + 6.92a + 6.05c$

$= 2.90\ 0.89 - 7.58a' + 6.78c$

$c = +.06$

$+.17$

Adopt $c = +.15$

$6.92a = -3.00\ 4.40$ $\quad a = -.43$

$7.58a' = +3.91\ 1.89$ $\quad a' = +.50\ .03$

Adopt

8.57 Chron Time 8 57 0 66 13.4

$\Delta T = -10^h\ 1^m\ 3.^s534\ -10\ 1\ 3.^s34$ 9.96148

$c = +.15$ Cl W 22 55 56.7 57.6 0.88991 C 7761 7.942

$a = -.43$ Cl E 13 46 43.6 9.60549

$+.50$ Cl. W. 9 9 13.1 14.0 0.85139 A 7.102

1 30.0 0.49540 B 3.129

9 7 43.1 44

10 43.1 44 = Chron. Corr.

−16 22.4

−82 35.8

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Moon culmination
Draper Transit.

* For observation of γ¹ Octantis and 7 ✶ taken tonight, see p. 122

Oct 19 - 1846 Ob. S. I. B.

* a star of about 5½ stages preceds about 4 seconds 3 cross threads - referred to γ¹ Oct. by the preceding ✶ is probably

clamp W

Level. W E

34.4 0.5 +34.9
−0.4 33.5 −33.1
+ .45

clamp E

Name of Star	τ Peg.	θ Piscium	ι Piscium	γ Oct.	33 Piscium	γ Pegasi
Transits	1 9h 07 53.5	15° 8.0	27 0.5	39 19.5	52 23.3	10h 0 13.5
	2 8 09.3	23.0	15.5	41 17.5	38.0	29.5
	3 25.0	37.5	30.0	Sarah's	52.5	45.5
	4 41.5	52.5	45.0	44 23.5	53 7.5	1 0.5
	5 57.5	16 7.5	28 0.0	46 14.5	22.3	16.0
	6 9 14.0	22.5	15.0	48 12.5	37.3	31.0
	7 31.0	38.0	30.5	—	53.0	46.5
	8 41.69	15 52.71	27 45.21		53 7.70	1 0.36
Red. to 10.07	−9.58	−8.40	−6.45		−2.28	−.99
	9 8 32.11	15 44.31	27 38.76	24	53 4.42	0 59.37
					5.42	
	23 15 33.12	22 45.49	34 40.11	46 15.29	53 4.96	7 56.90
	9 52 58.99	58.82	58.65		60.46	53 2.47
Bl				Adopt	.00	+.03
B	.84	.93	.93	3.13	.99	.89

θ = 9 52 +ΔT − 7.10 a + 7.76 c

60.46	+.18	+1.01	Aa	Cc	Σ	ΔT	
62.30	+.53	−1.03	−3.73	−.12	−3.85	58.45	
61.65	+.41	−1.01	−2.87	−.12	2.99	58.65	
61.95	+.40	−1.01	−2.81	−.12	2.93	59.02	
62.09	+.39	−1.01	−2.73	−.12	2.85	59.24	
61.72	+.40	−1.01	−2.81	−.12	2.93	58.79	
65.93	+1.03	−1.27	−7.23	−.15	7.38	58.55	
61.31	+.41	−1.01	−2.87	−.12	−2.99	58.31	58.71
43.09	−2.28	−2.85	+15.98	−.34	+15.64	58.76	

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$b = +.03$
$-.15$

w	c			w	c
0.1	34.0	−34.1	−34.7	0.1	34.3
34.1	0.3	+34.4	+32.8	33.4	−0.6
		+ .1	− .5		

	7 37 f Piscium	7 7 45 Piscium	6 23 51 Piscium	Mron	7 1 δ Piscium	37 56 μ And.	7 20 ε Psc	−69 26 11 Tuc
1	34.1	12 39.5	19 21.0	23 1.0	35 32.1	43 6.1	49 49.7	2 45.9
2	50.8	55.5	36.3	17.0	48.0	25.5	1.02	3 31.
3	8 5.5	13 10.1	51.0	32.1	36 3.5	44.1	50 16.1	4 14.
4	20.5	25.5	20 6.0	48.0	18.1	44 3.1	31.1	57.
5	35.5	40.5	21.0	25 3.0	33.5	22.0	46.5	5 38.
6	50.5	55.0	35.5	18.0	48.0	40.8	51 1.5	6 19.
7	9 5.5	14 10.	50.3	33.0	37 3.1	49.5	16.0	7 3.5

8 20.40	13 25.21	20 5.87	24 47.64	36 18.29	44 3.04	50 31.21	4 55.43
+ .22	1.05	2.15	2.92	4.81	6.09	7.15	9.57
8 20.62	13 26.26	20 8.02	24 50.56	~~36 43~~ ~~23 21.38~~	44 9.13	50 38.36	5 4.94
15 19.00	20 24.34	27 5.96		43 21.38 ~~52 56.91~~	50 3.17	57 36.96	12 21.59
53 1.62	1.92	2.06		1.72	5.96	1.40	52 43.35
+.03	+.03	+.03		.00	−.03	−.09	−.26
.92	.92	.93		.92	.74	.92	1.71

Note

Telescope was jarred at 4th * and azimuth evidently altered. Assuming collimation from Oct. 17 and 20, the reduction gives for 10.07 Chron Time

	Oct. 17	Oct. 20
ΔT =	−9 52 58.7	59.05
α =	−7.02 Cl. E	−6.85
c =	+.14 Cl W	−.13

Adopt

$0 = 62.42 + .51a - 1.05c$
$= 43.09 - 2.28a - 2.85c$
$0 = 19.35 + 2.79a + 1.80c$

If $c = +.\cancel{17}\ 12$

$2.79a = -19.53$
$a = -7.02$

If $c = -.13$ Oct. 20
$a = -6.85$
Δa +.09
Δc +.25
+.34

10	7	0	
−9	52	58.7	59.0
0	14	1.3	1.0
13	54	36.7	36.7
10	19	24.6	24.3
	1	41.5	41.5
17	43	1.1	42.8

10 43.1 = Chron. Corr.

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Az. adjusted on β Centauri

Moon Culmination. Draper Transit.

Oct 20 - 1896 Obs. S.I.B.

Clamp- E
End.

W. E.

0.5 34.3 −34.8 −0.6
33.1 −0.7 +32.4

$b = -.^s18$

W. E.

32.7 −0.9 +31.8 −0.7
0.5 34.0 −34.5

Reversed clamp W —

Name of star	γ Pegasi $+14\ 36$	σ And $36\ 13$	β Hydri $-77\ 50$	π And. $33\ 9$	δ Psc $+7\ 1'$	ε Psc $+7\ 29$	
1	9h 56m 14.1s	10h 1m 6.3	5 50.0	19 31.0	31 34.8	45s 48.5	
2	31.0 2	25.0 2	7 4.5 2	49.5 2	50.5 2	46 4.0	
3	46.5 3	43.8 3	8 16.0 3	20 7.5 3	32 5.5 3	18.5	
4	57 1.1 4	2 2.5 4	9 26.5 4	25.3 4	32 20.5 4	33.5	
5	17.0 5	20.8 5	10 36.5 5	43.0 5	35.5 5	48.5	
6	32.0 6	38.5 6	11 46.0 6	21 0.5 6	50.3 6	47 3.5	
7	47.5 7	57.0 7	12 57.0 7	18.0 7	33 5.5 7	19.2	
	9 57 1.43	2 1.99	9 25.21	20 24.97	32 20.37	46 33.71	
Red. to 10.50	−8.71	−7.88	−6.67	−4.86	−2.90	−0.56	
	9 56 52.72	1 54.11	9 18.54	20 20.11	32 17.47	46 33.15	
	0 7 56.89	12 57.81	20 27.74	31 23.73	43 21.38	57 36.97	
	9 48 55.83	56.30	50.80	56.38	56.09	56.18	
	−.16	−.14	−.41	−.14	−.16	−.06	
B	.89	.75	2.27	.78	.92	.92	

				Aa	Ce	Σ	ΔT	
0 = 9	48	55.67	+ΔT +.53a ∓ 1.03 c	−.56	+.13	−.43	55.24	
		56.16	.98 ∓ 1.24	−1.04	+16	−.88	.28	
		50.39	−4.17 ∓ 4.75	+4.42	+.62	+5.04	.43]	
		56.24	.91 ∓ 1.19	− .96	+.15	−.81	.43	
		55.93	.40 ∓ 1.01	− .42	+.13	−.29	.64	55.40
		56.12	.41 + 1.01	− .24	−.13	−.37	.75	
		56.22	.49 + 1.02	− .29	−.13	−.42	.80	
		56.53	.96 + 1.23	− .57	−.16	−.73	.80	55.80
		56.24	.54 + 1.03	− .32	−.13	−.45	.79	
		55.31	−1.24 + 1.87	+ .73	−.24	+.49	.80]	55.60
		56.40	.64 + 1.07	− .38	−.14	−.52	.88	

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	n	c
−33.3	−0.1	33.4
+32.4	33.0	−0.6
−0.2		

Fol. limb of moon rather ragged.

$b = -.506$

	n	c
+32.7	33.1	−0.4
−33.6	0.0	33.6
−0.2		

12 24 +35 4

75 Psc | β And. | Moon | Moon | +14 49 ν Psc | −57 46 ε Eri | +20 18 β Arietis

Fine but Fol. limb 11h 4m 31.0

49	20.0		52	—				6	35.0		14	5.5		21	22.0		36	59.3	
	35.8		55.4	19.0	2		46.8	2		5.0	2		21.0	2		49.8	2	37	15.0	
	50.5		55.2	36.5	3	5	2.0	3	7	6.0	3		36.0	3	22	17.0	3		30.5	
50	5.5		55.4	55.0	4		17.3	4		21.5	4		50.8	4		44.8	4		[4] 36.3	
	21.0		55.0 53	13.0	5		32.8	5		37.0	5	15	7.5	5	23	13.0	5	38	2.3	
	36.5		54.9	31.3	6		48.5	6		52.5	6		22.0	6		41.0	6		18.5	
	52.3		54.7	50.5	7	6	5.0	7	8	8.8	7		38.5	7	24	10.3	7		35.0	
50	5.9	4		55.09		5	17.63		7	21.69		14	51.61		22	45.41		37	46.70	
	+0.02			0.49			2.51			2.85			4.08			5.38			7.85	
50	5.96			55.58		5	20.14		7	24.54		14	55.69		22	50.79		37	54.55	
1	9.69		3	59.00								25	59.40		33	55.40		48	58.09	
	56.27			56.58									56.29			55.39			56.466	
	−.05			−.05									−.05			−.08			−.06	
	.90			.76									.89			1.41			.86	

$0 = 56.00 + \Delta T + .70a \mp 1.12c$

$= 50.39 \quad -4.17 \mp 4.75c$

$= 56.30 \quad +.61a + 1.07c$

$= 55.31 \quad -1.24a + 1.87c$

$0 = 5.61 + 4.87a - 3.63c$

$0.99 + 1.85a' + 0.80c$

$c = \mp .13$

$4.87a = -5.14 \quad a = -1.06$

$1.85a' = -1.09 \quad a' = -.59$

10	50	0	
−9	48	55.6	
1	1	4.4	
13	58	33.2	
11	2	31.2	
1	48	5	
11	0	42.7	
10	42	7	= Chron Corr.

Adopt for 10.50 Chron T.

$\Delta T = -9\ 48\ 55.60$

$c = \mp .13$ Cl. W

$a = -1.06$ Cl E

$-.59$ Cl W

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Moon Culmination — Draper Transit.

Oct 21-96 Obs. S. I. B.

Clamp W
Level.

See p. 118

W. E.
0.5 33.8 −34.3
33.6 0.4 +34.0
−0.1

$b = -.^s02$

+34.1
−34.2
.0

W E
33.7 0.4
0.5 33.7

Name of Star	Oct	Oct.					μ Androm	ε Pisc.	κ Tuc.	ψ Pisc	
							37 56	7 20	−69 26	14 49	
31 24.6	1	19h 25m 38.5s			−	1	10h 35s 9.0	1 47 53.0	55 11.5	11h 10 9.5	1
29.0 3.7	2	27 37.0	2		−	2	28.3	42 8.0	54.5	25.3	2
24.5 1.2	3	29 26.5	3	35	12.0	10.0	46.5	3	22.5	3 56 34.8	3 40.0
23.8	4	31 21.5	4	37	10.0	12.3	36 5.5	4	37.5	4 57 17.0	4 55.8
24.6 2	5	33 17.5	5	39	8.5	15.2	24.3	5	53.0	5 59.5	5 11 10.8
31 24.16	6		−	6 41	7.5	17.8	43.5	6	43 7.8	6 58 42.5	6 26.5
	7		−	7 43	11.5	19.2	37 3.0	7	23.3	7 59 26.8	7 42.5
							36 5.73		42 37.87	57 18.09	10 55.77
							−9.35		−8.27	−5.86	−3.62
							35 56.38		42 29.60	57 12.23	10 52.15
							51 3.18		57 36.97	12 21.58	25 59.42
							44 53.20		52.63	50.65	52.73
							−.01		−.02	−.03	−.02
							.74		.92	1.71	.89

These observations made so that obs. of * Oct. 19 might be used. But * evidently differs largely in δ so that diurnal intervals are unknown. ∴ Do not use.

Red. to 11.33

~~2 46 15.09~~

23 46 15.09

				Aa	Ca	Σ	ΔT	
0 = 9 44	53.19	+ΔT	+ 1.03a + 1.27c	−.90	−.23	−1.13	52.06	
	52.61		+ .41 + 1.01	−.36	−.18	−.54	52.07	
	50.62		− 2.28 + 2.85	+1.98	−.50	+1.48	52.10]	52.09
	52.71		+ .54 + 1.03	−.47	−.19	−.66	52.05	
	52.77		+ .48 + 1.02	−.42	−.18	−.60	52.17	
	52.43		+ .57 − 1.04	−.76	+ .19	−.57	51.86	
	52.20		+ .58 − 1.05	−.77	+ .19	−.58	51.62	
	52.68		+ .61 − 1.06	−.81	+ .19	−.62	52.06	51.79
	52.53		+ .62 − 1.06	−.82	+ .19	−.63	51.90	
½ wt	49.01		− 2.24 − 2.81	+ 2.98	+ .51	+3.49	52.50]	
	52.56		+ .28 − 1.00	− .37	+ .18	− .19	½ wt. 51.37	
	52.30		+ .53 − 1.03	− .70	+ .19	−.51	51.79	51.94

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Slight light usually cut off by finder.

Stand. ε

W	E.	
0.2	33.6	−33.9
33.3	0.1	+33.4
		−0.1

b_2 = −.03 / −.18

W.	E.	
32.8	−0.5	+32.3
0.8	34.1	−34.9
		−0.6

	11 37	16 27	17 19	19 8	19 25	−6 9 8	−0 7	14 39
	Π Psc.	4 Arietis	υ Arietis	Mirou	Mirou	β Cet. 686	θ Arietis	δ Hydræ	δ Ceti	σ Arietis
1	18 49.5	27 6 42.8	35 48.8	46 54.6	49 1.5	52 13.0	56 25.3	12h 2 36.0	−	1 29 45.1
2	16 4.8	59.5	36 5.0	11.0	18.3	28.0	42.0	3 20.5	−	2 30 2.0
3	20.0	27 15.0	20.8	27.0	34.3	43.5	58.0	4 2.5	18 42.5	57.0	17.5
4	34.5	30.5	36.0	43.0	50.5	59.3	57 13.8	45.0	57.5	57.2	33.0
5	49.5	46.0	52.0	59.0	50 6.0	53 15.0	29.5	5 26.0	19 12.5	57.3	48.0
6	17 5.3	28 0.5	37 7.5	48 14.5	21.5	30.5	44.8	6 7.0	28.0	58.43	3.0
7	21.0	16.8	23.0	30.5	37.1	46.5	58 0.8	49.0	42.8	58.2	18.5
	16 34.94	27 30.16	36 36.16	47 42.71	49 50.94	52 59.40	57 13.46	4 43.76	57.62	30 32.50
	−2.70	−0.90	+.59	2.42	2.77	3.28	3.98	5.21	7.55	9.45
	16 32.24	27 29.26	36 36.75	47 45.13	49 52.71	53 2.68	57 17.44	4 48.97	5.17	30 41.95
	31 39.45	42 36.80	51 44.52			8 9.97	12 24.88	19 59.66	34 13.44	45 49.49
	44 52.79	52.46	52.23			52.71	52.56	49.31	51.73	52.46
	−.02	−.03	−.03			−.03	−.03	−.30	−.17	−.16
	.90	.88	.87			.86	.86	1.70	.96	.89

$0 = 52.82 + \Delta T + .62a + 1.08c$

$= 50.62 - 2.28a + 2.85c$

$= 52.43 + .58a - 1.05c$

$= 49.01 - 2.24a' - 2.81c$

$= 2.20 + 2.90a - 1.77c$

$= 3.42 + 2.82a' + 1.76c$

$c = -.18$

$2.90a = -2.52 \quad a = -.87$

$2.82a' = 3.74 \quad a' = -1.33$

11 33	0	Adopt for 11.33 Chron T.
−9 44	51.9	ΔT = −9 44 51.94
1 48	8.1	c = −.18 clW
14 2	29.8	a = −.87 clW
		−1.33 clE
11 45	38.3	
1	55.6	
11 43	42.7	
10	42.7	= Chron. corr.

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9	44	39
	10	42.7
9	55	21.7
14	2	29.8
~~19~~	~~52~~	~~51.9~~
	3	36.1
12	1	27.6
	2	33.4

Oct-22.96

fast Sid. clk.

9	38	55
11	56	15
9	44	39
12	2	0

Calculation of Precession

$$3^s.07265 \left[+1^s.33683 \underset{[0.12606]}{\text{Corr.}} \sin \alpha_0 \tan \delta_0 \right]$$

α_0	log sin α_0	log tan δ_0	log Corr.	Corr.	Precession
342 28	9.47894n	8.98622n 9.11228n	8.59122	.0390	3.~~0~~12 ~~47~~
344 3	9.43901n	8.96464n 9.09070n	8.52971	.0339	3.107
3 49	8.82324	9.12621 .25227	8.07551	.0119	3,085
5 6	8.94887	9.09640 .22246	8.17133	.0148	3,087
6 46	9.07124	9.04873 17479	8.24603	.0176	3,090
15 17	9.42093	9.34215 46821	8.88914	.0775	3,150
25 39	9.63636	9.47021 59627	9.23263	.1709	3,244
27 56	9.67066	9.49385 61991	9.29057	.1952	3,268
32 2	9.72461	9.54025 66631	9.39092	.2460	3,319
33 6	9.73727	9.54714 67320	9.41047	.2573	3,330

$$\alpha = f + \tfrac{1}{15} g \sin(g+\alpha) \tan\delta + \tfrac{1}{15} h \sin(H+\alpha) \sec\delta)$$

Oct. 19 Oct. 20

Appr. Place.	α Piscium	75 Piscium
g	339 12	339 18
α	3 49	15 17
H	60 50	59 48
$g+\alpha$	343 1	354 35
$H+\alpha$	64 39	75 5
log sin $(g+\alpha)$	9.46552n	8.97496 n
" tan δ	9.12621	9.34215
" g	1.3273	1.3272
" $\frac{1}{15}$	8.82391	8.82391
" h	1.2815	1.2821
" sin $(H+\alpha)$	9.95603	9.98511
" sec δ	.00385	.01025
" I	8.7429	8.4682
" II	0.0653	0.1014

	α Piscium	75 Piscium
f	3.045	3.047
I	.055	.029
II	1.162	1.263
$\Delta\alpha$	4.26	4.34

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Apparent R.A. Special Lunar Comparison Stars.
(Introduced from the list in 1897 Ephem.)

	α 1897.0	P.M.	δ	α_0 1896.		
B.A.C. 7986	22 49 50.497	+.0024	−5 32	22 49	47.385	
					4.04	— $\Delta\alpha$
8017	22 56 11.8	—	−5 16	22 56	8.7	
					4.05	
d Piscium	0 15 17.828	−.0001	+7 37	0 15	14.743	
					4.26	
45 "	0 20 23.262	+.0015	7 7	0 20	20.275	
					4.17	
51 "	0 27 4.859	+.0009	6 23	0 27	1.769	
					4.19	
75 "	1 1 8.496	+.0014	12 24	1 1	5.346	
					4.34	
4 Arietis	1 42 35.635	+.0024	16 27	1 42	32.391	
c					4.41	
c "	1 51 43.350	+.0020	17 19	1 51	40.082	
					4.44	
B.A.C. 686	2 8 8.791	+.0011	19 8	2 8	5.472	
					4.50	
θ Arietis	2 12 23.700	−.0012	+19 25	2 12	20.370	
					4.51	

$\Delta\alpha$ except those calculated on p. 124 are from 1896 American Ephemeris Occultations.

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Reduction of Moon Culminations.

Doolittle pp 339-347

Assume $\varphi = -16° 22'.4$ $L = 4^h 46^m 6^s$ from Gr.

	Oct. 17/96	Oct. 19	Oct. 20	Oct. 21		Defective Limit Oct. 20	Oct. 21
δ	−3 37.6	+7 47.6	+12 54.4	+17 42.0	α'	13 45.0	13 49.0
π	3264	3240	3237	3239	α	1 18.4	2 4.0
λ	.0296	.0297	.0307	.0322	$\alpha'-\alpha$	12 27.6 / 184 54	11 45.0 / 176 15
S	61.36	61.33	62.36	63.95	δ'	−10 52.3	−11 1.3
φ'	−16 16.1				$\log \sin(\alpha'-\alpha)$	9.07968n	8.81560
$\varphi'-\delta$	−12 38.5	−23 53.7	−29 10.5	−33 58.1	" $\cos\delta$	9.99214	9.99159
$\log \sin($ " $)$	9.34015n	9.60752n	9.68796n	9.74721n	" $\sin x$	9.07182n	8.80719
" π	3.51375	3.51055	3.51014	3.51041	" $\cos x$	9.99695	9.99910
" $\frac{1}{60}\rho$	9.99988	9.99988	9.99988	9.99988	" S	1.79491	1.80584
	8.22185	8.22185	8.22185	8.22185			
Σ	1.07563n	1.33980n	1.41983n	1.47935n	" S'	1.79186	1.80494
$\Delta\delta$	+11.9	+21.9	+26.3	+30.2	S'	61.92	63.82
δ'	−3 25.7	+7 59.5	+13 20.7	+18 12.2			
" $\cos(\varphi'-\delta)$	9.98934	9.96106	9.94108	9.91873			
" $\sin\pi$	8.19932	8.19612	8.19571	8.19598			
" ρ	9.99988	9.99988	9.99988	9.99988			
Σ	8.18854	8.15706	8.13667	8.11459			
N_0	.01544	.01436	.01370	.01302			
A_1	0.98456	.98564	.98630	.98698			
$1-\lambda$	0.9704	.9703	.9693	.9678			
" (")	9.98695	9.98691	9.98646	9.98579			
" B_1	0.01305	0.01309	0.01354	0.01421			
" A_1	9.99324	9.99372	9.99401	9.99431			
" $f\cos\delta$	0.00629	0.00681	0.00755	0.00852			
	1.015	1.016	1.018	1.020			

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I. Using all stars and Washington Ephemeris

	Oct. 17	Oct. 19	Oct. 20	Oct. 21
Obs'd Transit	9 5 46.79 48.23	10 24 47.64 50.56	11 5 17.63 20.14	7 def 21.69 24.54	11 47 def 42.71 45.13	49 49.94 52.71
Red for Semi D.	61.36	61.33	62.36	−61.92	63.82	63.95
Tr. Centre	9 6 48.15 49.59	10 25 48.97 51.89	11 6 19.99 22.50	6 19.77 22.62	11 48 46.53 48.95	45.99 48 48.76
A	.23	.42	.51	.60
B	.98	.92	.89	.87
C	1.00	1.01	1.03	1.05
Aa	+.165 .687	−2.877 2.944	−.301	−.798
Bb	+.441	+.402 .438	−.053	−.026
Cc	+.150	+.131 .141	−.134	+.189
Σ	+.706	−2.718	−.488	−.635
Σ(F cos δ)	+.72	−2.76	−.50	−.65
Corr'd Tr. Centre	9 6 48.87 50.31	10 25 46.21 49.13	11 6 19.49 19.27 22.00 22.12	11 48 45.88 45.34 48.30 48.11
ΔT	−10 1 3.34	−9 52 59.05	−9 48 55.60 55.60	−9 44 51.94 51.94
δT	+1.60	+3.04	+2.68 2.68	+2.69 2.69
Σ	−10 1 1.74	−9 52 55.97	−9 48 52.92	−9 44 49.35
Trial α	23 5 48.59 47.13	0 32 53.17 50.24	1 17 26.57 26.35 29.09 29.21 26.46 29.15	2 3 56.53 55.99 58.96 58.77 56.29 58.86
α Washington	23 6 26.58	0 33 30.27	1 18 7.76	2 4 40.15
Δ	39.45 37.99	40.03 37.10	41.30 38.61	43.89 41.29
Diff. 1 hr. long	109.53	109.85	113.60	119.32
Δ long	0.h 3468 3602	0.3377 3644	0.3399 3636	0.3460 3678 2206 8
	20.m 808 21.612	20.262 21.864	20.394 21816	20.760
	21m 48.s 48 36.72	21m 15.s 72 51.84	21m 23.s 64 4896	22m 4.s 56 4.08
Wash. Long.	5 8 12.04			
Long.	4 47 24	47 56	47 48	47 26.4
Mean	4h 47m 38s			
Long.	4 46 24	20	23	8
Mean	4 46 19			

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II. Using Moon Culminating Stars only + Green. Epheem.

Moon $\alpha = T + \Delta T + \left[\overset{=0}{i F}\right] + [Aa + Bb + Cc] F\cos\delta \pm \frac{S}{15(1-\lambda)\cos\delta}$

Star $\alpha' = T' + \Delta T' + A'a + B'b + C'c$

$\alpha = \alpha' + T - T' + \Delta T - \Delta T' + (AF\cos\delta - A')a + (BF\cos\delta - B')b + (CF\cos\delta - C')c \pm \frac{S}{15(1-\lambda)\cos\delta}$

Oct. 17

	Moon	BAC 7986	BAC 8017	½ wt ϕ Aquarii	θ Piscium	ι Piscium
δ	−3 26	−5 32	−5 16	−6 36	+5 48	+5 4
A ($AF\cos\delta$)	.225	.229 (×F cos δ)	.189	.194	.171	.380	.367
B	.976	.990	.987	.985	.992	.930	.934
C	1.002	1.017	1.005	1.005	1.007	1.006	1.004
a = +.50 ΔA		.039	.034	.057	−.152	−.139
b = +.45 ΔB		.003	.005	−.002	.060	.056
c = +.15 ΔC		.012	.012	.010	.011	.013
$\Delta A\,a$		+.020	+.017	+.028	−.076	−.070
$\Delta B\,b$		+.001	+.002	−.001	+.027	+.025
$\Delta C\,c$		+.002	+.002	+.002	+.002	+.002
Arg. $(\Delta T - \Delta T')$ = T − T' below	$\Delta T - \Delta T'$	+2.441 (+451.4)	+1.399 (+431.0)	+.696 (+414.2)	−2.950 (−175.5)	−4.900 (−29 49.9)
Σ		+2.46	+1.42	−0.67	−3.00	−4.94
S term		+61.36	+61.36	+61.36	+61.36	+61.36
$T - T'$	+14 51.33	+8 30.96	−4 14.26	−17 57.54	−29 49.92
Σ	+15 55.15	+9 33.74	−3 13.57	−16 59.18	−28 53.50
α'	22 49 51.42	56 12.75	~~10 3.19~~ 9 0.35	22 45.50	34 40.12
α	23 5 46.57	46.49	46.78	46.32	46.62

Mean by weights (½ wt) h. 23 m. 5 s. 46.53

v	vv	pvv
.04	16	32
.04	16	32
.25	625	625
.21	441	882
.09	81	163

36) 1734

.0048

$r = .07$

$R_0 = \pm .05$

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Oct. 19

	Moon		α Piscium	45 Piscium	51 Piscium	δ Piscium	ε Piscium
δ	+8 0		7 37	7 7	6 23	7 1	7 20
A (A Fess δ)	.417	.424	.410	.402	.390	.400	.406
B (B .)	.920	.935	.922	.924	.927	.925	.923
C (C .)	1.010	1.026	1.009	1.008	1.007	1.008	1.009
$a = -6.85\,\Delta A$			.014	.022	.034	.024	.018
$b = +.03\,\Delta B$			.013	.011	.008	.010	.012
$c = +.13\,\Delta C$			.017	.018	.019	.018	.017
ΔAa			−.096	−.150	−.233	−.164	−.123
ΔBb			+.000	+.000	+.000	+.000	+.000
ΔCc			+.002	+.002	+.002	+.002	+.002.
$\Delta T - \Delta T'$			+2.868	+2.032	+.771	−1.891	−4.226
Σ			+2.77	+1.88	+0.54	−2.05	−4.35
S term		+ 1	1.33	+1 1.33	+1 1.33	+1 1.33	+1 1.33
T − T'		+16	27.34	+11 22.43	+4 41.77	−11 30.65	−25 43.57
Σ		+17	31.34	+12 25.64	+5 43.64	−10 31.37	−24 46.59
α'		~~23~~ 0	15 19.00	20 24.34	27 5.96	43 21.38	57 36.96
α		~~23~~ 0	32 50.34	49.~~38~~ 9	49.60	50.01	50.37

Mean ~~23~~ 0h 32m 50s.06

V	VV
28	784
8	64
46	2116
5	25
31	961
20) 3950	
198	

$\nu = .14$ $\quad r_0 = \pm 5.09$

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Oct. 20

	Moon		ε Piscium	75 Piscium	η Piscium	β Arietis
δ	+13 21		+7 20	+12 24	+14 49	+20 18
A (A Fcos δ)	.509	.518	.406	.493	.536	.637
B (B ")	.893	.909	.923	.898	.886	.856
C (C ")	1.027	1.035	1.009	1.024	1.034	1.066
a = −.59 Δa			+.112	+.025	−.018	−.119
b = −.06 Δb			−.014	+.011	+.023	+.053
c = ∓.13 Δc			+.026	+.011	+.001	−.031
ΔAa			−.066	−.015	+.011	+.070
ΔBb			+.001	−.001	−.001	−.003
ΔCc			−.003	−.001	−.000	+.004
ΔT−ΔT′			+3.077	+2.496	−1.571	−5.336
Σ			+3.01	+2.48	−1.56	−5.26
S term			+1 2.36	+1 2.36	+1 2.36	+1 2.36
T−T′			+18 ~~46.99~~ 43.92	+15 ~~14.18~~ 11.69	−9 ~~35.55~~ 33.98	−32 ~~34.47~~ 29.07
Σ			+19 49.29	+16 16.53	−8 33.18	−31 31.97
α′						
α						

II limit defective

ΔT−ΔT′			+3.417		+2.836		−1.232	−4.996
Σ (Defective Limit)			+3.35		+2.82		−1.2~~8~~2	−4.92
S term		−1	1.92	−1	1.92	−1	1.92	−1 1.92
T−T′		+20	47.98	+17	~~8.58~~ 15.75	−7	~~31.15~~ 29.92	−30 ~~30.04~~ 25.01
Σ		+19	49.41	+16	16.65	−8	33.06	−31 31.85
Mean of 2 limits		+19	49.35	+16	16.59	−8	33.12	−31 31.91
α′	0	57	36.97	1	9.69	25	59.40	48 58.09
α	1	17	26.32		26.28		26.28	26.18

Mean $1^h\ 17^m\ 26.^s29$

v	vv
3	9
1	1
0	
11	121
12	131
	11

$v = .033$ $R_0 = \pm .02$

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Oct. 21

	Moon	4 Arietis	ι Arietis	BAC 686	θ Arietis
	18 12	16 27	17 19	19 8	19 25
	.598 .615	.565	.581	.615	.620
	.867 .884	.877	.872	.862	.861
	1.052 1.073	1.042	1.047	1.058	1.060
$a = -1.33$		+.050	+.034	.000	−.005
$b = -.03$		+.007	+.012	+.022	+.023
$c = +.18$		+.031	+.026	+.015	+.013
		−.066	−.045	.000	+.007
		−.000	−.000	−.001	−.001
		+.006	+.005	+.003	+.002
		+3.320	+1.825	−0.867	−1.562
		+3.26	+ 1.78	− 0.86	− 1.55
		+1 3.82	+1 3.82	+1 3.82	+1 3.82
		+20 12.55	+11 6.55	−5 16.69	−9 30.75
1st limit (defective)		+21 19.63	+~~13~~ 12 12.15	−4 13.73	−8 ~~33.02~~ 28.48
		+3.668	+2.174	−0.519	−1.215
		+3.61	+2.13	− .52	− 1.21
		−1 3.95	−1 3.95	−1 3.95	−1 3.95
2d limit bright		+22 19.78	+13 13.78	−3 9.46	−7 23.52
		+21 19.4~~5~~ 4	+12 ~~15.60~~ 11.96	−4 13.93	−8 28.68
Mean		+21 19.54	+12 12.06	−4 13.83	−8 28.58
		1 42 36.80	51 44.52	8 9.97	12 24.88
		2 3 56.34	56.58	56.14	56.30

Mean $2^h\ 3^m\ 56.^s34$

v	vv
0	0
24	576
20	400
4	16
12	992
83	

$\sqrt{} = .09$

$\Omega_0 = \pm .06^s$

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Longitude from Greenwich Hourly Ephemeris

Doolittle pp 414-416

	Oct. 17	Oct. 19	Oct. 20	Oct. 21
A	23 5 46.53	0 32 50.06	1 17 26.29	2 3 56.34
A_1	5 39.81	32 9.61	17 20.17	4 24.05
$A-A_1$	6.72	40.45	6.12	− 27.71
ΔA	1.7766	1.7803	1.8396	1.9301
δA	−.0015	+.0017	+.0031	+.0041
log 60	1.77815	1.77815	1.77815	1.77815
" $(A-A_1)$	0.82737	1.60692	0.78675	1.44264n
" $\frac{1}{\Delta A}$	9.75041	9.74951	9.73528	9.71442
" x	2.35593	3.13458	2.30018	2.93521n
" x^2	4.71186	6.26916	4.60036	5.87042
" $\frac{1}{7200}$	6.14267	6.14267	6.14267	6.14267
" δA	7.17609n	7.23045	7.49136	7.61278
" $\frac{1}{\Delta A}$	9.75041	9.74951	9.73528	9.71442
$-\Sigma =$ " x''	7.78103	9.39179n	7.96967n	9.34029n
x'	226.95	1363.26	199.61	−861.42
x''	.01	−.25	−.01	−.22
			$17-(x'+x'')$	$14\ 21.64$
Gr. M. Time	14 3 46.96	15 22 43.01	16 3 19.60	16 4538.36
Ap. Sid. Time	23 5 46.53	0 32 50.06	1 17 26.29	2 3 56.34
" Noon	13 46 43.64	13 54 36.75	13 58 33.30	14 2 39.86
" Int.	9 19 2.89	10 38 13.31	11 18 52.99	12 1 26.48
Corr. to Mean	1 31.59	1 44.56	1 51.22	1 58.19
Ap. M. Time	9 17 31.30	10 36 28.75	11 17 1.77	11 59 28.29
Δ Long.	4 46 15.66	14.26	46 17.83	10.07

Mean $4^{h.}\ 46^{m.}\ 14^{s.}46$

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III. Using Moon Culminating Stars and Washington Ephem.

	Oct. 17	Oct. 19	Oct. 20	Oct. 21
α Arequipa	23 5 46.53	0 32 50.06	1 17 26.29	2 3 56.34
α Washington	6 26.58	33 30.27	18 7.76	4 40.15
Δ	log = 1.60260 40.05	1.60433 40.21	1.61773 41.47	1.64157 43.81
Diff. 1 hr. long.	2.03953 109.53	2.04080 109.85	2.05538 113.60	2.07671 119.32
Δ long.	9.56307 0.3657	9.56353 0.3660	9.56235 0.3650	9.56486 0.3672
	21.942	21.960	21.900	22.032
	$21^m\ 56^s.52$	21 57.60	21 54.00	22 1.92
Wash. long.	5 8 12.04			
long.	4 46 15.52	14.44	18.04	10.12

Mean 4 46 14.53

Results, using Moon Culm. Stars only.

	Long	Wt.
Oct. 17	4 46 15.6	4
19	14.4	1
20	17.9	25
21	10.1	3
	14.5	

Giving weights recip. prop. to squares of probable errors of the several determinations of Moon's α (which are ±.05, ±.09, ±.02, ±.06 resp. as calculated above) we have

Mean by weights 4 h. 46 m. 16.8 s.

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Longitude by Chronometer.

Mean Time Chronometer Bliss & Creighton 1131 was brought from New York in steamships Advance and Arequipa.. It was occasionally compared with navigator's chronometer and the following errors on Greenwich Time determined on the authority of the navigator

1896					
July 6	8 am	$4^h\ 5^m\ 30^s$	slow.	Str. Advance	
8	11 "	32	"	"	"
11	11 "	31	"	"	Arequipa
24	4 pm	30	"	"	"

Chronometer had had in Providence daily gaining rate of $1^s.8$ daily for two weeks preceding sailing. The effect of the voyage was to ~~check~~ reduce this rate to 0.

July 25 Chron. was carried to Arequipa. Observations with it were begun July 31 as recorded in this book

p. 26 shows that at first its rate was $1^s.6$ daily gaining. Carrying back to July 25 the error on Arequipa Time by this rate, we have the following approximate determination of longitude.

July 25	Error on Gr.	7.	4	57 30
"	" Areq.	7.	11	24
	Longitude		4^h	46^m 6^s

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At Ladd Observatory Providence R.I. moon culminations were observed by Fred. Slocum giving results as follows:

Oct. 19	α Moon's centre	$0^h\ 32^m\ 49^s.05$
21		$2\ 3\ 54.95$
22		$2\ 52\ 59.60$

From calculations ff. 129, 131 α Arequipa 19th $0\ 32\ 50.06$

21st $2\ 3\ 56.34$

	Oct. 19	Oct. 21
Δα	$1^s.01$	$1^s.39$
Δ 1h long	109.82	119.26
Δ long.	$0^h.0092$	0.0117
	$0^m.552$	$0^m.702$
	$33^s.12$	$42^s.12$
	$37^s.62$	

Long Prov. 4 45 35.95

4 46 13.57

same dates from f. 133

(by Gr. Eph. 4 46 12.25)

	19	21	22
Prov. Sid Time	0 32 49.05	2 3 54.95	2 52 59.60
" " noon	13 54 36.67	14 2 29.78	14 6 26.33
" int.	10 38 12.38	12 1 25.17	12 46 33.27
Corr to mean	1 44.55	1 58.19	2 5.58
Prov. mean time	10 36 27.83	11 59 36.98	12 44 27.69
Δ long	4 45 35.95	4 45 35.95	4 45 35.95
Green. M.t.	15 22 3.78	16 45 2.93	17 30 3.64
(a)	$22^m.063$	$14^m.951$	$29^m.39$
(4 Δ 1m Gr. Ephem.	$1^s.7806$	$1^s.9296$	$2^s.0401$
log (a)	1.34367	1.17467	1.47624
" (b)	0.25056	0.28554	0.30965
	1.59423	1.46021	1.78589
	39.28	28.85	61.08
α nearest hour	0 32 9.61	2 4 24.05	2 54 0.89
	0 32 48.90	2 3 55.20	2 52 59.81
Corr. to Eph.	+ 0.15	− 0.25	∓ 0.21
Mean		$-0^s.10$	

Long. corrected by Prov. observations, (assuming long. of Providence) is 4 46 16.8 +3.2

4 46 20.0

Corr. to long. $+2^s.73 \times \frac{1.8}{2.2}$ Oct. 17 $= +3^s.3$

$\frac{1.8}{2.2}$ " 19 3.3

$\frac{1.8}{2.2}$ " 20 3.3

$\frac{1.9}{2.2}$ " 21 $\frac{3.2}{3.2}$

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Running of Clock, (Sidereal)
Utschneider Liebherr u. Werner in München.
(Property of Mr. Muñiz – loaned to observatory)

Clock set up in Clock Room by Mr. Muñiz.
Errors determined by comparison with Chronometer
Bliss & Creighton 1131 on dates when error of latter
was determined by observation. See p. 26

1896		Error on local sidereal time	
Aug.	6	$0^m\ 12^s$	fast
	10	52	"
		altered regulator	
	13	1 8	fast
		altered regulator	
	17	1 15	fast
	22	1 20	"
	25	1 28	"
	28	1 27	"
	31	1 31	"
Sept	3	1 34	"
	7	1 .4	"
	11	1 5	"
	14	1 7	"
	17	1 8	"
	22	1 8.2	"
	23	1 7.2	"
	24	1 4.6	"
	28	1 1.2	"

Cause of change of 30^s unexplained.
Transit shed was erected West of clock room Sept. 7 – 12.

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1896

Oct. 1	$0^m\ 57.^s8$	fast		
6	0 53.0	"		
(S.S.B rds.)	$22^h\ 0$	33.4	"	
31		9.3	"	
Nov. 6		5.2	slow	altered regulator Nov. 7, 6 p.m.
12		14.0	"	" " 13, 9 a.m.
20		26.9	"	" " 21 9 a.m.
25		4.2	"	" " 26 9.30 a.m.
Dec. 1		4.6	"	
7		7.7	"	
22		19.4	"	
28		30.8	"	
1897 Jan 8		45.5		
15		59.7		
21	1	12.4		
22	1	14.5		
23	1	16.6		
26	1	23.1		
Feb. 1	1	29.9		
4	1	35.8		
23	2	9.3		
Mar. 17	3	9.2	2.7	
23	3	29.3	3.3	
30	3	51.1	3.1	
Apr. 5	4	9.4	3.0	Apr. 6 Set minute hand forward 4^m altered reg. 11 a.m.
6		11.4	slow	
7		12.8		

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Screw moved forward

Oct. 29/96 Value of Micr.

α Centauri

15	11		24	
20		43	58	34
25			33	35
0		45	7	34
5			41.5	34.5
10			16	34.5
15			50 ?	34
20			24.5 ?	34.5
25			56	31.5
0			33	37
5		49	7	34
10			41.5	34.5
15			16	34.5
20			50.2	34.2
25		51	24.7	34.5

Definition very poor. Star wholly disappears at times. Doubtful if the observations are worth reducing.

Good agreement in intervals. Do not reject.

5 | 34.34

6.868

8 0.7

70) 480.7

s 6.867

$\delta = -60\ 24.6$

log	6.867	0.83677
"	cos δ	9.69354
"	15	1.17609
"	1 rev.	1.70640
	1 rev.	50.86

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Screw moved forward.

Reduced times Doolittle p. 491

β Octantis

15	7	34	5.7	6.4	121.0
20		36	7	7.4	120.3
25		38	7.5	7.7	120.9
0		40	8.5	8.6	121.5
5		42	10	10.1	120.9
10		44	11		120.5
15		46	11.5		121
20		48	12.5		118.2
25		—		2365	118.3
0		52	9		118.5
5		54	7.5		123.4
10		56	11	10.9	121.5
15		58	12.5	12.4	120.9
20		0	13.5	13.3	120.6
25		2	14.5	13.9	

120.534

24.108

28 7.5

70 | 1687.5

log	24.107	d .38215
"	cos δ	9.14750
"	15	1.17609
"	1 rev.	1.70574
	1 rev.	50.79

γ' Octantis

14	8	42	40
19		44	52
24			

very faint

too faint

not seen even without illumination

β Octantis

	22	35	25
	14	33	59
	8	1	26
		1	18
	8	0	8
		10	42
	7	49	26

time of transit

δ = −81 55.6

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Value of 1 rev. Micrometer Screw.

(Micrometer 13" equatorial attached to Rogers transit for use as zenith telescope.

		Wt.*	Star.	δ	rev.			
p. 110	50.″61	7	β Pavonis	−66.°6	65	Screw	turned	backward
110	50.83	8	λ' Octantis	−83.2	65	"	"	"
138	50.86	8	α Centauri	−60.4	70	def. pour	"	" forward
139	50.79	9	β Octantis	−81.9	70	"	"	"
142	50.94	7	α Crucis	−62.5	60	Partly cloudy	"	"
143	50.89	7	α Crucis	−62.5	65	"	"	"
143	50.86	5	β Centauri	−59.9	40	"	"	"
144	50.88	8	α Pavonis	−57.1	70	"	"	"
		59						

50.″83 unweighted mean

50.83 weighted mean Adopt.

* Weights were assigned depending upon number of revolutions of screw and upon star's declination as follows:

No of rev.	Decl.	Sum	Product of decimal by weight	
6	1	7	427	Adding values
6	2	8	664	on next page
7	1	8	688	704
7	2	9	711	720
6	1	7	658	4905
6	1	7	623	75)6329
4	1	5	430	84
7	1	8	704	
			59)4905	
			83	

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Additional observations were made at close of series to test value adopted, p. 160

Wt	Star	δ	rev.	
50.″88	8	α Crucis	−62.5	70 } good definition. Screw
50.90	8	β Centauri	−59.9	70 } moved forward

If these values are added to the preceding the value of 1rev becomes 50.″84. The reductions have been made with value 50.″83.

It is to be noted that near the middle of the screw, viz. between readings 20 + 24 the value is appreciably smaller than the average while between 25 + 29 it is correspondingly larger.

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1896phae.proj.11711

Oct. 30/96

α Crucis

24	9 29 52			good def.
29	30 29		37	
4	31 5.7		36.7	
9	42.3		36.6	
14	19.3		37.0	
19	55.7		36.4	$\delta = -62\ 31.5$
24	31.7		36.0	
29	[34] 9.5		37.8	36.79 / 7.368
4		—		
9		—		clouds not seen
14		—		
19		36.1 ?		very dimly
24	[37] 36	14 ?		seen

24 − 29 = 35 rev.

4 17.5

35) 257.5

log	7.357	0.86670
" cos δ		9.66404
" 15		1.17609
" 1 rev		1.70683
1 rev		50.91

24 − 24 = 60 rev.

7 22

60) 442.0

	7.367	0.86729
		9.66404
		1.17609
		1.70742
		50.98

Adopt 50.94

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Oct. 31/96 Value of 1 rev

α Crucis

19	9 24 19.2	36.8
24	56	36.8
29	32.8	36.5
4	9.3	36.9
9	46.2	36.8
14	—	36.8
19	59.8	34.4
24	34.2	39.0
29	13.2	36.6
4	49.8	37.4
9	27.2	36.2
14	3.4	36.9
19	40.3	36.9
24	32 17.2	———
		36.77
		7.3554

7 58.0

65)478.0

log	7.3454	0.86652
"	cos δ	9.66404
"	15	1.17609
"	1 rev	1.70665
	1 rev	50.89

β Centauri

19	5		
29	1 12.7	67.7	
9	20.2	67.5	
19	3 27.5	67.3	
29	4 35.2	67.7	
9	~	6.7555	cloudy
19	—		
24	—		δ = -59 52.5

4 30.2

40)270.2

log	6.7555	0.82963
"	cos δ	9.70061
"	15	1.17609
"	1 rev	1.70633
	1 rev.	50.86

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α Parmis Oct. 31/96 δ = -57 4.2

14	5h	19	48.4	
				62.6
24		20	51	
				62.2
4		21	53.2	
				62.5
14		22	55.7	
				59.8
24		23	55.5	
				64.7
4		25	0.2	
				62.3
14		26	2.5	
				62.7
24		27	5.2	dimi clouds
		7	16.8	62.40
		70)	436.8	6.24

log 6.240 = 0.79518
" cos δ 9.73529
" 15 1.17609
" 1 mv 1.70656
1 mv 50.88

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Nov. 2/96

	Micr.	Level N	S
δ Sculptoris	2.930	50.2	21.7
12 Ceti	clouds		

	Nov. 3/96 am.	N	S	
β Leonis	27.312	21.6	47.3	14^sec late
γ Centauri	22.295	52.7	22.5	14^sec " clouds
	35.017			
	17.508		−68.9	(Corr. for late time inappreciable)
			+ 75.2	
			+ 6.3	
			+ 1.6	

Nov. 3/96

γ Centauri

Reduction

l	340 45	δ'	+15 8 54.0
α^h	188 57	δ	−48 23 27.7
H	45 50	$\frac{1}{2}(\delta'+\delta')$	−16 37 16.85
$l+\alpha^h$	169 42	$\frac{1}{2}(m-m')$	+14 49.93
$H+\alpha^h$	234 47	$\frac{1}{2}(l+l')$	+2.21
$\log g$	1.3390	$\frac{1}{2}(z-z')$	+ .25
$\log \cos(l+\alpha^h)$	9.99294 n		−16 22 24.5
Σ_1	1.3319 n		
" h	1.2905		
" $\cos(H+\alpha^h)$	9.76093 n		
" $\sin\delta^\circ$	9.87370 n		
Σ_2	0.9251		
" i	0.7837		
" $\cos\delta^\circ$	9.82222		
Σ_3	0.6059		
$N_0\Sigma_1$	− 21.47		
$N_2\Sigma_2$	+ 8.42		
$N_3\Sigma_3$	+ 4.04		
Σ	−9.01		
δ_0	−48 23 18.69		
δ	−48 23 27.7		

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Pairs of Stars from American + English Ephemerides (no other catalogues at hand) suitable for zenith telescope work.

(E = English Ephemeris; all others in American)

Mag.	Star	α	δ	ℓ	h	Setting
5	22 Andromedæ	0 5	+45 30	61 53 N	28 7	28 20
3	β Hydri	0 20	−77 50	61 27 S	28 33	
4	ξ′ Ceti	2 7	+ 8 22	24 45 N	65 15	65 28
3 E	θ Eridani	2 54	−40 43	24 20 S	65 40	
4	c Persei	4 1	+47 26	63 49 N	26 11	26 4
6	δ Mensæ	4 25	−80 27	64 4 S	25 56	
4 E	ε Leporis	5 1	−22 31	6 8 S	83 52	83 36
2	κ Orionis	5 43	− 9 42	6 41 N	83 19	
3	ι Aurigæ	4 50	+33 0	49 23 N	40 37	40 37
4	δ Doradus	5 45	−65 46	49 23 S	40 37	
2	ε Orionis	5 31	− 1 16	17 15 7 39 N S	72 21	~~72 18~~
3	α Columbæ	5 36	−34 8	17 45 S	72 15	
6	ξ Mensæ	6 49	−80 42	64 19 S	25 41	25 44
6	26 Lyncis	7 47	+47 50	64 13 N	25 47	
2 E	ξ Argus	8 0	−39 42	23 19 S	66 41	66 45
~~4 E~~	ε Hydræ	8 41	+ 6 48	23 11 N	66 49	

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Mag.	Star	α	δ	ζ	h	Setting
3	15 Argus	8 3	−24 0	7 37 S	82 23	82 6
2	α Hydræ	9 22	−8 12	8 11 N	81 49	
5	γ Cancri	8 37	+21 51	38 14 N	51 46	51 54
2 E	δ Argus	8 42	−54 20	37 57 S	52 3	51 53
3 E	κ Argus	9 19	−54 34	38 11 S	51 49	
2 E	λ Argus	9 4	−43 1	26 38 S	63 22	63 18
4	o Leonis	9 36	+10 22	26 45 N	63 15	
3	ι Argus	9 14	−58 50	42 27 S	47 33	47 20
4	μ Leonis	9 47	+26 30	42 53 N	47 7	
2	β Argus	9 12	−69 17	52 54 S	37 6	36 56
5	10 Leonis Minoris	9 28	+36 52	53 15 N	36 45	
4	μ Leonis	9 47	+26 30	42 53 N	47 7	47 11
1-6	η Argus	10 41	−59 8	42 45 S	47 15	
2	β Leonis	11 44	+15 9	31 32 N	58 28	58 14
2 E	γ Centauri	12 36	−48 23	32 0 S	58 0	
3	ε Corvi	12 5	−22 2	5 39 S	84 21	84 18
1	α Virginis	13 20	−10 37	5 46 N	84 14	
3	γ Corvi	12 10	−16 58	0 35 S	89 25	89 29
3	δ^2 Corvi	12 24	−15 56	0 27 N	89 33	
4	δ Muscæ	12 55	−70 59	54 36 S	35 24	35 39
5	B.A.C. 4536	13 30	+37 43	54 6 N	35 54	

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Mag.	Star	α	δ	ζ	h	Setting
3	β Corvi	12 29	−22 49	~~6 5~~ ~~26 34~~ S	~~3 84~~ ~~34 26~~	83 54 ~~84 28~~
1	α Virginis	13 20	−10 37	5 46 N	84 14	
3	α Canum Ven.	12 51	+38 53	55 16 N	34 44	35 4
4	δ Muscæ	12 55	−70 59	54 36 S	35 24	
	δ Muscæ B.A.C. 4536 } see prec. page					
1	β Centauri	13 56	−59 52	43 29 S	46 31	46 18
3	ε Bootis	14 40	+27 31	43 54 N	46 6	
0	α Centauri	14 33	−60 24	44 1 S	45 59	46 21
3	ε Bootis	14 40	+27 31	43 54 N	46 6	46 7
4 E	ψ Bootis	15 0	+27 21	43 44 N	46 16	
3	δ Scorpii	15 54	−22 20	5 57 S	84 3	84 0
3	ζ Ophiuchi	16 31	−10 21	6 2 N	83 58	
3	θ Ophiuchi	17 16	−24 54	8 31 S	81 29	
4	b Ophiuchi	17 20	−24 5	7 42 N	82 18	81 54
4	l Aquilæ	18 30	− 8 19	8 4 N	81 56	
4	δ Aræ	17 22	−60 36	44 13 S	45 47	45 48
4	μ Herculis	17 42	+27 47	44 10 N	45 50	
3	γ^2 Sagittarii	17 59	−30 26	14 3 S	75 57	76 15
4	η Serpentis	18 16	− 2 56	13 27 N	76 33	
3	λ Sagittarii	18 22	−25 29	9 6 S	80 54	80 54
5	κ Aquilæ	19 31	− 7 16	9 7 N	80 53	

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Mag.	Star	α	δ	ℓ	h	Setting
4	ζ Pavonis	18 31	−71 31	55 8 S	34 52	34 54
0	α Lyræ	18 33	+38 41	55 4 N	34 56	
5	κ Aquilæ	19 31	−7 16	9 7 N	80 53	80 48
4	ψ Capricorni	20 40	−25 39	9 16 S	80 44	
3 E	α Indi	20 30	−47 39	31 16 S	58 44	58 24
4	α Delphini	20 35	+15 33	31 56 N	58 4	
4 E	ε Aquarii	20 42	−9 53	6 30 N	83 30	83 30
4	ζ Capricorni	21 21	−22 52	6 29 S	83 31	
3	β Pavonis	20 36	−66 35	50 12 S	39 48	39 55
3	ε Cygni	20 42	+33 35	49 58 N	40 2	40 10
4	γ Pavonis	21 18	−65 50	49 27 S	40 33	
4 E	ε Aquarii	20 42	−9 53	6 30 N	83 30	
5	μ Aquarii	20 47	−9 22	7 1 N	82 59	83 20
4	ζ Capricorni	21 21	−22 52	6 29 S	83 31	
3	ε Cygni	20 42	+33 35	49 58 N	40 2	40 18
4 E	γ Pavonis	21 18	−65 50	49 27 S	40 33	
2	α Gruis	22 2	−47 28	31 5 S	58 55	58 56
2	α Pegasi	23 0	+14 39	31 2 N	58 58	
4	α Lacertæ	22 27	+49 45	66 8 ~~33 32~~ N	23 52	24 10
4	β Octantis	22 35	−81 56	65 33 S	24 27	
5	δ Sculptoris	23 44	−28 42	12 19 S	77 41	77 55
6	12 Ceti	0 25	−4 32	11 51 N	78 9	

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Oct. 31/96 Draper Jr.

Cl E.

	λ Pegasi +23 1	λ Aquarii −8 8	α Peg. +14 39	ε Peg	γ' Andr. −.4
	0.8 32.7 −33.5 −.2	32.3 0.3 +32.6	b = −.06		32.2 0.3 +32.5
					1.3 33.0 −34.0
	45.3	29.3	48.7	38	—
	2.3	45.3	5.2	55.2	48 26
	18.7	0.3	20.4	11.3 15.7 52	—
	35	15.5	36	27.7 16.8 52	19
	51	30.5	51.3	43.8 14.5 54	12.5
	6.7	45.2	6.3	59.5 17.3 56	7
	48 23	54 0.2	6 21.5	22 15.8 15.4 58	2
	7 47 34.57	53 15.19	5 35.63	21 27.33	16.04
Red. to 8 44	−9.24	−8.31	−6.29	−3.69	+1.36
	7 47 25.33	53 6.88	5 29.34	21 23.64	52 17.40
	22 41 34.71	47 15.30	59 38.47	15 33.00	46 14.02
	9 5 50.62	51.58	50.87	50.64	63.38
	−.05	−.06	−.05	−.07	−.38
	.84	1.00	.89	.84	3.13

				Aa	Cc	Σ	ΔT	
0 = 5	50.57	+ΔT +.69 a	−1.09 c	+1.26	+.29	+1.55	−9 5	52.12
	51.52	+.14	−1.01	+.25	+.27	+.52		.04
	50.82	+.53	−1.03	+.96	+.28	+1.24		.06 52.86
	50.57	+.69	−1.09	+1.26	+.29	+1.55		.12
	63.00	−7.10	−7.76	−12.92	+2.10	−10.82		.18
	52.00	+.53 .18	+1.03 1.01	+.96 22	−.28 27	+.68 .06		52.88 06
	50.74	+.80	+1.14	+1.46	−.31	+1.15		51.89 51.98
	52.14	+.12	+1.01	+.22	−.27	−.05		52.09 52.13
	61.04	−4.17	+4.75	−7.59	−1.28	−8.87		52.17
	50.53	+.91	+1.19	+1.66	−.32	+1.34		51.87

−9 5 52.03 10

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$b = -.06$
$-.12$

Cl US

32.3 0.3 +32.6
0.8 32.5 −33.6 −0.2
+28 31 −9 24

1.0 33.0 −34.0
32.2 0.2 +32.4 −0.4

	33 Pis	α Andr	ν Ceti	β Hydri	π Androm
	8.6	0.5	1.3	2249.5	12.5
	23.5	17.7	28	24 1	30
	38.2	34.2	42.7	25 9.5	47.5
	58	51.3	17.8	26 20.5	5.3
	8	8.2	13	27 31	23.2
	23.2	25.2	28.3	28 42.5	41
6	39.2	9 428	20 44	29 57	38 0
5	53.39	8 51.41	19 58.11	26 21.57	9 37 5.64
	+3.58	+4.07	+5.89	+6.94	+8.70
					9 46 2.5
5	56.97	8 55.48	20 4.00	26 28.51	37 14.34
0	4.91	3 4.69	14 11.78	20 27.22	31 23.72
5	52.06	50.79	52.22	61.29	50.62
	−.06	−.05	−.08	−.25	−.19
	.99	.81	1.01	2.27	.78

$0 = 50.65 + \Delta T + .64a - 1.07c$
$63.00 \quad -7.10a - 7.76c$
$51.09 \quad +.75a + 1.12c$
$61.04 \quad -4.17 + 4.75c$

$0 = 12.35 - 7.74a - 6.69c$

$= 9.95 - 4.92a + 3.63c$
$5970 \quad 2952 \quad 2178$
$15.92 \quad -7.87a + 5.81c$
$23 \quad 11 \quad 8$

$0 = 15.69 - 7.76a + 5.73c$

$0 = 3.34 - .02a + 12.42c$

$c = -.27$

$7.74a = 14.16$ ~~+0.54~~ $\quad a = +1.83$

$4.92a = 8.97 \quad = +1.82$

8 44 0
−9 5 52.03
23 38 7.98
14 41 55.41
8 56 12.49
1 27.84
54 44.65
10 44.65
slow

9 46 2.5
10 44.65
9 56 47.15
1 38.04
14 41 55.41
0 40 20.68
30
9.40 fast

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Nov. 3/96 pm

S N

α Ursis 5.617 15.7 58.2
α Pegasi lost

22 Andromedae 2.663 → N S
β Hydri → 14.8 46.8 −61.6 knocked slightly
0.579 61.2 10.8 +72.0 bad of level in
27.916 +10.4
13.958 +2.6 reversing.

	Nov. 3	Nov. 4	Nov. 5	Nov. 6	Nov. 6	Nov. 7
	22 Andromedae	δ² Corvi	δ² Corvi	γ Centauri	δ Sculptoris	δ² Corvi
φ	340 49	340 54	341 7	341 20	341 27	341 ~~43~~ 3
α_0	1 14	186 7	186 7	188 57	35~~9~~ 6 ~~56~~ 0	186 ~~37~~ 7
H	~~45~~ 5 21	44 51	43 50	42 50	42 20	41 50
$\varphi+\alpha_0$	342 3	167 1	167 14	~~+00~~ 170 17	337 27	167 40
$H+\alpha_0$	46 35	230 58	229 57	231 47	38 20	227 57
log g	1.3392	1.3394	1.3398	1.3410	1.3416	1.3424
" $\cos(\varphi+\alpha_0)$	9.9783	9.9888 n	9.9891 n	9.9938 7 n	9.9655	9.9899 n
Σ_1	1.3175	1.3282 n	1.3289 n	1.3348 7 n	1.3071	1.3323 n
" h	1.2908	1.2912	1.2918	1.2924	1.2927	1.2930
" $\cos(H+\alpha_0)$	9.8372	9.7992 n	9.8085 n	9.7914 n	9.8946	9.8259 n
" $\sin\delta_0$	9.8532	9.4387 n	9.4387 n	9.8737 n	9.6815 n	9.4387 n
Σ_2	0.9812	0.5291	0.5390	0.9575	0.8688 n	0.5576
" i	0.7804	0.7769	0.7698	0.7624	0.7586	0.7547
" $\cos\delta_0$	9.8457	9.9830	9.9830	9.8222	9.9430	9.9830
Σ_3	0.6261	0.7599	0.7528	0.5846	0.7016	0.7377
No. 1	+ 20.77	− 21.29	− 21.33	21.61 ~~− 20.64~~	+ 20.28	− 21.49
2	+ 9.58	+ 3.38	+ 3.46	+ 9.07	~~+~~ 7.39	+ 3.61
3	+ 4.23	+ 5.75	+ 5.66	+ 3.84	+ 5.03	+ 5.47
Σ	34.58	− 12.16	− 12.21	− 8.70 ~~− 7.73~~	17.92 ~~+ 32.70~~	− 12.41
δ_0	+45 29 35.90	−15 56 10.51	10.51	−48 23 18.69	−28 42 18.77	−15 56 10.51
δ	+45 30 10 48	−15 56 22.67	22.72	23 27.39	42 ~~46.07~~ 0.85	66 22 92

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Nov. 4/96 a.m.

	Micrms	N	S			
~~γ Corvi~~						
γ Corvi	10.897	48.8	25.4	+74.2	-2.5	-0.6
δ^2 "	21.652	26.5	50.2	-76.7		
	10.755					
	5.378					

	Nov. 3	Nov. 4	Nov. 7	Nov. 7	Nov. 12
	22 Androm.	γ Corvi			
	β Hydri	δ^2 Corvi			
δ	-77 50 13.5	-16 57 63.7	ε Cygni	γ Pavonis	δ Sculptoris
δ'	+45 30 10.48	-15 56 22.67	341 37	341 37	342 1
½(δ+δ')	-16 10 1.5	-16 27 13.2	310 30	319 28	356 0
½(m-m')	-11 49.48	+4 33.36	41 27	41 27	36 23
½(l+l')	+3.59	-0.83	292 7	301 5	338 1
½(r-r')	-.75	.00	351 57	0 55	32 23
	-16 21 48.1	-16 22 40.7	1.3429	1.3429	1.3510
	reject on account of jarring of instr. as above noted.		9.5758	9.7129	9.9672
			0.9187	1.0558	1.3182
			1.2932	1.2932	1.2960
			9.9957	9.9999	9.9266
			9.7428	9.9602 n	9.6815 n
			1.0317	1.2533 n	0.9041 n
			0.7518	0.7518	0.7073
			9.9207	9.6121	9.9430
			0.6725	0.3639	9.6503
			+8.29	+11.37	+20.81
					-8.02
			+10.76	-17.92	+4.47
			+4.70	+2.31	
			+23.75	-4.24	+17.26
			+33 34 50.13	-65 50 11.31	-28 42 18.77
			35 13.88	50 15.55	42 1.51

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Nov. 4/96 pm

		N	S	
α Gruis	20.003	53.2	22.8	+76.0
α Pegasi	25.118	19.2	52.0	−71.2 +4.8 +1.2
	5.115			
	2.558			

In reversal instrument was jarred in getting pivots into their places

δ	−47	27	47.7
δ′	+14	38	72.5
½(δ+δ′)	−16	24	17.6
½(m−m′)		+2	10.02
½(l+l′)			+ 1.66
½(z−z′)			+ .03
	−16	22	5.9

reject because of jarring as above and because part of error used is between 20 + 25 where value is uncertain. See p. 141

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1896phae.proj.11711

Mar. 5/96 am

		N	S		
λ Argus	1,882	53.0	8.5		
10 Leonis Min	not seen	Just. too faint			
γ Corvi	20.807	20.2	42.0	−62.2	
δ² Corvi	10.267	43.3	21.5	+64.8	+2.6 +.65
	10.540				
	5.270				

δ	−16	58	3.8
δ′	−15	56	22.72
½(δ+δ′)	−16	27	13.3
½(m−m′)	+	4	27.87
½(l+l′)			+.91
½(r−r′)			.00
	−16	22	44.5

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Nov. 6/96 a.m.

			N	S		
β Leonis	29.716		41.3	15.0	+56.3	
γ Centauri	4.787		16.0	41.3	−57.3	−1.0 −0.25
	35.071					
	17.535					
α Leonis	20.176		21.7	51.3	−73.0	jarred telescope
α Pegasi	15.390		44.2	11.0	+55.2	badly in reversal
	4.786				−17.8	
	2.393				− 4.45	
δ Sculp.	2.510		50.2	15.8	+66.0	
12 Ceti	6.417		14.8	49.7	−64.5	+1.5 +11.4
	33.907					
	~~26.093~~					
	16.954					
	~~13.046~~					

	β Leonis γ Centauri		α Leonis α Pegasi		δ Sculptoris 12 Ceti	
δ	+15	8 53.4	+14	39 12.5	− 4	31 28.6
δ′	−48	23 18.7	−47	27 47.9	−28	42 ~~46.1~~ 0.8
½(δ+δ′)	−16	37 12.6	−16	24 17.7	−16	36 ~~37.4~~ 44.7
½(m−m′)	+14	51.30	+ 2	1.64	+14	~~3.13~~ 21.77
½(l+l′)	−	.34	−	5.84		+.55
½(z−z′)	+	.25	+	.03		+.25
φ	−16	22 21.4	21	21.9	22	~~11.6~~ 22.1

reject

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Nov 7/96 am

		N	S	
γ Corvi	21.473	24.5	48.0	−72.5
δ² "	10.214	48.8	26.7	+75.5
	11.259			
	5.630			

pm

α Indi	12.667	49.0	29.2	
α Delphini	not seen			
ε Cygni	24.885	24.5	56.0	
γ Pavonis	jarred ~~telescope~~ end of level in reversal.			
	27.997	60.3	22.0	
	33.112			
	16.656			
α Gruis	25.947	54.8	13.0	
α Pegasi	0.553	12.7	50.2	
	4.606		+67.8	
	2.303		−62.9	
			+ 4.9	
			+ 1.2	

+3.0 +0.75

Instrument reversed by two persons to prevent jarring. minor thread seems to be getting slack

	γ Corvi	ε Cygni	α Gruis
	δ² "	γ Pavonis	α Pegasi
δ	−15 56 22.9	+33 35 13.9	+14 39 12.5
δ'	−16 58 3.9	−65 50 15.6	−47 27 48.0
½(δ+δ')	−16 27 13.4	−16 7 30.8	−16 24 17.8
½(m−m')	+4 46.17	+14 1.54	+1 57.06
½(l+l')	+ 1.04		+ 1.66
½(z−z')	.00		+.03
φ	−16 22 26.2	reject on account of jarring as above.	−16 22 19.0

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Nov. 6/96. Draper Transit

35.6 3.0 +38.6 −5.1 −.39 ref.
0.5 33.0 −33.5 −1.3

0.2 32.4 −32.6 +.4 +.12
33.3 0.8 +34.1

Cl W	ϕ Aquarii	τ Pegasi	θ Piscium	ι Pisc.	γ Octantis	
	−6 36	+23 10	+5 48	+54		
	32	59.3	14.7	51.9 7.3	—	
	4.7	15.7	29.7	52.1 22.5	24 43	32.7
	1.7	31.3	44.3	52.4 37.2	—	
	16.7	47.4	59.2	— doubt	28 32	34.3
	31.5	4	14.2	52.4 7	30 28.5	35.2
	46.7	20.3	29.3	52,4 1722	32 24.8	35.1
	7 52 2.5	5 37.3	5 45.2	—	34 26	33.7
	7 51 16.87	57 47.90	4 59.51	16 52.24	28 34.20	
Red. to 8 36	−7.35	−6.28	−5.09	−3.14	−1.22	
	7 51 9.52	57 41.62	4 54.42	49.10	28 32.98	
	23 9 0.15	15 32.95	22 45.37	34 39.99	46 13.27	
	8 42 9.37	8.67	9.05	9.11	19.71	
	+.37	+.10	+.11	+.11	+.38	
	.99	.84	.93	.93	3.13	

				a	ΔT		
0 =	42 9.49	+ΔT	+.17 a	+1.01 c	+.25	−8 42 9.74	
	8.77		+.69	+1.09	+1.01	9.78	
	9.16		.38	+1.01	+.55	9.71	9.76
	9.22		.37	+1.00	+.54	9.76	
	20.09		−7.10	+7.76	−10.36	9.73]	
	9.29		+.53 (18)	−1.03 (1.01)	−.06	9.23	
	9.20		+.53	−1.03	−.19	9.01	
	7.41		−4.17	−4.75	+1.50	8.91]	9.02
	9.12		+.91	−1.19	−.33	8.79	
	9.06		−.04	−1.06	+.01	9.05	
							9.38

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jarred in reversal

cl Σ

32.8 0.2 +33.0 +.1 +.03 0.4 33.0 −33.4 −.1 −.03
0.0 32.7 −32.7 32.3 0.6 +32.9

	ω Piscium	γ Pegasi	β Hydri	π Androm	β Ceti
	−6 17		−77 50		−18 33
	27.5	16.9	—	32.5	—
	43.3	33.2	— clouds	57.1	— clouds
	58.2	48.3	1 20 29.4	9.3	28.3 12.8
	13.2	4	2 32 ? 30.6	27.2	28.5 28.8
	28	19.4	3 42 29.8	44.7	28.4 44.5
	42.7	34.4	4 51 30.4	2.3	28.3 59.7
	43 57.7	50 49.7	6 1.5 29.7	14 19.8	28.2 21 15.5 ?
	43 12.94	50 3.70	2 29.98	13 26.69	7 37 29.5 =
	+1.19	+2.31	+4.35	+6.15	22 55 5
	43 14.13	50 6.01	2 34.33	13 32.84	20 28.34
	0 4.87	7 56.83	20 26.86	31 23.70	+7.30
	9.26	9.18	7.47	9/14	
	+.03	+.02	−.06	−.02	20 35.64
	.99	.89	2.27	.78	38 26.55
					9.09
					−.03

0 = 9.05 + ΔT + .48a + 1.03c — 8 36 0 — 7 37 29.5 — 1.06

20.09 + ΔT − 7.10a + 7.76c — − 8 42 9.38 — 10 49.04

9.16 + ΔT + .72a′ − 1.11c — 23 53 50.62 — 7 48 18.54

7.41 + ΔT − 4.17a′ − 4.75c — 15 5 34.74 — 1 16.93

15 5 34.74

c = −.10 — 8 48 15.88 — ~~23 53 50.62~~ 55 10.21

= +.12 adopt .00 — 1 26.54 — 22 ~~43 26.89~~

0 = 11.04 − 7.58a a = +1.46 — 8 46 49.04 — 5

= 1.75 + 4.89a′ a′ = −.36 — 10 49.04 — 5.21 slow

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Nov. 11/96

Micr.	α Crucis				β Centauri			
14	8	40	21.3	73.5	10	16	9.7	67.6
24		41	34.8	72.7		17	17.3	67.0
4		42	47.5	74.2		18	24.3	68.4
14		44	1.7			19	32.7	667
19		44	38.4			20	6.3	
24		45	14.2			20	39.4	68.4
29		45	52			21	13.8	67.5
34		46	28.8	73.6		21	47.8	67.8
14		47	42.4			22	55.3	
19		48	19.4			23	29.5	
24		48	56			24	3	

36.7 36.8 36.3 36.4 37.1 37.1 36.7 35.8 37.8 36.8 36.8 36.8 37.0 36.6

36.76

7.352

6763

8 34.7

70) 514.7

log	7.353	0.86646
" cos δ		9.66404
" 15		1.17609
" 1 rev		1.70659
1 rev		50.88

7 53.3

70) 473.3

log	6.761	0.83001
" cos δ		9.70061
" 15		1.17609
" 1 rev		1.70671
1 rev		50.90

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Results.

Value of latitude by zenith ~~distance~~ telescope method, using Rogers transit with micrometer of 13" equatorial attached, and with its striding level attached to finding circle for latitude level.

			Wt.	Stars	Zen Dist	Δz (½ m.mi.)	Time Int.
p 105	-16 22	40."6	~~6~~ 4	α Leonis + α Pegasi	A 31°	+1.'6	58m
106		34.9	~~5~~ 3	α Aquil + α Delphini	B 32°	−19.4	5
145		24.5	~~4~~ 2	β Leonis + γ Centauri	C 32°	+14.8	52
153		40.7	18	γ Corvi + δ² Corvi	D 1°	+4.6	14
155		44.5	18	" "	1°	+4.5	14
156		21.4	~~4~~ 2	β Leonis + γ Centauri	32°	+14.9	52
156		~~11.8~~ 22.1	~~5~~ 4	δ Sculptoris + 12 Ceti	E 12°	+14.4	41
157		26.2	18	γ Corvi + δ² Corvi	1°	+4.8	14
157		19.0	~~6~~ 4	α Leonis + α Pegasi	31°	+2.0	58
		29.9	~~73~~	Unweighted mean.			
		34.6		Weighted "			

In combining, weights were assigned on the following plan:

Pair	Zen Dist	Δz	Time Int.	Product
A	1	4	1	~~6~~ 4
B	1	1	3	~~5~~ 3
C	1	2	1	~~4~~ 2
D	3	3	2	18
E	2	2	1	~~5~~ 4

v	vv	pvv
~~6.3~~ 6.7	3969	15876
0.3	9	27
10.1	10201	20402
6.1	3721	66978
9.9	9801	176418
13.2	17424	348 48
12.5	15625	62500
8.4	7056	127008
15.6	24336	97344
	601401	
	√ = 77.6	
	3.0	
	2.0	

Wt × "	v	vv	pvv
~~24~~ 36	9.2	84.64	~~507.84~~
17 45	3.5	12.25	61.25
9 80	6.9	47.61	190.44
32 56	9.3	86.49	691.92
35 60	13.1	171.61	1372.88
8 56	10.0	100.00	400.00
11.05			
~~7 40~~	9.3	86.49	432.45
20 96	5.2	27.04	216.32
11 40	12.4	153.76	922.56
17174 p.162			
54) 10809	4.5	20.25	104.25
31.8			~~896.91~~
Rel. to p. 163 = 31.4			√ = 70.0
59 k / 9 m-1			23) 70.0
5.31			⅔ × 3.0
√ = 23			h_0 = 2."0

Unweighted mean −16 22 30

Weighted mean ~~35 ± x"~~ Adopt

→ −16 22 35 ± 2

Remarks on following page.

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The preceding results are evidently unsatisfactory and the resulting value of the latitude uncertain. It will be noticed that the probable error is the same as that of the determination by sextant (p. 39) which is intolerable in a zenith telescope. The probable error by this instrument should be not more than 0."1 (See Doolittle.).

The instrument was not designed for zenith telescope work. It was adapted for it by attaching the striding level to an improvised setting vernier, and by using the micrometer of the 13" equatorial at the eye end. The failure of the instrument to do reliable work is apparently due to the following:-

(1) The lack of reversing apparatus. It was very difficult to reverse the telescope without jarring it, or striking the level against the mounting, and all observations were rejected (6 in number) when jarring was evident to observer at the time of observation.

(2) Micrometer screw does not work easily. The spiral springs are not strong enough to keep the screw always moving regularly, (even though they were greatly strengthened by the insertion of brass pieces which shortened the springs, and all moving parts were kept well oiled.)

(3) The setting level was mounted firmly upon the improvised setting vernier, but possibly it was not as stable as required. Still in the long waits of some of the pairs it moved over a few divisions only. It was clamped directly to the axis and not to the setting circle which was independently clamped to the axis.

(4) The interval of time between the two stars of a pair was in several pairs too long to assume the stability of the instrument. In the lack of star catalogues in the Observatory library, the adoption of such pairs seemed unavoidable.

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Nov. 12/96 fm

		N	S	
δ Sculp.	18.197	14.7	53.6	Reversed by two
12 Ceti	21.669	64.8	25.0	persons.
		−68.3		
	33.472	+89.8		
		+21.5		
	16.736	+5.4		

δ	−4 31 29.1
δ′	−28 42 1.5
½(δ+δ′)	−16 36 45.3
½(m−m′)	+14 10.69
½(l+l′)	+7.45
½(r−r′)	+.25
φ	−16 22 26.9

In order to ascertain the cause of the change of value from about 40″ to about 20″ between Nov. 5 & 6, a careful examination was made to see if anything had become loose, but nothing was found out of order. The value of the screw was then redetermined, (p 160) the result agreeing with former determinations (p 141) and another pair observed as above, which agreed with the observations of Nov. 6 & 7. The change of value seems therefore unexplained and may be a mere coincidence.

If 50″.84 had been used for value of 1 rev. the resulting latitude would have been −16 22 27. If the discrepancy between a minus Δz and a plus be ascribed to error in the adopted value of 1 rev (which was determined with the micrometer in a horizontal position) the corrected value would be −16 22 32

From this discussion it results, that these observations must be regarded as giving only an approximate value of the latitude, of no more value than the former extant determination, and to be rejected whenever a more accurate determination is made. The approximate value of the latitude is −16° 22′ 35″ ± 2″ or combining with extant value p. 39

−16° 22′ ~~26~~ 30″; by weight −16 22 30.7 ± 3.6

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−32.5	+34.3						
+35.1	−32.5						
+0.6	+.4						
+.18	+.12						
	+.15						

Mrr. 12/96 Draper Tourist

33.1 0.9 +34.0 +0.2 =.06
0.5 32.0 33.3 1.0
1.5 32.7 −33.2
33.6 1.5 0.2 32.3

cl E	φ tg.	ε Regaci	θ Pisc.	ε Pisc.	γ Octantis	
	53.6	21.7	36.7	29.3 ?	− 58	51.5
	9.5	38.8	52.4	45.2	14.8 0	54
	24.4	58.2	7.6	0.2	14.8 2	49.5
	39.5	11.3	22.5	15.2	14.9 4	46
	54.4	27.5	37.3	30.1	14.9 6	42
	9.2	43.2	52.2	44.7	15.1 8	33
7 28	24.2	34 59.3	42 7.2	59.7	15.1 10	30
	27 39.26	34 11.00	41 22.27	[53] 14.93	4	43.71
Red. to 8.09	−6.79	− 5.72	− 4.54	−2.59		− 0.70
	7 27 32.47	34 5.28	41 17.73	53 12.34	4	43.01
	23 9 0.09	15 32.88	22 45.31	34 39.95	46	12.43
	8 18 32.38	32.40	32.42	32.39		30.58
	+.06	+.05	+.08	+.09		+.46
	.99	.84	.93	.93		3.13

				Δa	Cε	Σ	ΔT
0 =	18	32.44	+ΔT +.17a −1.01ε	−.01	+.12	+.11	32.55
		32.45	+.69 −1.09	−.06	+.13	+.07	.52
		32.50	+.38 −1.01	−.03	+.12	+.09	.59
		32.48	+.37 −1.00	−.03	+.12	+.09	.57
		31.04	−7.10 −7.76	+.57	+.93	+1.50	.54]
		32.72	+.18 +1.01	−.01	−.12	−.13	.59
		32.75	+.80 +1.14	−.06	−.14	−.20	.55
		32.67	+.53 +1.03	−.04	−.12	−.16	.51
		32.72	−4.17 +4.75	+.33	−.57	−.24	.48]
		—	+.91 +1.19				

− 8 18 32.55

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1896phae.proj.11711

1.3 33.2 −34.5 — 33.3 1.2 +34.5 $+0.2^{35}$ = +.08
33.4 1.4 +34.8 + .1 = +.03 — 0.7 32.8 −33.5
+28 32

Cl W

	33 Psc	α Andr	γ Peg	β Hydri	π And.
	51	44.5	40.5	—	58
	6.2?	1.4	55.9	36 33 53.6	15.8
	20.8	18	10.8	37 42.5 54.7	32.8
	35.5?	35	26.3	38 52.5 53.9	50.7
	50.7	52	41.7	39 58 48.6*	8.7
	5.8	9	57.3	41 9. 48.6	26.5
19	21.5	22 26.8	27 13.3	42 23.5 47.9	50 45.8
18	35.93	21 35.24	26 26.54	38 54.07	49 51.11
	+1.58	+2.07	+2.87	+4.91	+6.71
18	37.51	21 37.31	26 29.41	58.98	49 57.82
0	4.82	3 4.60	7 56.78	20 26.44	31 23.65
	32.69	32.71	32.63	32.54	34.17*
	+.03	+.04	+.04	+.18	8 55 13.5 =
	.99	.81	.89	2.27 .78	0 36 35

* A change in azimuth here due to jarring end of telescope in removing level.

0 = 32.48 + ΔT + .48 a − 1.03 c — 8 9 0 — 8 55 13.50
31.04 −7.10 a − 7.76 c — −8 18 32.55 — 10 51.26
32.71 +.66 a′ + 1.08 c — 23 50 27.45 — 9 6 5.16
32.72 −4.17 a′ + 4.75 c — 15 29 14.08 — 1 29.71
c = −.14, −.10, −.11 } −.12 — 8 21 13.37 — 15 29 14.08
1 22.11 — 0 36 48.95
0 = 1.44 + 7.58 a + 6.73 c — 19 51.26 — 36 35
= 0.01 − 4.83 a′ + 3.67 c — slow 10 51.26 — +13.95 slow

7.58 a = −.63
a = −.08
4.83 a′ = −.43
a′ = −.09

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Moon culmination

Nov. 13/96

b = +.21
.21
.30
+.24 adopt.

−33.6 1.3 32.3 33.3 2.0 +35.3
+36.3 33.6 2.7 0.5 32.0 −32.5
+.7 +.7

dW

	+0 51	−11 13	−4 46				−5 6	−5 22	
	π Ag	δ Ag.	κ Ag	β Ori.	BAC 7951		Moon	BAC 7993	
	8.2 very faint	17.3	30.3	—	—		39.5	—	
	23	32.4	45.3	—	—		54.7	43.8	14.2
	37.5	47.3	59.9	very faint	—		9.7	43.7	28.5
	52.3	2.5	47 14.7	52 11.5	—		24.7	44.1	43.7
	7.3	17.7	29.7	37.5	34.3		40	44.1	58.7
	22.3	33	44.8	53 58	27.0	49.4	55.7	44.1	13.7
6	35 38.2	49	0.7	55 51	27.8	5.0	5 11.3	44.1 7	29.1
6	34 52.69	40 2.74	47 14.06	50 27.43		rej.	4 25.09	6	43.98
Red to 7	18 −7.08	−6.23	−5.04	−4.52			−2.23		−1.85
	34 45.61	39 56.51	47 10.02	50 22.91			4 22.86	6	42.13
	20 1.45	25 12.31	32 25.96	35 37.44				51	57.91
	14 44.16	44.20	44.06	45.47					44.22
	+.23	+.24	+.24	+.71					+.24
	.95	1.02	.98	2.95					.99

				Aa	Cc	Σ	ΔT	
0 =	14 44.39	+ΔT	+.30a +1.00c	+.03	−.18	−.15	44.24	
	44.44		+.09 +1.02	+.01	−.18	−.17	.27	
	44.30		+.20 +1.00	+.02	−.18	−.16	.14	
	46.18		−6.48 +7.12	−.71	−1.28	−1.99	.19	
	44.46		+.19 +1.00	+.02	−.18	−.16	.30	44.23
	44.51		+.19 +1.00	+.02	−.18	−.16	.35	
	44.12		+.53 +1.03	+.13	−.19	−.06	.06	
	43.92		+.17 ∓1.01	+.04	+.18	+.22	.14	
	43.86		+.69 ∓1.09	+.17	+.20	+.27	.23	
	44.04		+.38 ∓1.01	+.10	+.18	+.28	.32	44.22
	44.08		+.37 ∓1.00	+.09	+.18	+.27	.35	
	44.63		−7.10 ∓7.76	−1.78	+1.40	−.38	.25	

Adopt − 8 14 44.22

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$b = +.09 \; +.12 \; +.08$ / $+.10$ adopt

+35.6 −31.8 + 1.0 / −5 16 — 33.8 1.8 / −0.2 32.0 — +14 39 — cE — 0.2 32.7 −32.9 / 33.2 0.8 +34.0 + .3 — 33.1 0.6 +33.7 / −0.2 32.2 −32.0 + .4 — 0.5 33.0 −33.5 / 33.5 1.0 +34.5 + .25

BtC 8017	c Reg.	q Reg.	r Reg.	θ Pisc.	ε Pisc.	y' Octantis
13.1	36.7	57.3	25.4	40.6	33.3	54 58
28.2	52.3	13	42.4	57.2	49.1	56 59
42.7	7.2	28.2	58.7	11.3	4	58 56
57.7	22.6	43.2	15	26.4	19.2	0 51.5
12.6	38	58.2	31	41.3	34	2 47.5
27.7	53.5	13.X	46.8	57.8	48.5	4 39.5
11 43.4	15 9.5	24 27.8	31 3.2	38 10.8	50 34	6 35.5
10 57.91	14 22.83	23 42.96	30 14.64	37 26.06	49 18.79	0 49.57
−1.16	−0.59	+0.94	+2.01	+3.19	+5.14	+7.04
10 56.75	14 22.24	23 43.90	30 16.65	37 29.25	49 23.93	0 56.61
56 12.48	59 38.33	8 0.08	15 32.87	22 45.30	34 39.94	46 12.29
44.27	43.91	43.82	43.78	43.95	43.99	44.32
+.24	+.21	+.10	+.08	+.09	+.09	+.31
.99	.89	.99	.84	.93	.93	3.13

$0 = 44.37 + \Delta T + .25a + 1.01c$

$46.18 \quad -6.48a + 7.12c$

$43.98 \quad +.70a \mp 1.03c$

$44.63 \quad -7.10a \mp 7.76c$

$0 = 1.81 - 6.75a + 6.11c$

$= 0.65 - 7.50a \mp 6.73c$

$c = \mp .19, \mp .16, \mp .25, \mp .12 \} \mp .18$

$6.73\,a = 0.71 \quad a = +.11$

$7.50\,a' = 1.86 \quad a' = +.25$

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Reduction for longitude

Special stars from 1897 Occulation list.

Corr. for precession (Prec. = $3^s.07265 + [0.12606 \sin\alpha_0 \tan\delta_0$

	α_0	δ_0	log sin α_0	log tan δ (+ Cont tan δ)	log Corr.	Corr.	Prec.
K Aquarii	338 6	−4 45.6	9.57 ~~35~~ 169 8n	8.92049n (9.04655n)	8.61824	.0415	3.114
BAC 7993	342 59	−5 21.6	9.46 ~~57~~ 635 4n	8.97231n (9.09837n)	8.56472	.0367	3.109
" 8017	344 3	−5 16.0	9.43901n	8.96464n (9.09070n)	8.52971	.0339	3.107

	Aff. Pl.	Star	α_0 1897	Corr. Prec.	$\Delta\alpha$ Aff. Pl.	ε	Aff. Pl.
	K Aquarii	K Aquarii	22 32 25.390	−3.114	+3.668	+0.57	25.96
η	342 2	BAC 7993	22 51 57.253	−3.209	+3.77x	+0.66	57.91
α	338 6	" 8017	22 56 11.8	−3.107	+3.79x	+0.68	12.48
H	35 28	* Epl. 1896 Occultations					
η+d	320 8						
H+d	13 34	δ −5 18.7		log cos($\phi'-\delta$)	9.99201		
log sin(η+d)	9.8069n	π 54 46 = 3286		" sin π	3.51667 4.68557		
" tan δ	8.9205n	λ .0300		" ρ	9.99988		
" η	1.3517	S 61.93		Σ	8.19413		
" $\frac{1}{15}$	8.8239	ϕ' −16 16.1		N_3	.01564		
" h	1.2972	$\phi'-\delta$ −10 57.4		A_1	0.98436		
" sin (H+d)	9.3703	log sin(") 9.27890n		$1-\lambda$	0.97000		
" sec δ	0.0015	" π 3.51667		" (")	9.98677		
" I	8.9030	" ρ 9.99988		" B_1	0.01323		
" II	9.4929	" $\frac{1}{60}$ 8.22185		" A_1	9.99315		
f	3.277	Σ 1.01730n		" F cos δ	0.00638		
I	.080	$\Delta\delta$ 10.4		F cos δ	1.015		
II	.311	δ' −5 8.3					
$\Delta\alpha$	3.668						

By Wash. Ephem. Diff / hr. long = $111^s.05$

α Greg. 22 50 40.60

α Wash 51 21.34

Δ −40.74

Δ long. $-0^h.3669 = 22^m\ 0^s.84$

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$$\alpha = \alpha' + T - T' + \Delta T - \Delta T' + (A\cos\delta - A')a + (B\cos\delta - B')b + (C\cos\delta - d')c \pm \frac{S}{15(1-\lambda)\cos\delta}$$

	Moon		π Aquarii	σ Aquarii	κ Aquarii	BAC 7993	BAC 8017
δ	−5 8		+0 51	−11 13	−4 46	−5 22	−5 16
A ($A\cos\delta$)	.196	.199	.295 .293	.092	.202	.192	.194
B	.985	1.000	.955	1.015	.983	.986	.985
C	1.004	1.019	1.000	1.019	1.004	1.005	1.004
a=+.11 ΔA			−.096	+.107	−.003	+.007	+.005
b=+.24 ΔB			+.045	−.015	+.017	+.014	+.015
c=−.18 ΔC			+.019	.000	+.015	+.014	+.015
ΔAa			−.011	+.012	−.000	+.001	+.001
ΔBb			+.011	−.004	+.004	+.003	+.004
ΔCc			−.003	.000	−.003	−.003	−.003
$\Delta T - \Delta T'$			+4.853	+4.004	+2.820	−0.381	−1.076
Σ			+4.85	+4.01	+2.82	−0.38	−1.07
S term			+1 1.93	+1 1.93	+1 1.93	+1 1.93	+1 1.93
$T - T'$			+29 32.40	+24 22.35	+17 10.03	−2 18.89	−6 32.82
Σ			+30 39.18	+25 28.29	+18 14.78	−1 17.34	−5 31.96
α'			22 20 1.45	25 12.31	32 25.96	51 $\frac{57}{44.91}$	56 12.48
α			22 50 40.63	40.60	40.64	40.$\frac{57}{25}$	40.52

½ wt. See p. 168–20 to tenths only

Mean α	22 50 40.60	log 60	1.77815	x'	149.59
A_1	50 36.11	" $(A - A_1)$	0.65225	x''	.00
ΔA	1.8009	" $\frac{1}{\Delta A}$	9.74451	Gr. M. Time	12 2 29.59
$A - A_1$ ΔA	+4.49	" x	2.17491		
δA	−.0026	" x^2	4.34982	Avg. Sid. Time	22 50 40.60
		" $\frac{1}{7200}$	6.14267	" " noon	15 33 10.67
Wash. Long	5 8 12.04	" δA	7.41497n	" Int	7 17 29.93
Δ long	−22 0.84	" $\frac{1}{\Delta A}$	9.74451	Corr. & Mean	1 11.67
		−2 = " x''	7.65197	Avg. M. Time	7 16 18.26
Δ long	4 46 11.20 by Wash. Ephem.			Δ Long.	4 46 11.33 by Greenw. Ephem.

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$b = -\frac{1.14}{1.00}$
-1.07

Nov. 20/96 Rogers Transit

30.0 59.8 −89.8 −49.8 30.0 12.0 +42.0
35.2 4.8 +40.0 −12.4 33.5 52.0 −85.5
−43.5
−10.9

	α Peisc.	γ' Octantis	33 Peisc	α Andr.		
Cl. W	58.5	—	24.0	—		
	4.4	30 12.5	45.8	—		
	25.2	31 32.5	55.7	7.3	B_3	7.3
	46	32 53	6.2	19.2	4	7.3
	6.7	34 13.5	16.5	31	5	7.3
	27.6	35 34	26.7	54.5	C_1	7.2
7	22 41.5	—	47 47.7	10.3	3	7.1
				51 26	5	7.1
	7 21 45.99	32 53.10	47 6.01	50 7.22		
Red. to 7 52	− 4.97	− 3.27	− 0.80	− 0.31		
	7 21 41.02	32 49.83	47 5.21	50 6.91		
	23 34 39.87	46 11.25	0 4.78	3 4.53		
	7 46 61.15	38.58	60.43	62.38		
Bl.	− 1.00	− 3.35	− 1.06	− .87		
	.93	3.13	.99	.81		

				A_a	C_a	Σ	ΔT		
$0 =$	60.05	$+\Delta T$	$+.37a$	$+1.00c$	-1.20	$+.10$	-1.10	−7 46 58.95	
	35.23		−7.10	+7.76	+23.00	+.78	+23.78	59.01	
	59.37		+.18	+1.01	− .58	+.10	− .48	58.89	58.96
	61.51		+.80	+1.14	− 2.59	+.11	− 2.48	59.03	
	45.26		−4.17	−4.75	+13.51	−.48	+13.03	58.29	
	62.30		+ .91	−1.19	− 2.95	−.12	− 3.07	59.23	
	59.04		− .04	−1.05	+ .13	−.10	+ .03	59.07	59.20
	60.69		+ .40	−1.01	− 1.30	−.10	−1.40	59.29	

−7 46 59.08

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$b = +.47$
$+.46$
$+.46$

	W				E			
15.8	34.3	−50.1	+20.5	16.8	38.3	−55.1	+20.2
46.3	24.3	+70.6	+5.1	49.0	26.3	+75.3	+5.0

Cl E.

	β Hydri		π Andr.	β Ceti	δ Peac			
5	29	3, 7.8	15.2	36	19.5		8 40	48
6	18.5	27.9	31.6	57.7	33.7		0 53	30
7	8	38.0	58.4	8.5	54.5		II	
	–		21.3	19.7	153	including first corr.		
	46	57.2	46.1	30.6	36	Cl. W +.38 × .94 = .36		
10	24	C, 6.9	10.7	41.3	57	Cl E −.38 × .85 = .32		
		19	27.1	26 3	31 11			

$0 = 61.14 + \Delta T + .58a + 1.07c$
$36.42 \quad -7.10a + 7.76c$
$= 61.18 \quad +.66a - 1.10c$
$= 44.40 \quad -4.17a - 4.75c$

7	7.56	18 21.20	25 19.54	30 15.29	$0 = 24.72 + 7.68a - 6.69c$
	+ 2.49	+ 4.33	+ 5.48	+ 6.28	$= 16.78 + 4.83a + 3.65c$
					$30.18 + 8.69a + 6.57c$
7	10.05	18 25.53	25 25.02	30 21.57	$30.78 + 8.86a + 6.70c$
20	25.83	31 23.59	38 26.46	43 21.30	$0 = 55.50 + 16.54a$
					$a = -3.36$
46	44.22	61.94	58.56	60.27	$c = -.17$
	+ 1.04	+ .36	+ .48	+ .42	61.14 61.18
					− 1.95 − 2.22
	2.27	.78	1.05	.92	− .18 + .18
					59.01 59.14

59.08 as before

I (neglecting first corr)

$0 = 60.78 + \Delta T + .58a + 1.07c$
$35.23 \quad -7.10a + 7.76c$
$= 61.50 + \Delta T + .66a - 1.10c$
$45.26 \quad -4.17a - 4.75c$
$= 25.55 + 7.68a - 6.69c$
$= 15.24 + 4.83a + 3.65c$
$12\ 192 \quad 8\ 864 \quad 2\ 920$
$= 27.43 + 8.69a + 6.57c$
$55 \quad 17 \quad 11$
$= 27.98 + 8.86a + 6.68c$
$= 53.53 + 16.54a$
$a = -3.24$
$c = +.10$

7	52	0		8 40	48
−7	46	59.08		+10	55.02
0	5	0.92		8 51	43.02
16	0	46.57		1	27.35
8	4	14.35		16 0	46.57
	1	19.83		0 53	56.94
8	2	55.02		53	30
	+10	55.02 slow			+26.94 slow

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Adjusted az. m γ' Octantis.

Level at one end
Adjusted and began ob. again
Nov. 25/96

W E
-10.8 16.7

3.3 Risc		γ Peg.		α Andr.	74	46.0	β Ceti
38	Z_2	7.7	56	β Hydri			34.6
14.5	3	21.9	13.2	45	55		49.1
24.7	4	43.4	38.8		44.5		11.2
35.2	5	4.8	4.5	47	33.5		32.7
56	C_1	26.3	30.4		22.7		54.8
9.9	3	47.5	56	49	12		16.2
7 28	23.7	5	36 1.9	41	13.2		6 31.1

-18 33
87 +9

8 5 32.81

Red to 36 -5.00

8 5 27.81

	Aa	Cc	E	ΔT			
0 = 7 27 2.46	+ ΔT −.04 a	− 1.05 c	+.00	−.21	−.21	2.25	0 38 26.42
2.68	+.40	−1.01	−.05	−.20	−.25	2.43	7 27 1.39
2.53	+1.03	−1.27	−.12	−.25	−.37	2.06	+1.07
2.62	+.41	−1.01	−.05	−.20	−.25	2.37	1.05
2.63	−2.28	−2.85	+.27	−.57	−.30	2.33	2.28
1.47	−2.28	+2.85	+.27	+.57	+.84	2.31	
2.15	+.54	+1.03	−.06	+.21	+.15	2.32	2.33
2.12	+.48	+1.02	−.06	+.20	+.14	2.26	
2.14	+.37	+1.00	−.04	+.20	+.16	2.30	
2.30	+.43	+1.01	−.05	+.20	+.15	2.45	

ΔT = − 7 27 2.30

.88 × .38 = .33
.91 × .38 = .35

II mid. first corr.

0 = −0.14 / ~~2.59~~ − 5.70 c c = −.02 / ~~+.45~~

0 = 2.28 + ΔT + .61 a − 1.10 c
1.98 − 2.28 a − 2.85 c
= 2.53 + .45 a + 1.02 c
2.12 − 2.28 a + 2.85 a

0 = 0.30 + 2.89 a + 1.75 c
= 0.41 + 2.73 a' − 1.83 c

2.89 a = −.26 a = −.09
2.73 a' = −.45 −.17 } −.13

2.28	2.53
− .08	− .06
+ .02	− .02
2.22	2.45

2.34 adopt

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9 15 30
1 48 30

-21.8 -28.3
- 5.4 - 7.1
- .50 - .65
-.58

+42.3 +46.0
+10.6 +11.5
.98 1.06
b = + 1.02

Reversed on this star

29.0 49.2 -78.2
35.2 14.7 +49.9
4 58 8 38

W	E							
11.7	30.7	-42.4	-40.0	10.5	29.5	35.8	16.7	+52.5
51.5	33.2	+84.7	+86.0	52.5	33.5	27.3	47.0	-74.3

δ Pisc.	μ Andr.	ε Pis	κ Tuc.	α W κ Tuc	η Pis	π Pis	ν Pis	ο Pis
31.5	15.3	44.7	4.5 A	20.7	22		22.3	14.2
45.5	41.5	58.7	23.8 group	40 α group	16.6	17.3	43	35.2
6.3	54.5	19.5	36 43.3	42 0	38.1	27.8	53.2	45.6
27.3	7.6	40.5	35	19.5	59.2	38.4	3.7	56.3
48.1	21	1.3	23	42 39.2	20.7	49	14.2	66
8.8	34.2	22.3	36 43.62	41 59.88	42.2	5859.6	24.6	17.2
11 23	19 0.2	36.2	+ 0.12	+ 0.99	53 56.5		3 45.5	7 38
10 27.21	18 7.76	[24] 40.46	36 43.74	42 0.87	52 59.36	58 38.42	3 3.79	6 56.27
- 4.20	- 2.93	- 1.86	+1.74	-.99	+2.79	+3.72	+ 4.45	+ 5.08
10 23.01	18 4.83	24 38.60	36 45.48 39	41 59.88 39	53 2.15	58 42.14	3 8.24	7 1.35
43 21.27	51 3.05	57 36.92	12 20.63	12 20.63	25 59.46	31 39.50	36 5.56	39 58.52
1.74	1.78	1.68	2.63	1.47	2.69	2.64	2.68	2.83
+.94	+.75	+.94	+1.89 -.65	+.34 +.65	-.52	-.52	-.54	-.53
.92	.74	.92	1.71	1.71	.89	.90	.93	.92

3.72 2.59 1.13

I neglecting print error.

$0 = 1.16 - 5.70c$

$c = +.20$

$0 = 2.6\frac{1}{2} + \Delta T + .61a - 1.10c$

$2.63 \quad -2.28a - 2.85c$

$= 2.18 \quad +.45a + 1.02c$

$1.47 \quad -2.28a + 2.85c$

$0 = 0.02 - 2.89a - 1.75c$

$= 0.71 + 2.73a' - 1.88c$

$2.89a = -.33$

$2.73a' \quad -.34$

$a = -.12$

8 36 0
-7 27 2.3 4
1 8 57.66
16 20 29.35
8 48 28.35
1 26.58
47 1.7 3
+11 1.7 3
chron slow

9 15 30
11 1.7 3
9 26 31.7 3
1 33.0 7
16 20 29.35
1 48 34.1 5
48 30
+ 4.1 5
clock slow

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Instrument on meridian Pier

N.W. Nov. 27/96 1.45 – 2.20 pm

Pivot Errors Rogers Transit

Alt	W	E			Alt.	W	E		
20 N	34.0	42.3	-76.3		20 S.	45.2	11.6	+56.8	
	32.7	24.3	+57.0	-19.3 -4.8		21.3	54.9	-76.2	-19.4 -4.8
20	45.1 ~~11.8~~	11.8 ~~45.1~~	+56.9		30	20.6	54.3	-74.9	17.7 ~~22.3~~ -4.4
	23.0	56.0	-79.0	-22.1 -5.5		45.5	11.7	+57.2	
30	22.3	55.5	-77.8		40	45.5	11.8	+57.3	
	45.7	12.2	+57.9	-19.9 -5.0		22.8	56.8	-79.6	-22.3 -6.6
40	45.1	11.8	+56.9		50	21.0	55.1	-76.1	
	23.0	56.2	-79.2	-22.3 -5.6		46.2	12.5	+58.7	-17.4 -4.4
50	22.6	56.0	-78.6		50	45.5	12.0	+57.5	
	45.2	12.0	+57.2	-21.4 -5.4		21.3	54.9	-76.2	-18.7 -4.7
50	45.1	11.8	+56.9		40	20.7	54.3	-75.0	
	23.4	56.7	-80.1	-23.2 -5.8		46.0	12.3	+58.3	-16.7 -4.2
40	22.5	55.8	-78.3		30	46.0	12.2	+58.2	
	45.3	12.0	+57.3	-21.0 -5.2		22.2	56.0	-78.2	-20.0 -5.0
30	45.4	12.2	+57.6		20	21.0	54.8	-75.8	
	22.3	55.2	-77.5	-19.9 -5.0		46.5	12.8	+59.3	-16.5 -4.1
20	22.2	55.4	-77.6						
	44.8	11.5	+56.3	-21.3 -5.3					

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Cl E 2.20 – 2.50 μm.

Alt	W	E			
20 S	61.5	27.8	+89.3		
	5.4	38.9	−44.3	+45.0	+11.2
30	5.8	39.3	−45.1		
	62.1	28.9	+91.0	+45.9	+11.5
40	62.3	29.0	+91.3		
	5.7	38.9	−44.6	+46.7	+11.7
50	5.0	38.5	−43.5		
	63.0	29.7	+92.7	+49.2	+12.3
50	62.5	29.3	+91.8		
	5.8	39.0	−44.8	+47.0	+11.8
40	5.4	38.6	−44.0		
	62.8	29.4	+92.2	+48.2	+12.0
30	62.3	29.0	+91.3		
	6.0	39.3	−45.3	+46.0	+11.5
20	5.8	39.2	−45.0		
	63.0	29.7	+92.7	+47.7	+11.9

Alt.	W	E			
20 N	5.8	39.0	−44.8		
	61.8	28.7	+90.5	+45.7	+11.4
30	62.1	29.0	+91.1		
	6.0	39.0	−45.0	+46.1	+11.5
40	6.2	39.3	−45.5		
	62.4	29.5	+91.9	+46.4	+11.6
50	61.8	28.7	+90.5		
	5.9	39.0	−44.9	+45.6	+11.4
50	6.0	39.0	−45.0		
	62.5	29.5	+92.0	+47.0	+11.8
40	62.4	29.1	+91.5		
	7.0	40.4	−47.4	+44.1	+11.0
30	6.4	39.7	−46.1		
	62.7	29.5	+92.2	+46.1	+11.5
20	62.0	28.7	+90.7		
	6.0	39.3	−45.3	+45.4	+11.4

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Results.

Alt.	Nov. 27 Cl. W.		Dec. 18	Dec. 19	Nov. 27 Cl. E.		Dec. 18	Dec. 19
20 N.	$-5.2^{d} = -.48^{s}$		$-7.0 = -.64$	$-.72$	$+11.4^{d} = +1.05^{s}$		$+5.8 = +.53$	$+.70$
30	-5.0	$-.46$	6.9	.63	.78	$+11.5$	1.06	5.6	.52	.73
40	-5.4	$-.50$	7.0	.64	.69	$+11.3$	1.04	5.4	.50	.71
50	-5.6	$-.52$	7.2	.66	.69	$+11.6$	1.07	5.8	.53	.71
20 S	-4.4	$-.40$	6.8	.63	.77	$+11.6$	1.07	5.6	.52	.70
30	-4.7	$-.43$	7.0	.64	.74	$+11.5$	1.06	5.8	.53	.67
40	-4.9	$-.45$	7.4	.68	.75	$+11.8$	1.09	5.8	.53	.76
50	-4.6	$-.42$	7.7	.71	.74	$+12.0$	1.10	6.3	.58	.83
		$-.458$		$-.654$	$-.735$		$+1.068$		$+.54^{30}_{40}$	.726

Assuming that the angle of the level V is the same as that of the telescope V, we have — Chaun. II, 155

Nov. 27 $\quad j = \frac{B' - B^*}{4} = \frac{+.458 + 1.068}{4} = +\frac{1.526}{4} = +.382$ Cl. W

Dec. 18 $\quad \frac{+.54^{3}_{0} + .654}{4} = +\frac{1.184}{4} = +.296$ Cl W

Dec. 19 $\quad \frac{+.726 + .735}{4} = +\frac{1.461}{4} = +.365$ Cl. W

$+.35$

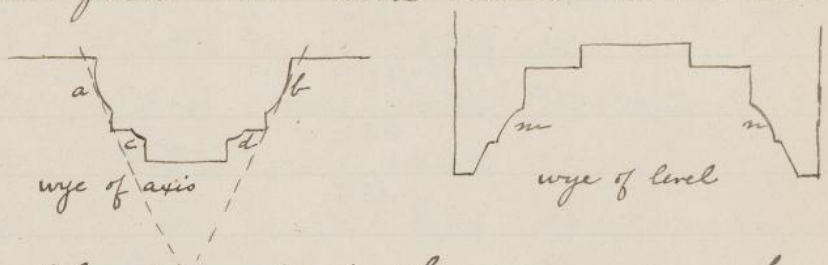
The formula is the same, if we assume that the curves of the wyes are precisely the same as those of the pivots. On this assumption the bearing is at all points of the curved surfaces.

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Angles of wyes.

The wyes of both frame and level are not made with plane faces but with curves like those of pivots, thus:



The axis of the telescope rests in the curves at a + b. In the meridian frame it does not touch at c and d but in the prime vertical frame it touches at d on the east side of the north axis and south axis also. The bearing seems to be at various points in a + b so that it is impossible to determine any one line of bearing as it would be if the wyes were made with plane faces. The level wyes rest upon the axis at m and n, but at what places cannot be determined.

The angles which the plane faces of wyes make with each other enter into the formula for pivot correction: Chauv. II, 153. In this case the best assumption seems to be that this angle would be formed by the meeting of the tangents at the middle points of a + b and m + n Measurements made on prime vertical axes give for their angles 22° and 23° (for i or ½ angle; whole angle 44° and 46°) and for level wye 31° for i or ½ angle. If however the line of bearing is below the middle of a + b the angle at ~~telescope~~ axis wye would be larger or if below the middle of m + n that at level wye would be smaller. There is evidently an uncertainty of several degrees in each case and it is therefore decided to assume their equality as stated on preceding page.

See further p. 216

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$b = +1.16 - .38 = +.78$

Nov. 27/96

	11.0	27.5	-38.5		-37.9	9.6	28.3		37.2	17.5	+54.7		
	52	34.9	+87.0	+12.6	+89.8	54.8	35.0		27.0	47.0	-74.0		
			+48.5	+1.16	+51.9						-19.3		
			+12.1		+13.0						-4.8		
cl E	β Hydri			β Ceti		δ Psc.		dW	ε Psc				
7	34	10.5			39.7		50.8		5				
	34	43.3	32.8		54.5		11.5		25.8				
C	35	15.5	32.2		16.2		22		36.5				
	35	49.2	33.7		38.2		32.4		46.7				
	36	21.8	32.6		0		42.8		57.2				
	38	—			21.8		53.3		7.5				
	38	49	49.7		58 36.2		3 14.2		17 28.5				
B	39	38.7	48.8		57 38.09		2 32.43		16 46.74				
	40	27.5	49.5		- 1.21		- 0.41		+ 1.94				
	41	17	97.5		57 36.88		2 32.02		16 48.68				
	42	54.5	33.0		38 26.41		43 21.26		57 36.90				
	43	27.5	33.0		19 10.47		19 10.76		19 11.78				
A	44	0.5	32.5		+.82		+.72		-.05				
	44	33	32.5		1.05		.92		.92				
	45	5.5											

					Aa	Cc	E	ΔT	
7	39	38.19	0 = 19	10.54 + ΔT	-4.17a	-4.75c	+.37	+.66	+1.03	11.57]
Red. to 8.05		-4.17		11.29		-.04	-1.05	+.00	+.15	+.15	.44
7	39	34.02		11.48		+.40	-1.01	-.04	+.14	+.10	.58
0	20	25.25		11.73		+.41	+1.01	-.04	-.14	-.18	.55
7	19	8.77		11.75		-2.28	+2.85	+.21	-.40	-.19	.56]
		+1.77									
		2.27								ΔT = - 7 19	11.52

$0 = 0.94 + 4.57a + 3.74c$

$= 0.02 - 2.69a + 1.84c$

$= 0.04 - 5.38a + 3.68c$

$= 0.04 - 5.49a + 3.75c$

$= 0.90 + 10.06a$

$a = -.09$

$c = -.14$

8	5	0
-7	19	11.52
0	45	48.48
16	28	22.47
8	17	26.01
	1	21.49
16		4.52

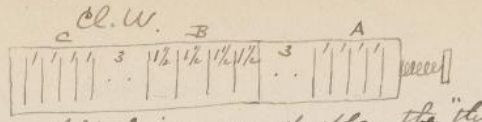
clim + 11 4.52 clm

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b = −.44
+.38
−.06

Cl. W.



All lines are double, the "thread" being middle of space between.

+51.0 35.5 15.5
−70.0 24.0 46.0
−19.0
−4.8
−.44

Thread Intervals

β Hydri $\log\cos\delta = 9.82860$ κ Tucanae $\log\cos\delta = 9.54541$

					log	log		log	log
κ Tucanae			A_1 to Mean	+327.3	2.51495	1.24855	+195.8	2.29181	1.83722
28	12.2		A_2	294.8	2.46953	1.79313	176.8	2.24748	1.79289
	31.2	19.0	A_3	262.3	2.41880	1.74240	157.5	2.19728	1.74269
A	50.5	19.3	A_4	229.3	2.36040	1.68400	137.3	2.13767	1.68308
	10.7	20.2	A_5	196.3	2.29292	1.61652	117.5	2.07004	1.61545
29	30.5	19.8	B_1	98.8	1.99476	1.31836	59.0	1.77085	1.31626
30	29	58.5	B_2	49.3	1.69285	1.01645	29.0	1.46240	1.00781
	59	30	B_3	+ 0.5	9.69897	9.02257	+ 1.0	0.00000	9.54541
B31	27	28	B_4	−49.2	1.69197	1.01557	− 29.5	1.46982	1.01523
	57.5	30.5	B_5	—			59.0	1.77085	1.31626
32	27	29.5	C_1	196.4	2.29314	1.61674	117.5	2.07004	1.61545
33	25.5	58.5	C_2	229.0	2.35984	1.68344	137.5	2.13830	1.68371
	45.5	20	C_3	262.7	2.41946	1.74306	157.5	2.19728	1.74269
C34	5.5	20	C_4	294.9	2.46967	1.79327	177.0	2.24797	1.79338
	25	19.5	C_5	−327.7	2.51548	1.83908	196.5	2.29336	1.83877
8 34	44.5	19.5							

			β Hydri	κ Tuc.		β Hydri	κ Tuc.	Mean	Small Int.	Adopt
8 31	28.04	A_1	68.95	68.74	C_5	69.04	68.99	68.92	6.892	69.00
	+4.35	A_2	62.11	62.07	C_4	62.13	62.14	62.11	6.901	62.10
8 31	32.39	A_3	55.26	55.30	C_3	55.34	55.30	55.20	6.900	55.20
12	~~19.05~~ 20.54	A_4	48.31	48.20	C_2	48.24	48.27	48.26	6.894	48.30
19	11.85	A_5	41.35	41.25	C_1	41.38	41.25	41.31	6.885	41.40
	−.10	B_1	20.81	20.71	B_5	—	20.71	20.74	6.913	20.70
	1.71	B_2	10.39	10.18	B_4	10.36	10.36	10.32	6.880	10.35
		B_3	+.10	+.35				Mean	6.895	

From f. 88 interval from λ' Octantis is 6.916

Combining by equal weights Interval A & C grups = 6.90 Adopt

B " 10.35 "

Observations show that spaces are equally ruled within accuracy of observations. Hence above are adopted.

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Latitude by Prime Vertical Transits.

Preliminary Tables, approximate for finding stars.

Doolittle p. 364

Chauvenet II, p. 240

$\phi - 16^\circ\ 22'.5$

$\log \sin \phi = 9.45014\,n$ $\qquad$ $\log \tan \phi = 9.46812\,n$

δ	$\log \sin \delta$	$\log \frac{\sin \delta}{\sin \phi}$ = $\log \sin h$	h	$\log \tan \delta$	$\log \frac{\tan \delta}{\tan \phi}$ = $\log \cos t$	t	t_h	I
0			0 0				6 0	
− 1	8.24186 n	8.79172	3 33	8.24192 n	8.77380	86 36	5 46	14
2	8.54282 n	9.09268	7 7 (3 34)	8.54308 n	9.07496	83 10	5 33	13
3	8.71880 n	9.26866	10 42 (3 35)	8.71940 n	9.25128	79 44	5 19	14
4	8.84358 n	9.39344	14 20 (3 38)	8.84464 n	9.37652	76 14	5 5	14
5	8.94030 n	9.49016	18 0 (3 40)	8.94195 n	9.47383	72 41	4 51	14
6	9.01923 n	9.56909	21 46 (3 46)	9.02162 n	9.55350	69 3	4 36	15
7	9.08589 n	9.63575	25 37 (3 51)	9.08914 n	9.62102	65 18	4 21	15
8	9.14856 n	9.69842	29 35 (3 58)	9.14780 n	9.67968	61 26	4 6	15
9	9.19433 n	9.74419	33 42 (4 7)	9.19971 n	9.73159	57 23	3 50	16
10	9.23967 n	9.78953	38 1 (4 19)	9.24632 n	9.77820	53 7	3 32	18
11	9.28060 n	9.83046	42 36 (4 35)	9.28865 n	9.82053	48 35	3 14	18
12	9.31788 n	9.86774	47 31 (4 55)	9.32747 n	9.85935	43 40	2 55	19
13	9.35209 n	9.90195	52 56 (5 25)	9.36336 n	9.89524	38 13	2 33	22
14	9.38368 n	9.93354	59 6 (6 10)	9.39677 n	9.92865	31 57	2 8	25
15	9.41300 n	9.96286	66 38 (7 32)	9.42805 n	9.95993	24 14	1 37	31
16	9.44034 n	9.99020	77 52 (11 14)	9.45750 n	9.98938	12 37	0 50	47
− 17	9.46594 n			9.48534 n				

h = alt.

t = hour angle when on prime vertical

I = interval for first thread in Rogers transit.

Δh = corr. to setting for first thread $-\frac{E}{+W}$ when applied to altitude.

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i 69.00 log 1.83885 — log cos φ 9.98202
log sin φ 9.45014 — " ¼ 4 cos φ 9.37996
" i / 5 sin φ 2.38871

	log cos h	log I	I		log Δh	Δh	
			s	m		′	
−1	9.99917	2.38954	~~251~~ 245	4.1	1.76950	59	
2	9.99665	2.39206	247	4.1	1.77202	59	
3	9.99239	2.39632	249	4.2	1.77628	60	
4	9.98628	2.40243	253	4.2	1.78239	61	
5	9.97819	2.41052	257	4.3	1.79048	62	
6	9.96789	2.42082	264	4.4	1.80078	63	
7	9.95509	2.43362	271	4.5	1.81358	65	
8	9.93935	2.44936	281	4.7	1.82932	68	
9	9.92009	2.46862	294	4.9	1.84858	70	
10	9.89641	2.49230	311	5.2	1.87226	75	
11	9.86698	2.52173	332	5.5	1.90169	80	
12	9.82956	2.55915	362	6.0	1.93911	87	
13	9.78015	2.60856	406	6.8	1.98852	97	
14	9.71052	2.67819	477	8.0	2.05815	114	= 1° 54
15	9.59825	2.79046	617	10.3	2.17042	148	2 28
16	9.32241	3.06631	1165	19.4	2.44627	279	4 39

	γ Com. Maj.	μ Hydrae	δ² Corvi	α² Librae	η Oph.
δ	−15 29	−16 18	−15 56	−15 37	−15 36
log sin δ	9.42644n	9.44819n	9.43857n	9.43008n	9.42962n
" sin h	9.97630	9.99805	9.98843	9.97994	9.97948
h	71 14	84 34	76 50	72 43	72 32
" tan δ	9.44250n	9.46601n	9.45559n	9.44641n	9.44592n
" cos t	9.97438	9.99789	9.98747	9.97829	9.97780
t	19 29	5 38	13 42	17 58	18 10
	1 18	0 23	0 55	1 12	1 13
" cos h	9.50728	8.97562	9.35752	9.47280	9.47754
" I	2.88143	3.41309	3.03119	2.91591	2.91117
I	761	2589	1074	824	815
	12.7	43.2	17.9	13.7	13.6
" Δh	2.26139	2.79305	2.41115	2.29587	2.29113
Δh	183	621	258	~~189~~ 198	195

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Prime Vertical Transits.

List of Stars – American & English Ephemerides.

Includes stars between δ −6° 30′ and −16 22, the former limit taken because opening of building in prime vertical is to h = 24° only.

	Star	α	δ	t	W	E	I	h	Δh
	ι Ceti	0 14	−9 24	3.43	3 57	20 ~~17~~ 31	5.0	35 26 ✓	72
	θ′ Ceti	1 19	−8 43	3 55	5 14	~~20~~ 21 ~~5~~ 24	4.8	32 32 ✓	69
	ζ Ceti	1 46	−10 51	3 17	5 3	~~20~~ 22 ~~43~~ 29	5.5	41 55 ✓	79
	67 Ceti	2 12	−6 54	4 22	6 34	~~19~~ 21 ~~38~~ 50	4.5	25 14 ✓	65
	ε Eridani	3 28	−9 49	3 35	7 3	23 53	5.1	37 14 ✓	74
	γ "	3 53	−13 48	2 13	6 6	1 40	7.8	57 48 ✓	111
	o′ "	4 7	−7 7	4 19	8 26	23 48	4.5	26 7 ✓	65
	β Orionis	5 10	−8 19	4 1	9 11	1 9	4.8	30 53 ✓	69
	τ "	5 13	−6 57	4 22	9 35	0 51	4.5	25 25 ✓	65
	κ "	5 42	−9 42	3 37	9 19	2 5	5.1	36 43 ✓	74
E	θ Can. Maj.	6 49	−11 55	2 57	9 46	3 52	6.0	47 6 ✓	86
E	γ " "	6 59	−15 29	1 18	8 17	5 41	~~13~~ 12.7	71 14 ✓	183
	μ Hydrae	10 21	−16 18	0 ~~35~~ 23	10 ~~56~~ 44	9 ~~46~~ 58	43.2	84 34	621
	α "	9 22	−8 12	4 3	13 25	5 19	4.7	30 24 ✓	68
	δ Crateris	11 14	−14 13	2 1	13 15	9 13	8.5	60 40 ✓	121
	δ² Corvi	12 24	−15 56	0 55 ~~11~~	13 ~~15~~ 19	11 29	17.9	76 50	258
	α Virginis	13 20	−10 37	3 21	16 41	9 59	5.4	40 46 ✓	78
	m "	13 36	−8 11	4 3	17 39	9 33	4.7	30 24 ✓	68
	κ "	14 7	−9 47	3 36	17 43	10 31	5.1	37 5 ✓	74
	λ	14 13	−12 54	2 35	16 48	11 38	6.7	52 23 ✓	96
	α² Librae	14 45	−15 37	1 ~~12~~	15 ~~54~~ 57	13 ~~32~~ 33	~~15~~ 13.7	72 43	~~189~~ 198
	β Librae	15 11	−9 0	3 50	19 1	11 21	4.9	33 42 ✓	70
	ζ Ophiuchi	16 31	−10 21	3 26	19 57	13 5	5.3	39 37 ✓	77
	η "	17 4	−15 36	1 13	18 17	15 ~~58~~ 51	~~15~~ 13.6	72 32	195

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	Star	α	δ	t	W	E.	I	h	Δh
	1 Aquilæ	18 30	−8 19	4 1	22 31	14 29	4.8	30 53 ✓	69
	κ "	19 31	−7 16	4 17	23 48	15 14	4.6	26 41 ✓	66
	α^2 Capricorni	20 12	−12 52	2 36	22 48	17 36	6.7	52 10 ✓	96
E	ε Aquarii ~~Aquilæ~~	20 42	−9 53	3 34	~~24~~ 0 16	17 8	5.2	37 29 ✓	74
	μ Aquarii	20 47	−9 ~~22~~	3 43	0 30	17 4	5.0	35 16 ✓	72
	ξ "	21 32	−8 19	4 1	1 33	17 31	4.7	30 53 ✓	69
	μ Capricorni	21 48	−14 2	2 7	23 55	19 41	8.1	59 21 ✓	115
	θ Aquarii	22 11	−8 18	4 1	2 12	18 10	4.8	30 59 ✓	69
	σ "	22 25	−11 13	3 10	1 35	~~20~~ 19 ~~50~~ 15	5.6	43 40 ✓	81
	λ "	22 47	−8 8	4 4	2 51	~~19~~ 18 ~~56~~ 43	4.7	30 10 ✓	68
	φ "	23 9	−6 37	4 27	3 36	18 42	4.5	~~24~~ 9 ✓	64

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Cl N

−79.5 − 36.8
+42.7 − 9.2 = −0.85 first corr.
+.3825
−.4760

Mar. 30/96

N	s						
22.0	57.5		+40.3		−82.0		−84.7	
38.8	3.9		−83.5		+41.7		+45.3	
			−43.2		−40.3		−39.4	
			−10.8		−10.1		−9.8	
			−.99		−.93		−.90	
			−.74		−.68		−.65	
			38.0	2.3	23.2	58.8	24.0	60.7
			24.5	59.0	39.0	27	41.0	4.3
ε Aquilae	azii	μ Aquarii		τ Orionis		β Orionis		γ Eridi	
19 34	t_2	32 47		53 36.5		11 35	8	39 53.5	
20 5	t_3	33 17.5		54 3		12 3		40 37.5	
22 41.5	B,	33 48		54 29.5		12 31		41 21.8	
23 28	2	34 18.5		54 57		12 59.5		42 6.3	
24 14.5	3	34 48.5		55 24		13 28.5		42 51.3	
25 0	4	36 19.3		56 45		14 52.5		45 5	
25 46.5	5	37 4.2		57 25.5		15 35		46 14	
27 18.5	C,	37 50		58 6		16 18.5		47 21.5	
27 49	2	38 34.5		58 47		17 1.5		48 31.5	
28 19.5	3	39 19.5		59 27.5		17 44.5		49 41.5	
28 49.8	4	40 48.3		0 49.5		18 10.5		52 3	
29 20	5	41 18.5		1 16.5		19 39.5		52 58.3	
		41 48		1 44.5		20 8.5		53 38.5	
		42 17.5		2 11.5		20 37		54 26.2	
		42 47		2 38.5		21 5.8		55 14.8	
Mean	7 25 12.19	7 37 ~~48.03~~ 48.42 ✓		7 58 6.77		8 16 19.~~22~~ 35		8 47 27.78	
Rate to 10^{i} 36 (p. 189)	31.34 .15	29.27 .14 ✓	0.00	25.94 .12	0.00	22.95 .11	0.00	17.83 .09	0.00
	I + 13.22 K								

+5	38.2	+0.51		+5	1.4	+0.37		+4	30.3	+0.26		+4	44.4	+0.30		+7	34.3	+1.32					
5	7.2	.39		4	30.9	.26		4	3.8	.19		4	16.4	.22		6	50.3	.91					
2	30.7	.04		4	0.4	.18		3	37.3	.13		3	48.4	.16		6	6.0	.65					
1	44.2	.01		3	29.9	.12		3	9.8	.09		3	19.9	.11		5	21.5	.45					
0	57.7	+.95		2	59.9	.08		2	42.8	.05		2	50.9	.06		4	36.5	.28					
+0	12.2			1	29.1	.01		1	21.8	.01		1	26.9	.01		2	22.8	.04					
−0	34.3			+0	44.2	+1.02		0	41.3	+.73		0	44.4	+.86		1	13.8	.01					
2	6.3	−.03		−0	1.6			+0	0.8			+0	0.9			+0	6.3	+3.66					
2	36.8	.05		0	46.1			−0	40.2			−0	42.1			−1	3.7						
3	7.3	.09		1	31.1	−.01		1	20.7	−.01		1	28.1	−.01		2	13.7	−.03					
3	37.6	.14		2	59.9	.08		2	42.7	.05		2	51.1	.06		4	36.2	.28					
−4	7.8	.20		3	30.1	.12		3	9.7	.09		3	20.1	.11		5	22.5	.45					
		−.51		3	59.6	.18		3	37.7	.14		3	49.1	.16		6	10.7	.68					
		+.44		4	29.1	.26		4	4.7	.19		4	17.6	.23		6	58.4	.97					
		+.04		−4	58.6	.35		−4	31.7	.27		−4	46.4	.31		−7	47.0	1.35					
						−1.00				−.75				−.88				−3.76					
						.00				.00				.00				.00					

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−89.0	+37.4	
+41.8	−84.8	
−47.2	−47.4	
−11.8	−11.8	
−1.09	−1.09	
−.84	−.84	
26.0 63.0	37.2 0.2	
39.3 2.5	23.8 61.0	

log k Cham. II, 591

κ Orionis	θ Aquarii	λ Aquarii	ε Aquarii	μ Aquarii	ι Orionis	β Orionis
			1321	1049	844	934
			1090	848	687	760
			512	667	545	603
—			125	504	416	462
			39	374	307	338
			2	92	78	88
+			13	23	19	23
			184	00	00	00
8 23			284	25	18	20
			405	96	75	84
8 54			547	374	306	338
			709	510	416	462
9 24.2				663	547	606
				836	692	767
10 55				1029	916	947
11 41		57 14.5	Σ 5231	7095	5866	6432
12 26.5	19 31.5 B_3	57 57	Mean 436	473	391	429
13 12.5	20 13.5	58 39	Corr 0	0	0	0

κ Orionis	θ Aquarii	λ Aquarii	γ Erid.	κ Orionis	θ Aq.	λ Aq.
13 58	20 56.5	59 21.5				
15 30.5	22 21	0 45.5	2383	689	286	361
			1970	525	153	208
16 1.5	22 49.5	1 24 [14]	1547	387	61	99
			1194	99	2	29
16 33	23 17.5	1 52 [42]	883	25	19	13
			236	00	55	46
—	23 46	2 10	63	24	110	95
			1	96	180	162
—	24 13.5	2 38	48	388		237
			206	531		
9 12 27.20	9 22 8.62	10 0 11.28	875	698		
			1202			
0.00	+38.38	+32.97	1587			
13.72	12.13	~~4.70~~ 6.88	2022			
.07	.06	~~.03~~ .03	2518			
+4 4.2 +0.19	+2 37.1 +0.05	+2 56.8 +0.07	Σ 16735	3462	866	1250
3 33.2 .13	1 55.1 .02	2 14.3 .03				
3 3.0 .08	+1 12.1 +.07	1 32.3 .01	Mean 1116	315	108	139
1 32.2 .01	−0 12.4	+0 49.8 +.11				
0 46.2 +.41	0 40.9	−0 34.2	Corr. 0	0	0	0
+0 0.7	1 8.9	1 2.7				
−0 45.3	1 37.4 .01	1 30.7 −.01				
1 30.8 .01	−2 4.9 .02	1 58.7 .02				
3 3.3 .08	−.03	2 26.7 .04				
3 34.3 .13	.00	−.07				
−4 5.8 .20		.00				
−.42						
.00						

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+43.1 +43.9
+10.8 +11.0
+10.9 = +1.5 00
−.38 print corr.
+0.62

Nov. 30/96

Cl. ε	η Aretis	ι Hydri	f Tauri	ε Eridani	δ Persei	ν Tauri
	2.0 39.2 −41.2 +85.9 61-7 24.2				47 27	23 47
	60.8 23.5 +84.3 −42.0 2.0 40.0				poor def.	poor def.
	20 40 −77 46		12 35 −9 49			
	11.7	22 16 A_5	23.3	16.8	Clw 29 B_3	57.5 B_1
10 36 0	33.8	— 31.4	44.6	37.7	29.0 44.5 4	3 2
−7 6 52.92	45	24 42 $5B_2$ 31.3	55.3	48.2	29.2 29.4 0 5	1434 14.5 3
3 29 7.08	56.2	25 31 5 3 31.5	58	59	29.4 30.7 C_1	25.7 4
16 40 12.14	7	26 20 5 4 31.7	16.3	9.3	29.5 41 2	37 5
10 48 54.94	18.1	27 10 5 32.3	27.1	19.7	29.5 57.2 3	59.5 C_2
1 46.31	10 16 40	28 47 C_1 31.6 32	48.2	35 40.7	29.3 29.1 1.2 4	7.2 2
47 8.63		29 19.5 C_2 31.5			44 11.2 5	14.84 15 3
+11 8.63						0.17 14.67 22.5 4
Clww slow.						49 30 5
	10 15 55.97	25 31.61	32 5.80	34 58.77	42 29.30	48 14.50
Red to 10.36	−3.30	−1.72	−0.64	−0.17	+1.06	+2.01
	15 52.67	25 29.89	32 5.16	34 58.60	42 30.36	48 16.51
3	9 0.43	18 38.54	25 12.74	28 6.33	35 37.67	41 23.37
7	6 52.24	51.35	52.42	52.27	52.79	53.14
	+.53	+1.40	+.56	+.63	−.14	−.18
	.85	2.26	.90	1.01	.65	.84

7 6

$0 = 52.77 + \Delta T + .64a - 1.07c$

			Aa	Cc	Σ	ΔT
52.75	−4.15	−4.72	−.50	+.90	+.40	.15
52.98	+.50	−1.02	+.06	+.19	+.25	.23
52.90	+.12	−1.01	+.01	+.19	+.20	53.10
52.65	+1.33	+1.48	+.16	+.28	−.12	52.53
52.96	+.70	+1.09	+.08	+.21	−.13	.83
53.78	−3.19	+3.76	−.38	−.71	−1.09	.69
						53.13
						52.68
						7 6 52.90

$0 = 52.88 + \Delta T + .42a - 1.03c$

52.75		$-4.15a - 4.72c$
52.80		$+1.02a + 1.28c$
53.78		$-3.19a + 3.76c$
$0 = 0.13$		$+4.57a + 3.69c$
$= 0.98$	$-4.21a$	$+2.48c$
$0 = 1.07$	$-4.59a$	$+2.70c$
$0 = 1.20$		$+6.39c \quad c = -.19$
		$4.57a = +.57$
		$4.21a = +.51$
		$a = +.12$

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+55.5
−81.4
−25.9
− 6.5 = −0.60
+.38
−.22

−6.0 = −0.55
+.38
b = −.17

+10.2 +9.4
+9.8 = +0.90
−.38
b = +0.52

Tabulate Latun & Jennie vertical. Jen and knight have for remaining stars

γ Hydri

46.5	9.0		
21.9	59.5		
−74	33		
47.0	54	53.5	1
46.1	52	18.5	3
46.9	52	45.3	4
47.2	53	11.5	5
46.0	55	46	B_3
46.1	56	25	4
46.2	57	4	5
46.3	58	22	C_1

γ Tauri

−78.0	20	58.0		
+53.8				
−24.2	46.0	7.8		
15	23	8.0	27.5	
	46.3	50.0	25 35.5	1
	1	48.4	26 15.5	3
	22.3	49.8	58.5	4
	33	50.2	40.5	5
	437	49.3	29 44.5	B_1
	54.5 rej.	[47.4]	30 45	? 2
	5.3	48.0	31 48	B_3
	26.6			
	41.2		21	

δ Mensae

+88.2	63.2	25.0		
−45.6				
+40.6	3.6	42.0		
	51.5	B_5	46.7	
35	55	C_1	45.3	
	37.5	2	46.2	57.8
	−	3	9	5?
	−	4	31.2	C_1
38	41.5	5	−45.4	38.7

τ Tauni

−48.7	5.2	43.5		
+86.2	62.2	24.0		
+37.5				
22	45	18 40	33.0	
	58.26			
	− 4.2			
	4.34			
	58.66			
	40.7	B_1	33.7	
	51.6	2	45.8	
	2.6	3	58.3	
	13.5	4	10.5	
	46.2	1	24.5	5 23
	37	4	46.1	C_1 47.5
	1.1	5	53 0.6	3 42
				4 12.4
				58 20.6

δ Tauri

55	46.48			
	+3.25	Red.		
55	49.73			
48	55.51			
	54.22			
	−.44			
	1.98			
−80	27.5			
−16	22.5			
−64	5			
9.95397	m			
0.78050				
9.64054				
0.73447	m			
0.42104				
−5.426				
2.637				
6.033				

11	20	43.77					
		−3.06					
11	39	20	40.71				
4	13	57.62					
	6	43.15					
		−.16					
		,88					
		42.99					
		42.58					
		41.50					
		42.10					
		41.94					
		42.42					
		42.69					

0 = 42.99 + ΔT + .55a + 1.04c

	−5.43	+6.03			
	−5.43	−6.03			
	+ .68	− 1.08			
	+ .61	− 1.06			
	+ .90	− 1.19			

0 = 1.08 + 12.06 c c = −.09

0 = 0.41 + 5.98a − 4.99c

I = 1.06 + 6.19a′ + 4.91c

II or 0 = 0.85 + 6.16a′ + 4.92

31	49.28						
	−1.18						
31	48.10						
25	5.07						
	43.03						
	− .45						
	2.64						
		Aa	Cc	Σ	ΔT		
		−.08	−.09	−.17	42.82		
		+ .81	− .54	+ .27	.85	7 6	42.60
		+ .54	+ .54	+1.08	42.68	Red. 10 36	10.35
		− .07	+ .10	+ .03	41.97 rej.		52.95
		− .06	+ .10	+ .04	42.46		52.90
		− .09	+ .11	+ .02	42.71	II Red. τ Tauni	52.92
				I	42.82	42.82 adopt	
				rej.	42.59	42.38	
				τ Tauni	42.70	42.60	

5.98a = −0.86 a = −0.15

6.19a′ = −0.62 a′ = −0.10

6.16a′ = −0.41 rej.

31	45.90	41	46.60	52	2.51	56	58.46
	− 1.18		+ 0.46		+ 2.14		+ 2.95
31	44.72	41	47.06	52	4.65	57	1.41
25	5.07	36	5.56	45	22.68	50	19.13
	39.65		41.50		41.97		42.28
	+ 1.85		+ .44		+ .45		+ .41
	2.64		.84		.86		.78

Adopt for 10 36

ΔT = −7 6 52.92

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Nov. 30/96

N S
13.6 51.7 −65.3 +1.2 5
52.5 14.0 +66.5 +0.3 = +0.03
b = −.33

Cl. S

	θ Can Maj.	ε Ceti	α Hydrae	γ Can Maj.
	4 35.5 C_3		12 22 5	35 45
	5 12.5 4	27 C_4	22 33	36 52.5
	5 48 5	8 56.5 C_5	23 0.8	37 54
			23 29.5	39 7.5
			23 57.5	40 16.5
			25 22	43 51
			26 4.5	45 40
			26 47.5	47 34
			27 30	49 28.5
			28 13	51 27.5
			—	55 32.5
			30 7	56 58
			30 36.5	58 25
			31 4.5	59 53
			31 33	1 # 24
			26 35.99	
	11 5 12.00	11 8 ~~42~~.75	12 ~~25~~ ~~10.27~~	12 4~~8~~ 0.93
	− 62.10	+ 65.55	+ 2.96	0.00
Rate from i_{0} 36	4.80	5.37	18.17	21.69
	I .02	.02	.04	.11
	K			
	+ 0 36.5 0.00	+ 0 14.8 0.00	+ 4 31.0 +0.26	+ 12 15.9 +5.31
	− 0 0.5		4 3.0 .19	11 8.4 3.98
	− 0 36.0 0.00	− 0 14.7 0.00	3 35.2 .13	10 1.9 2.91
			3 6.5 .09	8 53.4 2.03
	.00	.00	2 38.5 .05	7 44.4 1.33
			1 14.0 +.72	4 9.9 .21
			+ 0 31.5	2 20.9 .04
			− 0 11.5	+ 0 26.9 +15.81
			0 54.0	− 1 27.6 −.01
			1 37.0 −.01	3 26.6 .12
			3 31.0 .12	7 31.6 1.22
			4 0.5 .18	8 57.1 2.07
			4 28.5 .26	10 24.1 3.23
			−4 57.0 .35	11 52.1 4.81
			−.92	− 13 28.1 6.92
			−.20	−18.38
			−.01	− 2.57
				− .17

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53.3 15.0 +68.3 5.00
15.0 53.2 −68.2 .38
b = −.38
25

y Enid

5	49.5	
6	38	
7	25.5	
8	14.5	
10	34.5	
11	45	
12	54	
14	2.5	
15	10.5	
17	26	
18	10	
18	55	
19	38.5	
20	22.5	
13 13	21.86	
	+ 4.93	
25.85		
.12		

+7	32.4	+1.23
6	43.9	.87
5	56.4	.60
5	7.4	.39
2	47.4	.06
1	36.9	.01 +3.16
+0	27.9	
−0	40.6	
1	48.6	−.01
4	4.1	.19
4	48.1	.31
5	33.1	.49
6	16.6	.71
−7	0.6	.99 −2.70
		+.46
		+.03

Dec. 1/96

9 20 46 Chron. = 14 15 35 Clock
11 9.20
21
31 55.20
3 32.23
16 40 12.14
14 15 39.57
15 35
+4.57 slow

log k

	θ Can Maj.	ι Ceti	α Hydræ	γ Can Maj.	γ Enid.
	15	03	848	6252	2363
	00	03	682	5158	1884
	15		535	4183	1467
			402	3285	1092
			291	2490	324
			64	721	108
			11	229	09
			2	8	19
			34	89	136
			109	493	698
			514	2355	958
			668	3331	1282
			833	4497	1638
			1019	5854	2043
				7454	
Σ	30	06	6012	46399	14021
Mean	10	03	429	3093	1000
Corr.				+1	
				3094	

Clock Correction ΔT = −7 6 52.92 at 10 36

Rate +3 56.56 Mean Sid

(p. 27) + 1.15 on Mean = 0.048 per hour

3 57.71 = 9.905 " "

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Reduction of obs. of γ Eridani Nov. 30/96
transits E & W and telescope reversed between.
Chauv. II, f252.

8h

47m	γ Eridani	obsd I	½ I	ϑ − ½ I	Mean	(ϑ − ½ I)°	log sin (ϑ − ½ I)
21.7s Cl. N.	8 39 53.5	+ 7 28.0	+ 3 44.0	+ − 2 16 52.2	52.3	34° 13.0′	9.74999
21.8	40 37.5	6 44.0	3 22.0	16 30.2	30.3	34 7.6	9.74898
22.0	41 21.8	5 59.7	2 59.85	16 8.0	8.1	34 2.0	9.74794
22.3	42 6.3	5 15.2	2 37.6	15 45.8	46.0	33 56.4	9.74689
22.8	42 51.3	4 30.2	2 15.1	15 23.2	23.8	33 50.8	9.74583
21.7	45 5	2 16.5	1 8.25	14 16.4	16.4	33 34.2	9.74269
22.6	46 14	+ 1 7.5	+ 0 33.75	13 41.9	42.2	33 26.5	9.74103
21.5	47 21.5			13 8.2	8.2	33 17.0	9.73940
22.4	48 31.5	− 1 10.0	− 0 35.0	12 33.2	33.4	33 8.3	9.73772
22.7	49 41.5	2 20.0	1 10.0	11 58.2	58.3	32 59.6	9.73603
23.1	52 3	4 41.5	2 20.75	10 47.4	47.9	32 41.8	9.73255
22.9	52 50.3	5 28.8	2 44.4	10 23.8	23.8	32 36.0	9.73140
23.3	53 38.5	6 17.0	3 8.5	9 59.7	60.0	32 29.9	9.73020
22.9	54 26.2	7 4.7	3 32.35	9 35.8	35.8	32 24.0	9.72902
23.2	55 14.8	7 53.3	− 3 56.65	− 2 9 11.5	11.5	32 17.9	9.72781
22,46 = T							

$$\vartheta = \tfrac{1}{2}\left[T' + \Delta T' - (T + \Delta T)\right]$$

ΔT − 7 6 52.92 at 10 36 Chron
Red + 13 13 = 25.8
8 47 + 17.9

T′	13	12	54	53.87	T	8 47	21.5	22.46
ΔT′	− 7	6	27	27.03	ΔT	− 7 7	27.6 (10.8)	10.85
Σ	6	6	27	26.84		1 40	10.7	11.61
2ϑ			4	26	16.3			
ϑ			2	13	8.15	± W/E		

φ = − 16 22.5
δ = − 13° 47′.95
log sin φ 9.45014n
" cos δ 9.98728
9.43742

	Corrected ΔT	ΔT′
Corr. Mean to Sid	17.85	25.77
" chron rate	− 7 7 10.77 (+.12)	− 7 6 27.15 (+.12)
	− 7 7 10.85	− 7 6 27.27

b cl N = − 0.s52 − 0.65
b cl S − 0.38 − 0.25
Mean − 0.45 = − 6.″75

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	y Eridani	obsd I	$\frac{1}{2}$I	$\vartheta - \frac{1}{2}$I	log Denom.	log I	I
Cl S.	—				9.18741	2.65144	448.2
13 12^m 52^s.8	13 5 49.5	+7 4.5	+3 32.25	+2 9 35.9	9.18640	2.60~~339~~ 66	404.3
53.2	6 38	6 16	3 8	10 0.2	9.18536	2.55658	360.2
52.9	7 25.5	5 28.5	2 44.25	10 23.9	9.18431	2.49964	316.0
54.4	8 14.5	4 39.5	2 19.75	10 48.4	9.18325	2.43375	271.5
53.3	10 34.5	2 19.5	1 9.75	11 58.4	9.18011	2.13584	136.7
54.1	11 45	+1 9	+0 34.5	~~13~~ 12 ~~37~~ 3.7	9.17845	1.83~~351~~ 649	68.6
54.0	12 54						
53.9	14 2.5	−1 8.5	−0 34.25	13 42.4	9.17514	1.83980	~~138.8~~ 69.1
53.8	15 10.5	2 16.5	1 8.25	14 16.4	9.17345	2.14250	138.8
54.5	17 26	4 32	2 16	15 24.2	9.16997	2.44703	279.9
54.0	18 10	5 16	2 38	15 46.2	9.16882	2.51513	327.4
54.8	18 55	6 1	3 0.5	16 8.2	9.16762	2.57432	375.2
54.2	19 38.5	6 44.5	3 22.25	16 30.4	9.16644	2.62665	423.3
54.3	20 22.5	−7 28.5	−3 44.25	+2 16 52.4	9.16523	2.67362	471.6

13 12 53.87 = T′

i	log i						
69.0	1.83885	T′+ΔT′	1^h	40^m	11.61^s	log tan δ	9.390246$_n$
62.1	1.79309	T′+ΔT′	6	6	26.~~60~~ 84	" sec ϑ	0.077~~89~~ 7 8
55.2	1.74194	Δ = 2ϑ	4	26	14.~~99~~ 77	" cos λ	~~9.94 1090~~ ~~9.720 186~~ 0.000000 ~~9.409 137~~
48.3	1.68395	ϑ	2	13	7.~~50~~ 38	" tan φ′	~~9.188 2839~~ 9.468044
41.4	1.61700		33	16	~~52.50~~ 50.70	φ′	−16 22 21.~~7~~ 0
20.7	1.31595	Σ = 2α	7	46	38.21		7 46 38.45
10.35	1.01494	2λ	3	53	19.21		3 53 19.~~10~~ 22 ½Σ
		λ	1	56	~~19.10~~ 23.00		
		λ	~~58~~ 29	~~19~~ 10	~~46.50~~ 41.50		3 53 15.21 α
		δ	−13	47	57.4	0 0	~~3.89~~ 4.01 = λ

~~0′ 58.35~~ 60.15

− 6.8	
−16 22 ~~28.2~~ 27.8	= φ
log λ	0.60314
" sin φ	9.45014$_n$
" a	0.05328$_n$
a	−1.13

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+70.3	−56.5	+67.0	+67.2	−63.5
−59.3	+66.5	−60.5	−63.8	+70.5
+11.0	+10.0	+ 6.5	+ 3.4	+ 7.0
+ 2.75 = +.25	+ 2.5 +.23	+ 1.6 = +.15	+ .85 = +.08	+ 1.75 = +.16
−.25	−.25	−.25	−.25	−.25
.00	−.02	−.10	−.17	−.09

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Cl. S

N	S								
49.5	20.8	12.0	44.5	50.5	16.5	51.2	16.0	13.8	49.7
15.3	44.0	49.5	17.0	13.0	47.5	14.2	49.6	53.5	17.0
κ Aquilae		ε Aquilae		μ Aquarii		ξ Draconis		β Draconis	
		7 11	10	24	53.5	45	40.5	3	39.2
6 44	6	11	40.5	25	24	46	7	4	7.5
44	33.5	12	11.5	25	54	46	33.7	4	35
45	1.5	12	43.5	26	24.8	47	1.2	5	4
45	29	13	14.8	26	55.5	47	28	5	32.2
46	57.5	14	47.5	28	25.5	48	49	6	57.5
47	32.8	15	34.5	29	11	49	30	7	40
48	14	16	20.8	29	56	50	10.5	8	23
48	55	17	7	30	41	50	51	9	5.2
49	36	17	53	31	26	51	32	9	48.5
50	58.5	19	25	32	55.5	52	53	11	14.2
51	25	19	55.5	33	25	53	20.5	11	43.5
51	53	20	26.5	34	55.5	53	48.5	12	12.5
52	20	20	56.5	34	24.8	54	15.5	12	41
52	46.7	21	26.8	34	54	54	42.5	13	9.5
6 48	33.04	7 16	19.56	7 29	55.07	7 50	10.86	8 8	23.52
i_0	+ 4.93		.00		.00		.00		.00
	31.45		26.89		24.66		21.33		18.34
Rate for 10	.13		.12		.11		.09		.08

I	K	log K											
+4	27.0	+.25	823	+5	9.6	1106	+5	1.6	1051	+4	30.4	845	+4	44.3	933
3	59.5	.18	662	4	39.1	899	4	31.1	849	4	3.9	687	4	16.0	758
3	31.5	.12	516	4	8.1	711	4	1.1	671	3	37.2	545	3	48.5	604
3	4.0	.08	391	3	36.1	539	3	30.3	511	3	9.7	416	3	19.5	460
1	41.5	.01	118	3	4.8	395	2	59.6	372	2	42.9	307	2	51.3	339
1	0.2	+.64	42	1	32.1	98	1	29.6	93	1	21.9	78	1	26.0	86
+0	19.0		5	+0	48.1	24	+0	44.1	23	0	40.9	19	0	43.5	22
−0	22.0		6	−0	1.2	0	−0	0.9	0	+0	0.4	0	+0	0.5	0
1	3.0		46	0	47.4	26	0	45.9	24	−0	40.1	18	−0	41.7	20
2	25.5	−.04	245	1	23.4	101	1	30.9	96	1	21.1	76	1	25.0	84
2	52.0	.06	342	3	5.4	397	3	0.4	376	2	42.1	304	2	50.7	337
3	20.0	.11	462	3	35.9	539	3	29.9	509	3	9.6	415	3	20.0	462
3	47.0	.15	595	4	6.9	704	4	0.4	667	3	37.6	547	3	49.0	606
4	13.7	.22	744	4	36.9	885	4	29.7	846	4	4.6	697	4	17.5	766
		−.58		−5	7.2	1090	4	58.9	1031	−4	31.6	852	−4	46.0	945
		+.06	4997			7514			7113			5800			6422
		.00	357			501			474			387			428

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−101.0	−89.7	+.11	+64.2	−568		
+105.6	+95.2	+.13	−56.5	+61.0		
+ 4.6	+ 5.5	+.12	+ 7.7	+ 4.2		
+ 1.2	+ 1.4	−.25	+ 1.9	+ 1.05		
		−.13				
32.0 69.0	35.5 54.2	42.0	22.2	17.8	39.0	
71.3 34.3	57.0 38.2	18.0	38.5	41.0	20.0	
before	after					

Enid. κ Orionis θ Aquarii

[8]	39					
31	56	24.2				
32	40	24.3				
33	23.5	23.7				
34	8.5	24.5				
35	52.5	24.0				
37	7.5	24.2				
38	15.5	24.1				
39	24.5	24.5	4	30	11 38.5	
40	33	23.9	5	16	12 20.5	
41	43.5	24.7	6	2	13 3.5	
42	3.5	23.6	7	34.5	14 28.5	
44	51.5	24.1	8	5	14 56.8	
45	39.5	24.3	8	36	15 25.5	
46	27.5	24.2	9	7.5	15 53	
47	16	24.4	9	38.5	16 21	
8	39 29.50					
9	39	24.18	9	7 21.19	9 14 15.91	
				−38.38	+38.38	
		.00				
	13.22		8.65		7.51	
	.06		.04		.03	

+7	33.5	+1.24	2375	+2	51.2	+.06	339	+2	37.4	+.05	287
6	49.5	.91	1936	2	5.2	+.03	181	1	55.4	+.02	154
6	6.0	.65	1547	+1	19.2	+.01	73	+1	12.4		61
5	21.0	.44	1190	−0	18.3		2	−0	12.6		2
4	37.0	.28	886	0	43.8		22	0	40.9		19
2	22.0	.04	233	1	14.8		65	1	9.6		56
1	14.0	+3.56	64	1	46.3	−.02	130	1	37.1	−.01	109
+0	5.0		0	−2	17.3	−.04	218	−2	5.1	−.03	187
−1	3.5		47			.00	1030			.00	869
2	14.0	−.03	207								
4	34.0	.27	867				129				109
5	22.0	.45	1198								
6	10.0	.67	1581								
6	58.0	.97	1989								
−7	46.5	−1.35	2513								
		−3.74	16633								
		−.01	1109								

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+79.2 −28.5 +76.5 b=+1.18 −64.3 −.65
−28.9 +76.0 −30.2 1.09 +36.0 −.68
+50.3 +47.5 +46.3 1.07 −28.3 −.66
+12.6 +11.9 +11.6 1.11 −7.1 +.38
−.38 b=−.28 clw
c=+.73 clE

W E
51.2 28.0 2.3 26.2
2.6 26.3 50.2 26.0
−9 34 14 39

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50.2 26.3
32 27.0
20 55

20.3 44.0
30.0 6.0
3 41

clE

clW

clc

μ Hydri	δ Trietis	ε Trietis	α Ceti	4 Trietis
27 58.5	58	25.7	3.3	4.2
28 37	12.2	40.5	17.1	19.2
29 15	33.5	27	38	41.1
–	44.2	13.8	48.2	52.2
32 7.5	55.2	24.9	58.7	3.3
33 4.5	6	36.1	9.2	14.4
34 1	16.6	47.1	19.3	25.5
–	37.8	9.2	40.1	47.5
36 52.5	45 52.2	53 24.1	56 54	9 2.5
37 31	44 55.11	52 24.90	55 58.66	10 8 3.32
38 9	−2.48	−1.25	−0.66	+1.32
9 33 4.00	44 52.63	52 23.65	55 58.00	8 4.64
−4.42				
32 59.58	45 49.82	53 20.86	56 55.23	9 0.43
2 33 58.32				
6 69 1.26	2.81	2.79	2.77	4.21
+1.82	+.65	+.62	+.69	−.24
2.49	.89	.85	.94	.85

Red. to 10 00

				Aa	Ca	z	ΔT		
μ Hydri	0 =	3.08	+ΔT −4.93a −5.52c	−.59	+1.49	+.90	3.98]		
−79 33.8		3.46	+.53 −1.03	+.06	+.28	+.34	3.80		
−16 22.5		3.41	+.65 −1.07	+.08	+.29	+.37	3.78	3.78	
−63 11.3		3.46	+.34 −1.00	+.04	+.27	+.31	3.77		
9.95061		3.97	+.64 +1.07	−.09	−.29	−.38	3.59		
0.74196		4.35	−4.15 +4.72	+.58	−1.27	−.69	3.66]	3.66	
9.65424		3.99	+.50 +1.02	−.07	−.28	−.35	3.64		
0.69257		4.04	+.12 +1.01	−.02	−.27	−.29	3.75		
0.39620							ΔT −6 59	3.72	

4.93 0 = 3.44 +ΔT +.51a −1.03c
2.49 4.00 +ΔT +.42a +1.03c
5.52 c = −.27

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+33.0
−62.4
−29.4
−7.4

28.5 4.5
17.7 44.7

Dec. 2

Red. to App. Place. of δ

	τ Orionis	κ Orionis	φ Aquarii	ζ Ceti
ℓ	344 1	344 2	344 2	344 3
d_0	78 8	85 42	347 14	26 35
H	17 8	17 5	17 1	16 58
ℓ+d_0	62 9	69 44	33 1 16	10 38
H+d_0	95 16	102 47	4 15	43 33
δ_0	−6 57.4	−9 42.4	−6 36.6	−10 51.0
log cos(ℓ+d_0)	9.6695	9.5396	9.9429	9.9925
" g	1.3705	1.3706	1.3706	1.3707
Σ_1	1.0400	0.9102	1.3135	1.3632
" cos(H+d_0)	8.9628n	9.3449n	9.9988	9.8602
" ℓ	1.3070	1.3070	1.3071	1.3071
" sin δ_0	9.0832n	9.2269n	9.0611n	9.2747n
Σ_2	9.3530	9.8788	0.3670n	0.4420n
" cos δ_0	9.9968	9.9937	9.9971	9.9922
" i	0.4136	0.4127	0.4112	0.4099
Σ_3	0.4104	0.4064	0.4083	0.4021

ν Hydri	f Tauri	ε Eridani		
52.5	30.6	24.2		
25.5	51.7	45		
16 2.5	2.4	56 ?		
51.5	13.1	6.2		
17 40.5	23.5	16.7		
29.2	34.3	27.2		
19 18.5	24 55.5	48.1	C_1	
20 56.2		2.2	3	
21 28.5		28 16.1	5	
17 40.54	24 13.01	27.6.20		
+2.90	+3.98	+4.45		
17 43.44	24 16.99	27 10.65		
18 38.46	25 12.75	28 6.33		
4.98	4.24	4.32		
−.63	−.25	−.28		
2.26	.90	1.01		

N_1	+10.96	+8.13	+20.58	+23.08
N_2	+ .23	+ .76	− 2.33	− 2.77
N_3	+ 2.57	+ 2.55	+ 2.56	+ 2.52
Σ	+13.76	+11.44	+20.81	+~~23~~22.83
δ_0	−6 57 25.69	−9 42 24.35	−6 36 34.51	−10 51 0.04
δ	~~39.4~~ 11.9	12.9	13.7	50 37.2

0 = 0.36 + 5.44a + 4.49c
= 0.35 − 4.57a′ + 3.69c
5.44a = +0.64
4.57a′ = −0.65
a = +.12
a′ = −.14

10 0 0
−6 59 3.72
3 0 56.28
16 48 5.26
10 12 51.02
1 40.40
11 10.62

Rate on M.J. 1.05 per day
.044 " hour

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+26.3 −74.2 −47.9 −12.0 −1.10 +.25 −.85

−72.4 +25.0 −47.4 −11.8 −1.07 +.25 −.82

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22.8	3.5	24.9	47.5	24.8	50.3	24.8	2.2
27.2	47.0	24.0	1.0	25.5	−1.0	26.2	49.0
Cl. N.		φ Aquarii		θ Cam Maj.		ζ Ceti	
				—		56 51	
				—		57 24.2	
				47 9.5		57 57.2	
				—		58 31	
				48 20		59 4	
33	48	B_1		50 6.2		0 44	
34	28.5			51 0		1 33.5	
35	8.5			—		2 23.5	
35	48.5			52 47.5		3 12	
36	29.2			53 42		4 2	
37	48.5			55 31		5 39	
38	15.5			56 8		6 11	
38	42.5			56 45.5		6 44	
39	8.5			57 22		7 15.8	
39	35			57 58.5		7 48	
10	36	55.27		10 53	20.93	12 2	21.35
		+ 27.60			− 16.31		.00
					8.76		20.10
					.04		.09

12	18	57.53	
		.00	
		22.83	
		.10	

i_0

Rate from 10 0 6.06 .03

I	κ		log k
+3	7.3	+.09	405
2	26.8	.04	249
1	46.8	.02	131
1	6.8	+.15	52
+0	26.1		8
−0	53.2		32
1	20.2	−.01	74
1	47.2	.02	132
2	13.2	.03	205
−2	39.7	.05	295
		−.11	1583
		.00	158

+6	11.4	+.68	1508
5	0.9	.36	1046
3	14.7	.10	438
2	20.9	.04	229
+0	33.4	+1.18	13
−0	21.1		6
2	10.1	−.03	195
2	47.1	.06	323
3	24.6	.16	484
4	1.1	.18	671
−4	37.6	.28	890
		−.66	5803
		+.52	528
		+.05	

+5	30.4	1262
4	57.2	1020
4	24.2	807
3	50.4	613
3	17.4	440
1	37.4	110
+0	47.9	27
−0	2.1	0
0	50.6	30
1	40.6	116
3	17.6	451
3	49.6	609
4	22.6	797
4	54.4	1001
5	26.6	1233
		8516

+4	43.5	928
4	15.0	752
3	47.0	595
3	19.0	458
2	50.5	336
1	26.0	86
0	43.3	22
+0	1.0	0
−0	42.0	20
1	24.5	83
2	50.5	336
3	19.3	459
3	48.0	600
4	16.5	760
−4	45.0	938
		6373

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-77.2
+26.6
-50.6
-12.6 -1.16
+.25
-.91

-77.7 +27.3
+25.3 -77.0
-52.4 -49.7
-13.1 -12.4
1.21 -1.14
-1.18 +.38 .25 = -0.80 -0.93

27.2 50.0 | 28.2 49.5 | 27.0 0.3
(2.0 (246) | (1.5 (238) | 23.0 54.0

γ Can. Maj.	γ Eridani	
28 1.5 ?	—	
29 8	57 50	53.3
30 15	58 38	53.2
31 23.5	59 26.5	53.9
32 34	0 14	53.9
36 7	2 35.2	54.0
37 58	3 44.5	53.6
39 49.5	4 54.5	54.5
41 45.5	6 2.8	54.2
43 44	7 11.	54.3
47 51.5	9 25.5	54.0
49 16	10 10.5	54.5
50 45.5	10 55	54.8
52 13.5	11 39	54.7
53 43.5	12 22.5	54.3
12 40 18.40 .00	13 54 522.07 +4.93 13 4	54.09

26.33 .12 Dec. 7/96 am 30.38 .13
Chron Clock

7 55 23 = 13 13 40
11 15.0
20 8 6 38.0
3 18.2
17 3 51.5
13 13 47.7
+7.7

I		
+7 32.1	+1.23	2360
6 44.1	.87	1886
5 55.6	.60	1460
5 8.1	.39	1097
2 46.9	.06	322
1 37.6	.01	110
+0 27.6	+3.16	9
-0 40.7		19
1 48.9	-.02	136
4 3.4	.19	684
4 48.4	.16	960
5 32.9	.49	1280
6 16.9	.71	1640
-7 0.4	.98	2041
	-2.55	14004
	+.61	1000

γ Eridani

ΔT at 10 00 -6 59 3.72
Red. to 8 39 24 -13.24
Rate chron. - .01
ΔT -6 59 16.97
Red. to 13 4 54 +30.38
Rate chron. + .12
ΔT′ 6 58 33.22

T 8 39 24.18 | T′ 13 4 54.09
ΔT -6 59 16.97 | ΔT′ 6 58 33.22
Σ 1 40 7.21 | Σ′ 6 6 20.87

2ϑ 4 26 13.66
ϑ 2 13 6.83
ϑ° 33 16 425
Σ+Σ′ 7 46 28.08
½(") 3 53 14.04
α 3 53 15.22
λ -1.18
δ -13 47 67.8

b Cl S
b Cl N -0.80
Mean -0.26
b -0.53
= -7.″95

log tan δ 9.390250n
" sec ϑ 0.077786
" tan φ′ 9.468036n
φ′ -16 22 20.0
b -8.0
φ -16 22 28.0

log λ 0.07188n
" cos φ 9.45014n
" a 9.52202

γ Can. Maj

I	K	
+12 16.9	+5.33	6269
11 10.4	4.02	5188
10 3.4	2.93	4204
8 54.9	2.04	3304
7 44.4	1.33	2490
4 11.4	.21	730
2 20.4	.04	227
+0 28.9	+15.90	9
-1 27.1	-.01	88
3 25.6	.12	488
7 33.1	1.23	2371
8 57.6	2.07	3337
10 27.1	3.28	4540
11 55.1	4.87	5904
-13 25.1	-6.97	7499
	-18.55	46648
	-2.65	3110
	-.18	+1
		3111

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Instrument on
Prime vertical pier

Dec. 14/96

dl N

Pivot error Rogers Transit

12.10 – 12.35 pm

Alt	N	S				Alt	N	S			
20 E	36.0	5.5	+41.5			20 W	33.3	3.7	+37.0		
	22.3	53.0	−75.3	−33.8	−8.4		24.0	53.5	−77.5	−40.5	−10.1
30	22.0	52.8	−74.8			30	23.0	52.6	−75.6		
	36.8	6.0	+44.8	−30.0	−7.5		34.2	4.6	+38.8	−36.8	−9.2
40	36.2	5.6	+41.8			40	34.3	4.7	+39.0		
	21.7	52.2	−73.9	−32.1	−8.0		24.3	54.0	−78.3	−39.3	−9.8
50	21.9	52.4	−74.3			50	34.8	5.0	+39.8		
	36.6	5.8	+42.4	−31.9	−8.0		24.0	53.7	−77.7	−37.9	−9.5
50	36.0	5.4	+41.4			50	23.6	53.3	−76.9		
	22.2	52.3	−74.5	−33.1	−8.3		34.3	5.5	+39.8	−37.1	−9.3
40	21.0	51.4	−72.4			40	34.5	4.7	+39.2		
	36.4	6.0	+42.4	−30.0	−7.5		23.9	53.7	−77.6	−38.4	−9.6
30	35.8	5.5	+41.3			30	23.8	53.7	−77.5		
	23.0	52.2	−76.2	−34.9	−8.5		35.2	53	+40.5	−37.0	−9.2
20	22.0	52.1	−74.1			20	35.0	5.0	+40.0		
	35.9	5.8	+41.7	−32.4	−8.1		24.5	54.2	−78.7	−38.7	−9.7

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cl S

12.35 – 1.05 Jesse.

Alt	N	S					N	S			
20 E	48.0	18.3	+66.3			ZW	12.5	42.3	−54.8		
	9.4	39.1	−48.5	+17.8	+4.4		45.3	15.6	+60.9	+6.1	+1.5
30	10.3	40.2	−50.5			30	45.8	16.0	+61.8		
	48.8	19.0	+67.8	+17.3	+4.3		12.6	42.4	−55.0	+6.8	+1.7
40	48.3	18.5	+66.8			40	12.2	42.2	−54.4		
	9.8	39.7	−49.5	+17.3	+4.3		46.1	16.0	+62.1	+7.7	+1.9
50	10.2	40.0	−50.2			50	46.0	16.0	+62.0		
	48.3	18.5	+66.8	+16.6	+4.2		12.3	42.3	−54.6	+7.4	+1.8
50	48.3	18.4	+66.7			50	11.7	41.6	−53.3		
	9.9	39.8	−49.7	+17.0	+4.2		46.5	16.5	+63.0	+9.7	+2.4
40	9.9	39.8	−49.7			40	46.6	16.6	+63.2		
	48.0	18.2	+66.2	+16.5	+4.1		11.8	41.8	−53.6	+9.6	+2.4
30	47.9	17.9	+65.8			30	12.3	42.3	−54.6		
	9.1	39.0	−48.1	+17.7	+4.4		46.0	15.9	+61.9	+7.3	+1.8
20	9.2	39.1	−48.3			20	46.2	16.0	+62.2		
	48.6	18.8	+67.4	+19.1	+4.8		11.5	41.5	−53.0	+9.2	+2.3

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Result

Alt.	Dec. 14		Dec. 18	Dec. 19	Dec. 14		Dec. 18		Dec. 19
	dl. N.				dl S.				
20 E	$-8.2^{d} = -.75^{s}$		$-8.0 = -.74$	$-.70 + 4.6 = +.42$			$+3.4 = +.31$		$+.23$
30	8.0	.74	8.3	.76 -.71 4.4	.40		3.0	.28	.17
40	7.8	.72	8.4	.77 -.74 4.2	.39		3.2	.29	.25
50	8.2	.75	8.0	.74 -.72 4.2	.39		3.0	.28	.30
		-.740		-.752 -.718	+.400			+.290	+.238
20 W	$-9.9 = -.91$		$-7.2 = -.66$	$-.74 + 1.9 = +.17$			$+2.4 = +.22$		.14
30	9.2	.85	8.0	.76 -.76 1.8	.17		2.4	.22	.18
40	9.7	.79	7.9	.73 -.76 2.2	.20		2.6	.24	.23
50	9.4	.86	8.0	.74 -.66 2.1	.20		2.2	.20	.20
		-.852		-.722 -.730	+.185			+.220	.188
Mean		-.796		-.737 -.724	+.292			+.255	+.213

Dec. 14 $f = \frac{+.292 + .796}{4} = \frac{1.088}{4} = +0.272$ dl N.

18 $f = \frac{+.\overset{55}{272} + .\overset{37}{744}}{4} = \frac{\overset{0992}{1.016}}{4} = +0.\overset{248}{254}$ dl N

19 $f = \frac{+.213 + .724}{4} = \frac{0.937}{4} = +0.234$ dl N.

$+0.25$

See pf. 176, 177 for values on meridian pier and discussion of formulae and p. 216 for further remarks.

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Formulæ for Reduction of Prime Vertical Transits for Latitude.

In the observations made at Arequipa and recorded in this book, stars were observed at E transit and others at W transit, the instrument reversed near the middle of the series. Observations for clock correction made on the meridian with the duplicate frame were also made near the middle of the series. The method of reduction is therefore that of Bessel Chauv. II pp 265-270 with modifications as below. As in one case (γ Eridani) the same star was observed at both E + W transits the method Chauv. II pp. 252, 253 was also used (See pp 190, 191, 197)

The following are the formulæ:-

(Letters used as in Chauvenet II pp. 265-270.)

Transits over several threads reduced by tables VIII

i° obtained from thread intervals p. 179, ~~sign changed for southern hemisphere~~.

(1) $T_1 = T + K$

(2) $\tau_1 = T_1 + \Delta T - \alpha$ $\quad [\tau_1 \mp$ for $\begin{matrix}E\\W\end{matrix}$ transits$]$

(3) $\tan \varphi_1 = k \tan \delta \sec \tau_1$

(4) $\tan z = \tan \tau_1 \cos \varphi_1$, z and $\tau \pm$ for $\begin{matrix}W\\E\end{matrix}$ transit

$\frac{c + i^\circ}{\gamma} = (\varphi - \varphi_1 - b)\cos z + a \sin z$

(5) $\therefore \varphi = \varphi_1 + b + \frac{c + i^\circ}{\gamma} \sec z - a \tan z$

b is determined by level

c by observations on meridian

a by observations of γ Eridani

(6) $a = \lambda \sin \varphi^*$ Chauv. (176) or better $a = (\varphi_1 - \varphi_0) \cot z$

Chauv. p. 269 Note

* Incorrect if axis is reversed between observations as T and T' are affected in the same direction. Chauv. II p 252 Note

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Each star gives an approximate value of φ. By the above formulæ, the assumed value φ_0 adopted from the reduction of γ Eridani. As an approximate value of c is known the formulæ used in forming the equations of condition may be modified thus:

$$\left(\frac{c_0}{\gamma} + \Delta\frac{c}{\gamma} + \frac{i_0}{\gamma}\right)\sec z = \varphi_0 + \Delta\varphi - \varphi_1 - b + (a_0 + \Delta a)\tan z$$

$$f = \varphi_1 + b - \varphi_0 - a_0 \tan z + \frac{c_0 + i_0}{\gamma}\sec z \;\#$$

$$\therefore \Delta\frac{c}{\gamma}\sec z + f - \Delta\varphi - \Delta a \tan z = 0$$

$$\text{or } C\overset{\Delta}{c} - A\overset{\Delta}{a} - \Delta\varphi + f = 0$$

The following precepts are to be noted in fixing the significance of the quantities and their signs in the southern hemisphere:

Formulæ (3) (4) + (5) show that a is + when φ_1 is too great or τ too great, numerically, W transit. This occurs when the N. end of the axis is W of the true N, for then the star reaches the prime vertical before it crosses the collimation axis.

The formulæ also show that b is + when φ_1 is too small numerically, or when the zenith of the instrument is nearer the equator than the true zenith. This occurs when S end of axis is too high. If however φ is − in southern hemisphere, then sign of b is + when N end of axis is too high.

The formulæ also show that c is + when φ_1 is too small numerically, or τ too small. This occurs when the star reaches the collimation axis before the thread for E transit, after the thread

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for W transit. When c is determined from meridian observations, it is + when thread is reached before collimation axis. In the telescope with diagonal eyepiece this is apparently east of collimation axis. Hence in transferring telescope to prime vertical pier, Cl W corresponds with Cl S as far as signs of c is concerned. But if ϕ_1 is to regarded − in southern hemisphere, Cl W corresponds with Cl N

	App. motions	Left		Right		
Facing	N	W	←	E	meridian tr.	
	S	E	→	W	" "	
	E	N	←	S	from vert. "	
	W	S	←	N	" " "	

The sign of i_0 is + or − according as mean of threads observed is later or earlier than mean of all the threads. Correction $i_0 \sec z$ is numerically + when ϕ_1 is too small or τ too small. In E transits this occurs when mean of observed times is later than mean of all, and in W transits when earlier. But if ϕ is taken −, then i_0 is − for late transits E and + for late transits W.

See Jfp 223, 225

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$\log a_0$ 0.05328n p. 191

a_0 −1.13

Reduction of Observations Nov. 30/96

Cl. N.

	ε Aquarii	μ Aquarii	τ Orionis	β Orionis	γ Eridani	κ Orionis
$T' = T + K$	7 25 12.23	7 37 48.42	7 58 6.77	8 16 19.35	8 47 27.78	9 12 27.20
ΔT	−7 7 24.41	7 7 22.33	7 7 18.98	7 7 15.98	7 7 10.84	7 7 6.71
Σ	0 17 47.82	0 30 26.09 ✓	0 50 47.79	1 9 3.37	1 40 16.94	2 5 20.49
λ	20 47 5.77	20 47 5.71	5 12 38.02	5 9 36.96	3 53 15.21	5 42 53.98
τ_1	+3 35 42.10	+3 43 20.38	−4 21 50.23	−4 0 33.59	−2 12 58.27	−3 37 33.49
	53 55 31.5	55 50 5.7	65 27 33.45	60 8 23.85	33 14 34.03	54 23 22.35
α δ	−9 52 25.4	−9 22 14.8	−6 57 11.5	−8 19 4.9	−13 47 57.4	−9 42 12.4
log tan δ	9.240688n	9.217 68 tn	9.086201n	9.164964n	9.390246n	9.232983n
" k	44	47	39	43	112	32
" sec τ_1	0.230004	0.250589	0.381597	0.302873	0.077609	0.234875
" tan ϕ_1	9.470736n	9.468 37 7n	9.467837n	9.467880n	9.467967n	9.467890n
" cos ϕ_1	9.98181	9.98200	9.98204	9.98204	9.98203	9.98203
" tan τ_1	0.13755	0.16832	0.34048n	0.24101n	9.81654n	0.14496n
" tan z	0.11936	0.15032	0.32252n	0.22305n	9.79857n	0.12699n
" a tan z	0.17264n	0.20360n	0.37580	0.27633	9.85185	0.18027
c	−.14	−.14	−.14	−.14	−.14	−.14
ι_0	+13.22					
$c + \iota_0$	+13.08					
" "	1.11661	9.14613n	9.14613n	9.14613n	9.14613n	9.14613n
" cos z	9.78170	9.76157	9.62497	9.71051	9.92764	9.77684
" $\frac{c+\iota_0}{\cos z}$	1.33491	9.38456n	9.52116n	9.43562n	9.21849n	9.36929n
$\frac{c+\iota_0}{\cos z}$	+21.62	− .24	− .33	− .27	− .17	− .23
− a tan z	+1.49	+1.60	− 2.38	− 1.89	− 0.71	− 1.51
b	− .60	− .66	− .74	− .68	− .65	− .80
Σ	+22.51 =	+ .70	−3.45	− 2.84	− 1.53	−2.54
	+5 37.6	+ 10.5	−51.8	− 42.6	− 23.0	− 38.1
ϕ'	−16 28 7.7	22 39.4	21 54.5	22 0.0	22 11.2	22 1.3
ϕ	−16 22 30.1	28.9	46.3	42.6	34.2	39.4

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Cl. A.

δ Aquarii	λ Aquarii	θ Camillaj.	i Celæ	α Hydræ	γ Camillaj.	γ Indiani
9 22 8.62	10 0 11.28	11 5 12.00	11 8 41.75	12 26 35.98	12 48 0.76	13 13 21.89
7 7 5.11	7 6 ~~57.85~~ 58.83	7 6 48.10	7 6 47.53	7 6 34.66	7 6 31.12	7 6 26.95
2 15 3.51	2 53 ~~15.43~~ 12.45	3 58 23.90	4 1 54.22	5 20 1.32	5 41 29.64	6 6 54.94
22 11 24.17 ,17	22 47 ~~14.96~~ 14.89	6 49 25.73 .75	0 14 11.56 .73	9 22 32.36 .36	6 59 7.36 .33	3 53 16.21 .12
+4 3 39.34	+4 5 58.47 57.56 23.40	−2 51 1.83 .85	+3 47 42.66 37.35 .49	−4 2 31.04	−1 17 37.72 .69	+2 13 39.73 57.30 .82 .35
60 54 50.1	61 29 37.05 39.9	42 45 27.45 24.5	56 55 39.1 39.8	60 37 45.6 36.0	19 24 25.8 41.3	33 24 55.95 .6
−8 17 47.2 47.2	−8 7 39.3 75	−11 54 23.9 8	−9 23 40.1 2	−8 12 36.3 07	−15 28 41.5 4	−13 47 57.4 8
9.163820n	9.154766n	9.323982n	9.218666n	9.159212n	9.442346n	9.390246n
11	14	1	10	43	309	100
0.313253	0.3212485 195	0.134167 8	0.263049 1	0.309399	0.025405	0.078470 2
9.477084n	9.476028n 5984	9.458150n 57	9.481715n 03	9.468654n 49	9.468060n 58	9.468816n 20
9.98129	9.98138	9.98279	9.98090	9.98197	9.98202	9.98196
0.25471	0.26512	9.96597n	0.18628	0.24965n	9.54691n	9.81939
0.23600	0.24650	9.94876n	0.16718	0.23162n	9.52893n	9.80135
0.28928n	0.29978n	0.00204	0.22046n	0.28490	9.58221.	9.85463n
∓.14	∓.14	+.14	+.14	+.14	+.14	+.14
+38.38	+32.97	−62.10	+65.55	+2.96		+4.93
+38.24	+32.83	−61.96	+65.69	+3.10		+5.07
1.58252	1.51627	1.79211n	1.81750	0.49136	9.14613	0.70501
9.70089	9.69299	9.87360	9.75018	9.70416	9.97650	9.92684
1.88163	1.82328	1.91851n	2.06732	0.78720	9.16963	0.77817
+76.14	+66.57	−82.89	+116.77	+6.13	+.15	+6.00
+1.95	+1.99	−1.00	+1.66	−1.93	−0.38	+0.72
−.84	−.84	−.22	−.22	−.22	−.22	−.22
+77.25	+67.72	−84.11	+118.21	+3.98	−.45	+6.50
+19 18.8	+16 55.8	−21 1.6	+29 33.2	+59.7	−6.8	+1 37.5
41 52.5	39 ~~28.8~~ ~~34.5~~	1 ~~23.2~~ ~~23.3~~	~~52~~ ~~44~~ 51 58.8	23 ~~38.9~~ ~~39.5~~ 39.2	22 ~~23.9~~ ~~23.1~~ 7	24 0.3 8 23.3
33.7	33.0 38.7	248 23.9	25.6 27.2	29.8	29.9	22.8

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Reduction to apparent place.

	Nov. 30/96			Dec. 2/96		
	ε Aquarii	θ Can. Maj.	γ Can. Maj.	ε Aquarii	θ Can. Maj.	γ Can. Maj.
$\mathcal{G}$	343 40	343 42	343 42	344 1	344 3	344 3
α_0	310 31	102 20	104 46	310 31	102 20	104 46
H	19 1	18 54	18 53	17 10	17 2	16 57
$\mathcal{G}+\alpha_0$	294 11	86 2	88 28	294 32	86 23	88 49
$H+\alpha_0$	329 32	121 14	123 39	327 41	119 22	121 43
δ_0	−9 52.6	−11 54.5	−15 28.8	−9 52.6	−11 54.5	−15 28.8
log tan δ_0	9.2408n	9.3240n	9.4424n	9.2408n	9.3240n	9.4424n
" sin$(\mathcal{G}+\alpha_0)$	9.9601n	9.9990	9.9998	9.9589n	9.9991	9.9999
" g	1.3688	1.3688	1.3688	1.3705	1.3707	1.3707
" $\frac{1}{15}$	8.8239	8.8239	8.8239	8.8239	8.8239	8.8239
" h	1.3063	1.3063	1.3063	1.3071	1.3071	1.3071
" sin$(H+\alpha_0)$	9.7050n	9.9320	9.9204	9.7280n	9.9403	9.9298
" sec δ_0	0.0065	0.0094	0.0160	0.0065	0.0094	0.0160
Σ_1	9.3936	9.5157n	9.6349n	9.3941	9.5177n	9.6369n
Σ_2	9.8417n	0.0716	0.0666	9.8655n	0.0807	0.0768
f	+3.440	+3.440	+3.440	+3.459	+3.461	+3.461
N_1	+ .247	− .328	− .431	+ .248	− .329	− .433
N_2	− .695	+ 1.179	+ 1.166	− .734	+ 1.204	+ 1.193
Σ	+2.99	+ 4.29	+ 4.18	2.97	4.34	4.22
α_0	20 42 2.73	6 49 21.44	6 59 3.18	2.73	21.44	3.18
α	20 42 5.72	6 49 25.73	6 59 7.36	5.70	25.78	7.40

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1896phae.proj.1171U

Nov. 30/96

	ε Aquarii	τ Orionis	κ Orionis	θ Can. Maj.	ι Cetí	γ Can. Maj.	Seef. 195
l		343 40	343 41	343 42			
α_0		78 8	85 42	3 32			
H		19 1	18 57	18 54			
$l+\alpha_0$		61 48	69 23	347 14			
$H+\alpha_0$		97 9	104 39	22 26			
δ_0		−6 57.4	−9 42.4	−9 24.0			
log cos$(l+\alpha_0)$	9.61124 183	9.6744	9.5467	8.8400 .7999	9.9891	8.4275	8.3150
" g	1.3688 705	1.3688	1.3688	1.3688 705	1.3688	1.3688	1.3705
Σ_1	0.9812 .9788	1.0432	0.9155	0.2088 .1704	1.3579	9.7963	9.6855
" cos$(H+\alpha_0)$	9.9355 269	9.0951n	9.4030n	9.7148n .6906n	9.9658	9.7486n	.7208n
" h	1.3063 71	1.3063	1.3063	1.3063 071	1.3063	1.3063	3071
" sin δ_0	9.2343n 43	9.0832n	9.2269n	9.3146n 146	9.2131n	9.4264n	4264n
Σ_2	0.4761 n683	9.4846	9.9362	0.3357 123	0.4852n	0.4763	.4543
" cos δ_0	9.9935	9.9968	9.9987	9.9906	9.9941	9.9840	
" i	0.4586 .4144	0.4570	0.4561	0.4544 .4108	0.4548 3f	0.4529	.4092
Σ_3	0.4521 .4079	0.4538	0.4498	0.4450 .4014	0.4484	0.4369	.3932
N_1	+ 9.58 9.75	+ 11.05	+ 8.23	+ 1.62 1.48	+ 22.80	+ .63	.48
N_2	− 2.99 2.94	+ .31	+ .86	+ 2.17 2.05	− 3.06	+ 2.99	2.85
N_3	+ 2.83 2.56	+ 2.84	+ 2.82	+ 2.79 252	+ 2.81	+ 2.73	2.47
Σ	+ 9.42 9.37	+ 14.20	+ 11.91	+ 6.58 6.05	+ 22.65	+ 6.35	5.80
δ_0	−9 52 34.86	−6 57 25.69	−9 42 24.35	−11 54 30.48	−9 24 2.77	−15 28 47.83	
δ Nov. 30	−9 52 ~~44.3~~ 25.4	−6 57 ~~39.9~~ 11.5	−9 42 12.4	−11 54 23.9	−9 23 40.1	−15 28 41.5	
Dec. 2		25.5		24.4			42.0

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1896phae.proj.1171U

Instrument on
Prime vertical Pier

Dec. 18/96

Print error Rogers Transit 8.30 – 9.00 am

cl S Alt.	N	S					N	S			
20 E	7.0	46.2	−53.2			20W	8.7	46.0	−54.7		
	53.3	14.5	+67.8	+14.6	+3.6		50.5	13.2	+63.7	+9.0	+2.2
30	52.8	14.0	+66.8			30	50.7	13.3	+64.0		
	6.8	45.3	−52.1	+14.7	+3.7		9.2	46.4	−55.6	+8.4	+2.1
40	7.8	46.3	−54.1			40	9.0	46.3	−55.3		
	52.5	14.0	+66.5	+12.4	+3.1		51.0	13.8	+64.8	+9.5	+2.4
50	52.0	13.7	+65.7			50	50.5	13.5	+64.0		
	7.2	45.5	−52.7	+13.0	+3.2		9.7	46.6	−56.3	+7.7	+1.9
50	7.5	45.7	−53.2			50	9.6	46.6	−56.2		
	51.2	13.0	+64.2	+11.0	+2.8		51.6	14.7	+66.3	+10.1	+2.5
40	51.2	13.0	+64.2			40	51.2	14.0	+65.2		
	6.7	44.5	−51.2	+13.0	+3.2		8.6	45.3	−53.9	+11.3	+2.8
30	8.5	46.5	−55.0			30	8.4	45.3	−53.7		
	51.2	13.5	+64.7	+9.7	+2.4		50.8	14.0	+64.8	+11.1	+2.8
20	50.6	12.8	+63.4			20	50.6	13.8	+64.4		
	6.3	44.0	−50.3	+13.1	+3.3		8.3	45.2	−53.5	+10.9	+2.7

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1896phae.proj.11710

9.05 – 9.35 a.m.

cl N

	N	S					N	S			
20 E	18.4	55.2	−73.6	−31.4	−7.8	20 W	19.0	55.2	−74.2	−29.7	−7.4
	39.4	2.7	+42.1				40.2	4.3	+44.5		
30	39.9	3.0	+42.9	−31.8	−8.0	30	40.3	4.3	+44.6	−31.3	−7.8
	19.0	55.7	−74.7				19.9	56.0	−75.9		
40	18.9	55.9	−74.8	−34.2	−8.6	40	20.1	56.3	−76.4	−33.8	−8.4
	38.7	1.9	+40.6				39.2	3.4	+42.6		
50	39.5	2.9	+42.4	−32.4	−8.1	50	39.0	3.2	+42.2	−32.6	−8.2
	19.2	55.6	−74.8				19.6	55.2	−74.8		
50	19.3	56.1	−75.4	−31.6	−7.9	50	19.8	55.6	−75.4	−31.5	−7.9
	40.1	3.7	+43.8				39.8	4.1	+43.9		
40	39.8	3.3	+43.1	−32.9	−8.2	40	40.4	4.8	+45.2	−29.7	−7.4
	19.8	56.2	−76.0				19.7	55.2	−74.9		
30	19.6	56.1	−75.7	−34.3	−8.6	30	20.6	56.4	−77.0	−32.7	−8.2
	38.9	2.5	+41.4				40.0	4.3	+44.3		
20	38.9	2.4	+41.3	−33.0	−8.2	20	40.5	4.9	+45.4	−28.4	−7.1
	19.0	55.3	−74.3				19.0	54.8	−73.8		

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1896phae.proj.11711

Instrument on
Meridian pier
9.40 – 10.10 am.

bb E.

Alt.	N	E				Alt.	W	E			
20 N	53.0	17.7	+70.7	+23.0	+5.8	20 S	52.1	17.5	+69.6	+21.6	+5.4
	6.2	41.5	−47.7				6.7	41.3	−48.0		
30	6.3	41.8	−48.1	+20.9	+5.4	30	6.5	41.0	−47.5	+22.6	+5.6
	52.2	16.8	+69.0				52.2	17.9	+70.1		
40	52.2	16.8	+69.0	+22.9	+5.7	40	52.3	17.9	+70.2	+22.8	+5.7
	5.4	40.7	−46.1				6.5	40.9	−47.4		
50	5.8	41.1	−46.9	+23.7	+5.9	50	6.6	41.0	−47.6	+24.7	+6.2
	52.9	17.7	+70.6				53.3	19.0	+72.3		
50	53.0	17.7	+70.7	+23.0	+5.8	50	53.2	18.7	+71.9	+25.8	+6.4
	6.3	41.4	−47.7				6.0	40.1	−46.1		
40	6.8	42.0	−48.8	+20.4	+5.1	40	6.4	40.5	−46.9	+23.1	+5.8
	52.1	17.1	+69.2				52.0	18.0	+70.0		
30	52.8	17.8	+70.6	+23.0	+5.8	30	52.8	18.7	+71.5	+23.5	+5.9
	6.4	41.2	−47.6				7.0	41.0	−48.0		
20	6.4	41.3	−47.7	+23.3	+5.8	20	6.8	40.8	−47.6	+23.6	+5.9
	52.9	18.1	+71.0				52.6	18.6	+71.2		

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1896phae.proj.11710

10.10 – 10.45 am

cl W

Alt	W	E				Alt	W	E			
20 N	20.2	54.1	−74.3	−28.2	−7.0	20 S	20.7	53.8	−74.5	−28.2	−7.0
	39.9	6.2	+46.1				39.6	6.7	+46.3		
30	39.7	6.0	+45.7	−28.1	−7.0	30	39.3	6.3	+45.6	−25.8	−6.4
	20.1	53.7	−73.8				19.2	52.2	−71.4		
40	20.4	54.1	−74.5	−28.8	−7.2	40	19.8	53.0	−72.8	−28.5	−7.1
	39.6	6.1	+45.7				38.5	5.8	+44.3		
50	39.7	6.0	+45.7	−29.2	−7.3	50	38.9	5.8	+44.7	−30.5	−7.6
	20.8	54.1	−74.9				21.2	54.0	−75.2		
50	21.0	54.7	−75.7	−29.0	−7.2	50	21.0	54.2	−76.2	−31.0	−7.8
	40.0	6.7	+46.7				38.4	5.8	+44.2		
40	39.8	6.3	+46.1	−27.2	−6.8	40	38.5	5.8	+44.3	−30.5	−7.6
	20.0	53.3	−73.3				21.0	53.8	−74.8		
30	20.0	53.5	−73.5	−27.4	−6.8	30	21.5	54.3	−75.8	−30.6	−7.6
	39.8	6.3	+46.1				38.9	6.3	+45.2		
20	39.7	6.2	+45.9	−27.5	−6.9	20	38.9	6.2	+45.1	−26.9	−6.7
	20.0	53.4	−73.4				19.8	52.2	−72.0		

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1896phae.proj.11711

Instrument on
Meridian Piers

Dec. 19/96

8.30 – 9.00 am

Clw

Alt.	W	E					W	E			
20 S	17.8	57.2	-75.0			20 N	17.7	55.1	-72.8		
	40.3	1.2	+41.5	-33.5	-8.4		40.0	2.8	+42.8	-30.0	-7.5
					.77						.69
30	40.5	1.4	+41.9			30	40.0	2.8	+42.8		
	17.9	56.7	-74.6	-32.7	-8.2		18.8	55.9	-74.7	-31.9	-8.0
					.75						.74
40	18.3	57.2	-75.5			40	18.2	55.2	-73.4		
	40.9	2.3	+43.2	-32.3	-8.1		40.7	3.8	+44.5	-28.9	-7.2
					.75						.66
50	40.0	1.5	+41.5			50	40.7	3.9	+44.6		
	18.1	56.7	-74.8	-33.3	-8.3		19.0	55.8	-74.8	-30.2	-7.6
					.76						.70
50	18.2	58.8	-75.0			50	18.8	55.4	-74.2		
	40.9	2.7	+43.6	-31.4	-7.8		40.6	4.1	+44.7	-29.5	-7.4
					.72						.68
40	40.6	2.2	+42.8			40	40.3	3.9	+44.2		
	18.6	56.7	-75.3	-32.5	-8.1		19.6	55.9	-75.5	-31.3	-7.8
					.75						.72
30	18.7	56.9	-75.6			30	19.0	55.1	-74.1		
	40.9	2.9	+43.8	-31.8	-8.0		42.0	6.0	+48.0	-36.1	-9.0
					.74						.83
20	40.0	2.1	+42.1			20	41.2	5.2	+46.2		
	18.9	56.6	-75.5	-33.4	-8.4		21.0	57.0	-78.0	-31.8	-8.0
					.77						.74

		Middle	Mean
Mer. pier Level W end of axis		36.6	37.2	36.9
" middle " "		38.5	38.5	38.5
" E end " "		40.5	40.2	40.2

		Middle	Mean
Pr. Vert pier N end		28.8	29.4	29.1
middle		26.2	27.0	26.6
S end		27.5	29.0	28.2

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9.05 – 9.40 am.

Cl E

Alt	W	E					W	E			
20 S	58.0	23.0	+82.0			20 N	55.2	19.8	+75.0		
	7.9	43.8	-51.7	+30.3	+7.6 .70		4.9	40.0	-44.9	+30.1	+7.5 .69
30	8.0	43.9	-51.9			30	4.9	40.0	-44.9		
	57.1	21.7	+78.8	+26.9	+6.7 .62		56.1	21.0	+77.1	+32.2	+8.0 .74
	tightened side screws level										
40	58.3	23.0	+81.3			40	55.4	20.3	+75.7		
	5.9	41.0	-46.9	+34.4	+8.6 .79		5.0	39.9	-44.9	+30.8	+7.7 .71
							* Struck end of tel. in reversing				
50	5.8	40.8	-46.6			50	4.9	39.9*	-44.8		
	58.3	23.6	+81.9	+35.3	+8.8 .81		55.1	20.2	+75.3	+30.5	+7.6 .70
50	58.3	23.6	+81.9			50	55.0	19.9	+74.9		
	5.1	40.0	-45.1	+36.8	+9.2 .85		4.4	39.1	-43.5	+31.4	+7.8 .72
	shut shutter										
40	5.8	41.0	-46.8			40	5.0	39.9	-44.9		
	57.0	21.3	+78.3	+31.5	+7.9 .73		55.2	20.5	+75.7	+30.8	+7.7 .71
30	56.9	21.1	+78.0			30	55.1	20.2	+75.3		
	5.6	41.0	-46.6	+31.4	+7.8 .72		4.9	39.3	-44.2	+31.1	+7.8 .72
20	5.0	40.6	-45.6			20	4.8	39.3	-44.1		
	55.5	20.0	+75.5	+29.9	+7.5 .69		54.8	20.3	+75.1	+31.0	+7.8 .72

Cl E 20N level Wendy ones 53.8 19.3 54.5 20.0 56.5 22.0 clamped to N

" middle 55.8 21.2 55.8 21.2 53.5 19.0 " " S

" E 57.8 23.2 57.3 23.0 56.0 20.4 middle

Reductions on succ. page.

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1896phae.proj.11711

Instrument on
Fennic vertical fiber

9.55 – 10.30 am

Cl N Alt	N	S						Cl E Alt	N	S					
20 W	20.5	55.5	-76.0					20 E	21.2	54.1	-75.3				
	38.9	5.3	+44.2	-31.8	-8.0	.72			39.1	6.5	+45.6	-29.7	-7.4	.68	
30	39.0	5.4	+44.4					30	40.0	7.1	+47.1				
	22.4	55.9	-78.3	-33.9	-8.5	.78			22.1	55.0	-77.1	-30.0	-7.5	.69	
40	21.8	55.2	-77.0					40	22.7	55.8	-78.5				
	38.2	5.0	+43.2	-33.8	-8.4	.77			39.3	6.7	+46.0	-32.5	-8.1	.75	
50	38.0	4.8	+42.8					50	39.3	6.7	+46.0				
	19.2	52.3	-71.5	-28.7	-7.2	.66			22.1	54.9	-77.0	-31.0	-7.8	.72	
50	20.6	53.8	-74.4					50	22.9	55.3	-78.2				
	39.0	6.1	+45.1	-29.3	-7.3	.67			39.6	7.0	+46.6	-31.6	-7.9	.73	
40	38.9	5.7	+44.6					40	39.4	6.9	+46.3				
	22.3	55.3	-77.6	-33.0	-8.2	.75			22.7	55.0	-77.7	-31.4	-7.8	.72	
30	21.8	54.8	-76.6					30	22.2	54.8	-77.0				
	38.4	5.7	+44.1	-32.5	-8.1	.75			38.8	6.5	+45.3	-31.7	-7.9	.73	
20	38.0	6.1	+44.1					20	38.5	6.2	+44.7				
	21.9	54.8	-76.7	-32.6	-8.2	.75			21.7	54.0	-75.7	-31.0	-7.8	.72	

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cl S

Alt.	S #	N #			
			10.35 – 10.55 am		
20 W	16.0	48.3	+64.3		
	45.0	12.8	−57.8	+6.5	+1.6
					.15
30	45.0	12.7	−57.7		
	16.0	48.3	+64.3	+6.6	+1.6
					.15
40	16.1	48.4	+64.5		
	42.5	10.2	−52.7	+11.8	+3.0
					.28
50	43.3	11.1	−54.4		
	16.1	48.3	+64.4	+10.0	+2.5
					.23
50	15.6	48.0	+63.6		
	44.1	11.9	−56.0	+7.6	+1.9
					.17
40	43.8	11.3	−55.1		
	15.4	47.9	+63.3	+8.2	+2.0
					.18
30	44.3	11.8			
	~~44.8 47.2~~		−56.1		
	16.4	49.0	+65.4	+9.3	+2.3
					.21
20	16.0	48.6	+64.6		
	45.6	13.0	−58.6	+6.0	+1.5
					.14

12.20

~~10.35~~ – 12.35 pm

	S	N			
20 E	42.7	10.0	−52.7		
	15.4	48.0	+63.4	+10.7	+2.6
					.24
30	15.1	47.8	+62.9		
	44.2	11.8	−56.0	+6.9	+1.7
					.16
40	43.6	10.0	−53.6		
	16.0	48.8	+64.8	+11.2	+2.8
					.26
50	16.0	48.8	+64.8		
	42.1	9.4	−51.5	+13.3	+3.3
					.30
50	43.0	10.2	−53.2		
	16.7	49.3	+66.0	+12.8	+3.2
					.29
40	15.9	48.6	+64.5		
	43.8	10.7	−54.0	+10.5	+2.6
					.24
30	44.9	12.0	−56.9		
	16.0	48.9	+64.9	+8.0	+2.0
					.18
20	15.8	48.7	+64.5		
	43.8	11.0	−54.8	+9.7	+2.4
					.22

			S	N	
	43.8	11.0	clamped to E		
	44.8	12.0		W	
	44.3	11.6	middle		

		S	N	S	N
cl S	20 E level	Sund axes	44.0	11.0	45.5	12.5
		middle	42.6	9.7	43.3	10.6
		N and S axes	45.3	12.3	46.8	13.0

Reduction p. 212

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Remarks on pivot irregularities.

The observations for pivot correction pp. 174-177, 198-200, 208-215 show that this correction is large and must be taken into account in all reductions. The difficulty of determining where the axis rests in its curved wyes and where the level wyes rest upon the axis causes an uncertainty in the numerical value which affects the hundredths figure and perhaps the tenths figure. Experiments made by placing very thin paper at various places showed that the bearing is along the whole surface of a + b (fig. p. 177) White powder placed along a + b ~~show~~ was more disturbed upon the upper parts of a + b west axis meridian pier and upon the lower parts of a + b east " " ". The pivot vertical axis wyes showed irregular wearing at various places of a + b and decided pressure at d on the east sides of both wyes. The wyes do not appear to have been polished with much care. The pivots of the telescope however have been carefully polished. These facts, affecting the numerical value of the correction, show the necessity of eliminating the correction as far as possible in the latitude work.

In order to determine whether the pivots are cylindrical or conical, the level frame was moved to various places on the axis pp 213, 215. The reduction p 212 shows no evidence that the error in assuming the cylindrical shape is larger than the uncertainty in the level readings themselves, which is certainly 1 or 2 divisions. Hence it is neglected but care

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was taken to place the level carefully in the same position on the axis, determined on the meridian pier by the brass strap which clamps the axis on the eastern end, and on the prime vertical pier by the holes bored in the top of each wye. Care was also taken to have the level frame vertical. The observations pp 213, 215 show that an extreme error of 1–2 div. may arise from this cause, with the present adjustment of the level in its frame.

A comparison of the separate results pp. 176 and 200 shows no irregularities in the form of the pivots greater than the uncertainties of the determination.

The difference in diameter of the pivots indicated by the observations is as follows:

$r' - r = p\, I_0 \sin i \sin 15''$ Chauv. II p. 157

$p = 0.25$ pr. vert., 0.35 mer.

$I_0 = 20.0$ inches

$i = 31°$

log p	9.39794	9.54407
" I_0	1.30103	
" $\sin i$	9.71184	
" $\sin 15''$	5.86167	
" $r' - r$	6.27248	6.41861
$r' - r$	0.0002 in.	0.0003 in.

The diameter of the pivots is 2.0 inches

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Transit House.

The transit house was designed and built for the Rogers transit at Harvard College Observatory and sent to Arequipa in sections.

In setting it up the following minor changes were made:

The floor timbers and flooring were altered about the piers, which were made of larger dimensions than the Cambridge plan called for.

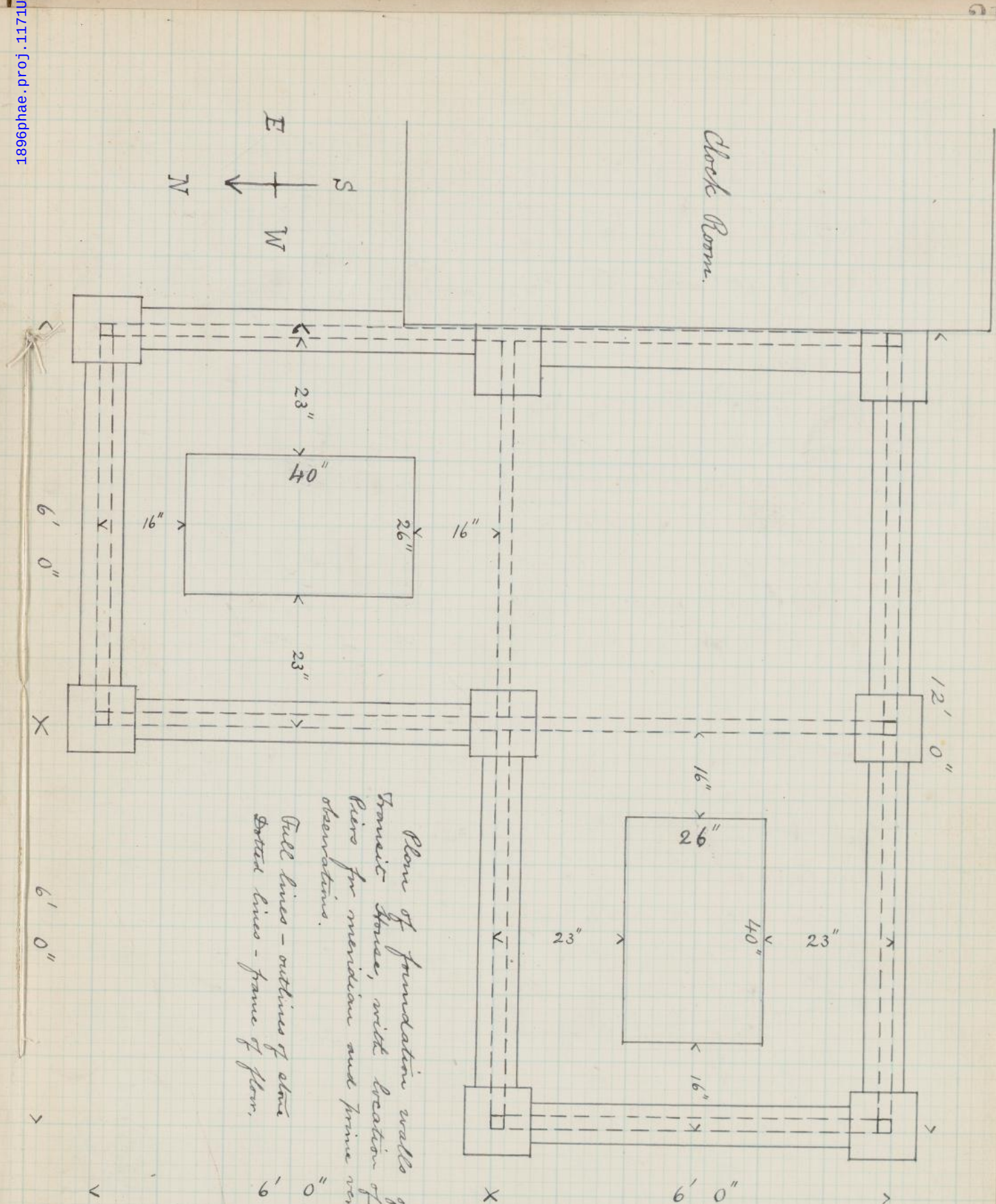
The building was placed close to the Clock Room of the Observatory and part of the side of the building not used, that the wall of the Clock Room might form part of the side of the room.

Shutters were cut in the eastern part of the roof that an opening might be made in the line of the meridian over the prime vertical pier. This rendered possible the use of a second transit instrument in the meridian. The roof timbers were not cut and interfere a little with observing. The Draper transit was mounted on the second pier and used in meridian simultaneously with the Rogers transit on the regular meridian pier.

Shutters were cut in the vertical walls N and S of the meridian pier so that the telescope might be pointed as low as the horizon.

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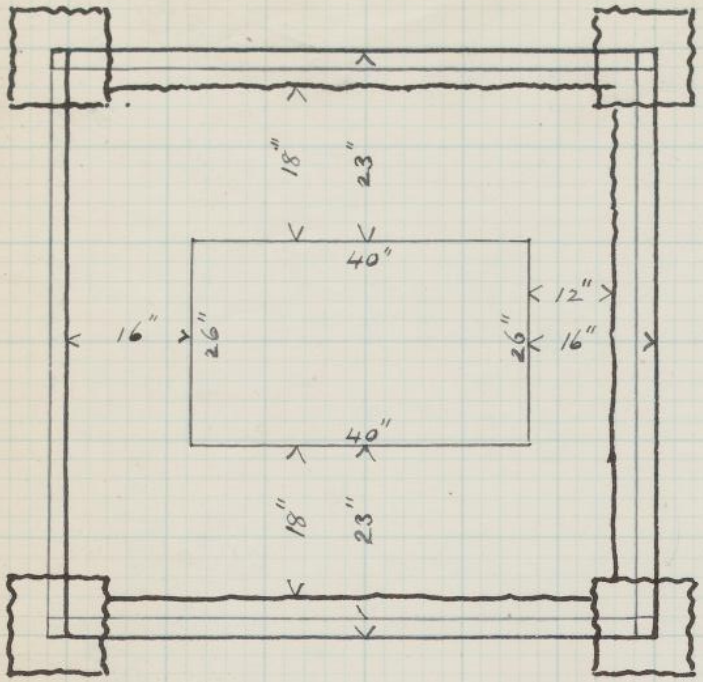
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Plan of foundation walls of Bruce Tower, with location of Piers for meridian and prime vertical observations.

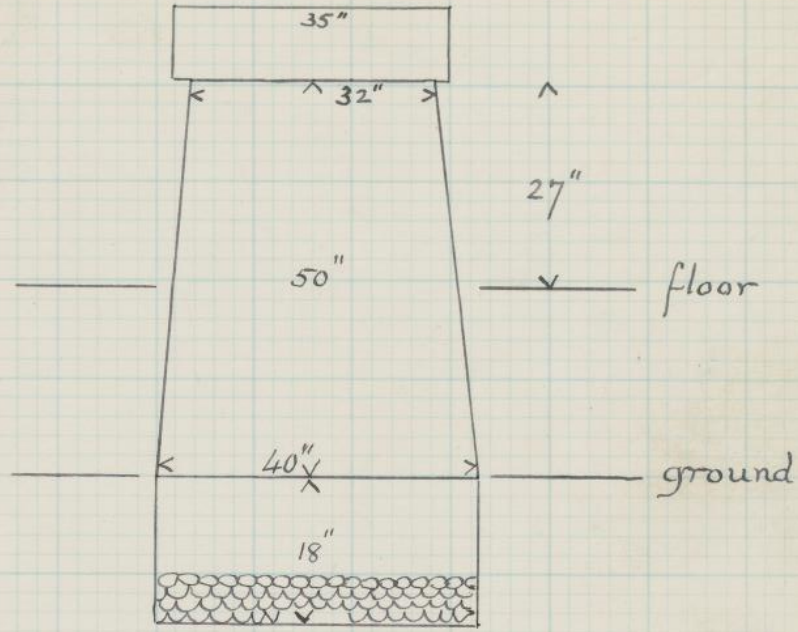
Full lines - outlines of above
Dotted lines - frame of floor.

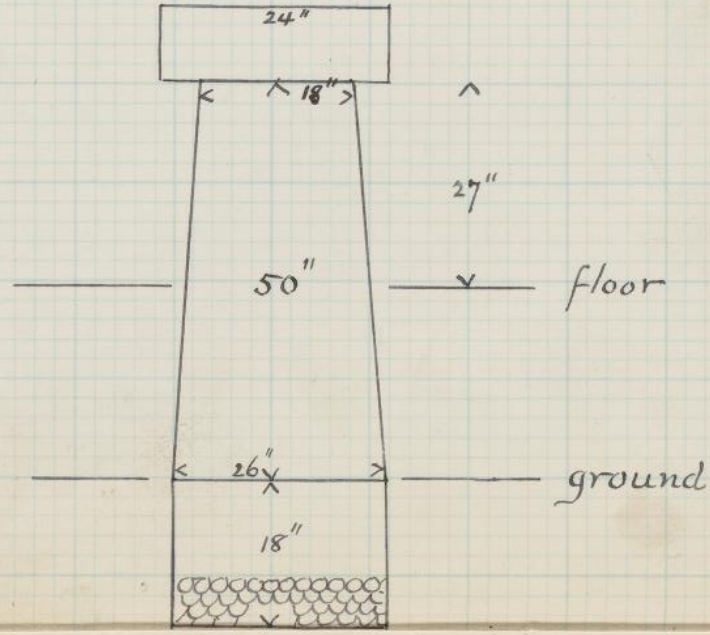
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Plan of Piers of Transit House.

(The dimensions were approximately followed by the mason. The material was the light stone known as "sillar" laid in cement)





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Cl. ε

β Centauri

Dec. 22/96 am.

Cl W α Cent

Cl E α Cent

allowed level

Red. to 19 56

Clock + 19.35 alone

$0 = 0.99 + 4.06c \quad c = -.24 \quad \Delta T = -5\ 42\ 8.96$

$0 = 8.54 + \Delta T - 1.37a - 2.01c$
$\quad\ 8.65 \quad + .63a - 1.06c$

$0 = 0.11 + 2.02a + 0.95c$
$2.02a = +.12 \quad a = +.06$

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$\log a_0 = 9.52202 \pm .197$

	μ Aquarii	τ Orionis
φ−φ₀	−7.4	+12.7
log "	0.86923n	1.10380
" cot z	9.84964	9.67731n
" a"	0.71887n	0.78111n
" is	1.17609	9.50502
	9.54278	

Approx. value of a_0. $a_0 = (\varphi_1 - \varphi_0)\text{est}\, z$

Adopt 9.52202n
−.33

Reduction of Observations Dec. 2/96

Cl. S

	κ Aquilæ	ε Aquarii	μ Aquarii	τ Orionis	β Orionis	γ Eridani	κ Orionis	
$T' = T + K$	6 48 33.04	7 16 19.56	7 29 55.07	7 50 10.86	8 8 23.52	8 39 29.49	9 7 21.19	9
ΔT	−6 59 35.30	59 30.73	59 28.49	59 25.14	59 22.14	59 17.00	59 12.41	
Σ	23 48 57.74	0 16 48.83	0 30 26.58	0 50 45.72	1 9 1.38	1 40 12.49	2 8 8.78	2
α	19 31 20.40	20 42 5.70	20 47 5.69	5 12 38.04	5 9 36.99	3 53 15.22	5 42 53.97	22
τ_1	4 17 37.34	3 34 43.13	3 43 20.89	−4 21 52.32	−4 0 35.61	−2 13 2.73	−3 34 45.19	4
	64 24 20.1	53 40 46.95	55 50 13.35	65 28 4.8	60 8 54.15	33 15 40.95	53 41 17.85	60
δ	−7 15 26.9	−9 52 25.5	−9 22 14.8	−6 57 11.9	−8 19 5.2	−13 47 57.8	−9 42 12.9	−8
$\log \tan \delta$	9.104994	9.240689	9.217550	9.086208	9.164967	9.390250	9.232990	9.
" k	36	50	47	39	43	111	13	
" $\sec \tau_1$	0.364518	0.227459	0.250612	0.381741	0.302984	0.077701	0.227548	0.
" $\tan \varphi_1$	9.469548	9.468198	9.468209	9.467988	9.467994	9.468062	9.460551	9.
" $\cos \varphi_1$	9.98190	9.98201	9.98201	9.98203	9.98203	9.98202	9.98261	9.
" $\tan \tau_1$	0.31968	0.13364	0.16835	0.34068n	0.24116n	9.81685n	0.13378n	0.
" $\tan z$	0.30156	0.11565	0.15036	0.32268n	0.22319n	9.79887n	0.11639n	0.
" $a \tan z$	9.82358n	9.63767n	9.67238n	9.84470n	9.74521n	9.32089n	9.63841n	9.
c	+.20	+.20	+.20	+.20	+.20	+.20	+.20	
i_0	+4.93						−38.38	
$c + i_0$	+5.13						−38.18	
" "	0.71012	9.30103	9.30103	9.30103	9.30103	9.30103	1.58184n	
" $\cos z$	9.65009	9.78405	9.76153	9.63303	9.71039	9.92755	9.78358	9
" $\frac{c+i_0}{\cos z}$	1.05999	9.51698	9.53950	9.66804	9.59064	9.37348	1.79826n	1
$\frac{c+i_0}{\cos z}$	+11.48	+.33	+.35	+.47	+.39	+.24	−62.84	
$-a \tan z$	+.67	+.43	+.47	∓.70	∓.56	∓.21	∓.43	
h	+12.15	+.74	+.72	∓.40	−.26	∓.10	−63.35	
Σ	+11.48	+.33	+.35	−.47	−.39	−.24	−62.84	
φ'	−16 25 34.5	22 40.8	22 42.2	22 13.8	22 14.6	22 23.3	6 25.6	+1
φ	22 32.3	29.7	31.4	19.8	18.5	24.8	15.8	2

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Cl. N.

δ Aquarii	ζ Aquarii	θ Cam. Maj.	ζ Ceti	α Hydrae	γ Cam. Maj.	γ Eridani
9 14 15.91	10 36 55.27	10 53 20.98	12 2 21.35	12 18 57.53	12 40 18.22	13 5 22.11
59 11.26	6 58 57.63	58 54.92	58 43.53	58 40.79	58 37.27	58 33.21
2 15 4.65	3 37 57.64	3 54 26.06	5 3 37.82	5 20 16.74	5 41 40.95	6 6 48.90
22 11 24.16	23 8 59.88	6 49 25.78	1 46 23.99	9 22 37.40	6 59 7.40	3 53 15.22
4 3 40.49	4 28 57.76	−2 54 59.72	3 17 13.83	−4 2 15.66	−1 17 26.45	2 13 33.68
60 55 7.35	67 14 26.4	43 44 55.8	49 18 27.45	60 33 54.9	19 21 36.75	33 23 25.2
−8 17 47.2	−6 36 13.7	−11 54 24.4	−10 50 37.2	−8 12 36.6	−15 28 42.0	−13 47 57.8
9.163820	9.063601	9.323987	9.282282	9.159216	9.442350	9.390250
0.313319	0.413445	0.141235	0.185754	0.301537	0.025280	0.078344
9.477150	9.476062	9.465275	9.468093	9.468795	9.467941	9.468694
9.98128	9.98134	9.98224	9.98202	9.98296	9.98203	9.98197
0.25480	0.37728	9.98102n	0.06555	0.24851n	9.54577n	9.81897
0.23608	0.35857	9.96326n	0.04757	0.23047n	9.52780n	9.80094
9.75810n	9.88055n	9.48528#	9.56959n	9.75257#	9.04982#	9.32296n
+.20	−.20	−.20	−.20	−.20	−.20	−.20
+38.38	+27.60	−16.31				+4.93
+38.58	+27.80	−16.51				+4.73
1.58636	1.44404	1.21775n	9.30103n	9.30103n	9.30103n	0.67486
9.70088	9.60337	9.86708	9.82440	9.70501	9.97663	9.92696
1.88554	1.84067	1.35067n	9.47663n	9.59608n	9.32441n	0.74790
+76.83	+68.29	−22.42	−.30	−.39	−.21	+5.60
+.57	+.76	−.31	+.37	−.57	−.11	+.21
−.15	−.85	−.82	−.90	−.90	−.91	−.93
+76.25	+68.22	−23.55	−0.83	−1.86	−1.23	+4.88
+19 18.7	+17 39.0	−5 53.2	−12.4	−27.9	−18.4	+1 13.2
42 1.0		16 26.3	22 27.3		22 7.8	23 44.6
22 42.3	22 35.7	22 19.5	39.7	22 17.0	26.2	31.4

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In adapting the formulæ derived for a northern station to a southern, it is allowable either to retain + signs for northern ϕ and δ, retaining the formulæ as derived or to modify them considering southern ϕ and δ to have the + sign.

Thus in Bessel's Fourier vertical formulæ, the retention of signs as stated, involves the following precepts:

a = az. of rotation axis + when east of north

b = inclination of rotation axis, + when north end is the higher

c = collimation constant of mean of threads, + when small circle described by the fictitious mean thread is south of collimation axis. If c is determined in the meridian its sign for Cl W becomes the same for Cl. N.

Again, the alteration of signs required by considering southern latitude and declination + requires the following precepts:

a = azimuth of rotation axis, + when east of south

b = inclination of rotation axis, + when south end is the higher.

c = collimation constant, + when fictitious thread describes in the sky a small circle north of collimation

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axis. If c is determined by meridian observations, its sign for Cl W is the same for Cl S.

Test: γ Eridani Nov. 30/96 pp 204, 205

I southern of +δ —. II southern of +δ +

λ +				λ +	
a −				a +	
b −				b +	
c − Cl W = Cl N				c − Cl W = Cl S	
N	S			N	S
9.467967n	9.468820n	log tan q_1		9.467967	9.468820
9.85185	9.85463n	" a tan z		9.85185n	9.85463
−.14	+.14	c		+.14	−.14
9.21849n	0.77817	" $\frac{c+i_0}{\cos z}$		9.21849	0.77817
−16 22 11.2	24 0.8	q_1		+16 22 11.2	24 0.8
−.65	~~+6.00~~ −.22	b		+.65	+.22
−.17	+6.00	$\frac{c+i_0}{\cos z}$		+.17	−6.00
$\frac{-.71}{1.53}$ −23.0	$\frac{+.72}{+6.50} = 137.5$	−a tan z		$\frac{+.71}{1.53} = 23.0$	$\frac{\mp .72}{-6.50} = 137.5$
−16 22 34.2	22 23.3	q		+16 22 34.2	22 23.3

28.8

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