1892phae.proj : 3890

Long. and Lat. No. 1

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La Paz Lat. Obsns reduced by these curves.

See L×L 1–174.

Mr Lau

Stars	Sc Rdg.	Dec		
σ	515.74	+36	11	35.6
μ	210.53	+37	55	12.7
K	470.89	−69	26	49.8
δ	523.91	−69	08	48.4

Combinations			mean
σ ∨ K	515.74	−470.89	492
σ ∨ δ	515.74	−523.91	520
μ ∨ K	210.53	−470.89	340
μ ∨ δ	210.53	−523.91	366

+ 15	10.4
+ 11	35.6
− 26	46.0
26	49.8
33 00	03.8
16 30	01.9

Lat + 04."—

1st Cor. ☆.

at 470-1, 1d = 21.57

0.11 = 2."37 — 471

21.63 — 2

21.70

21.73

21.77

21.71

510.25 — 501

19.21

.22

.24

.29

.34

.41

.50.

.56

.67 — 510

.80

190.96

20.16

20.45

20.74 — 515

at 515-6, 20.95 | 0.74 = 15.50

912.21

45 × 0.09 = − 4.05

908.16

From Summation:

50d = 1019.7 (+0.8)

21d = 420.8

598.9

15d = 293.6

0.11 = 002.4

0.74 = 015.5

910.4

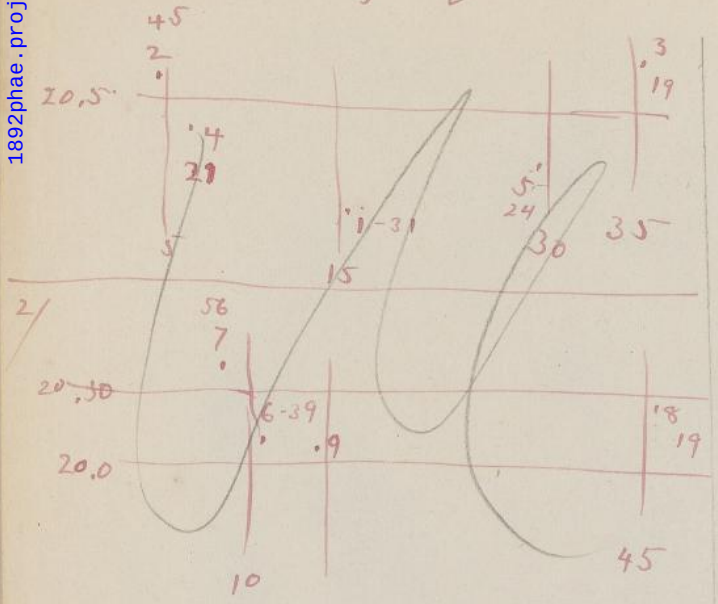
or − 8."1

Corr B = + 910" 20416 / 20410 = C

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History of Eccentricity curve of Gr. Sc.



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2nd

Cor A,

23	464.0	4 | 20.95	0 02 54.4
16	314.5	5,24	69 8 48,4
	149,5	21.67	69 11 42.8
0.26	5.2	,91	36 11 35.6
0,91	19.7	21.67	33 00 07.2
	174.4	19503	16 30 03.6
	+7"	19.7	

Cor B = 0 ±

3d 210.53 & 470.89

Cor ~~A~~, B,

200d & 300d	= 2063.3	10d (A) = 192.8	19.71	MPlan 205
300 & 400	2054.2	,53 10.4	,53	20675
200 & 400	4117.5	203,2	5913	20410
	- 205.8	+2.6	9855	2.6
210.53 & 400,	3911,7	205,8	10.4463	

400 & 450d	= 1020.5 -	2048 | 1023.9	
	+ 3.4	2041 | 1020.5	
400 & 450	1023.9		3.4
210+ & 400	3911.7		
20d	= 399.4	2044	408.8
	+ 0.6	2041	805,2
0.89	= 19.1 at 21.48		+ ,6
	5354.7		

400 & 500	2045.3	
13	464.0	
,91 =	19.7	
4th	6440.7	
M	6356.7	
	54.0	

Which will throw these two out by about

2.5"!

The main cause of this difference is in

3d Curve B.

μ + K		
~~90 55 10.7~~		
32	59	58.0
+		53.5
32	60	51.8
16	30	25.9

4th

33	00	02.4	1 --- 16 30 01.9
		54.0	2 --- 03.6
2 | 33	00	56.4	3 --- 25.9
16	30	28.2	4 --- 28.2
			4 | 59.6
			14.9

12.0
11.5
11.0
13.3
4.6 av = 12."1

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Summation of Curve for Conc. *.

Short 2

528.98 − 26
21.70
550.68 − 27
21.68
572.36 − 28
21.65
594.01 − 29
21.60
615.61 − 30
21.54
637.15 − 31
21.45
658.60 − 32
21.36
679.96 − 33
21.26
701.22 − 34
21.14
722.36 − 35
21.07
743.43 − 36
20.95
764.38 − 37
20.77
785.09 − 38
20.42
805.51 − 39
20.10
825.61 − 40

825.61 − 40
19.87
845.48 − 41
19.71
865.19 − 42
19.58
884.77 − 43
19.47
904.24 − 44
19.41
923.65 − 45
19.32
942.97 − 46
19.25
962.22 − 47
19.21
981.43 − 48
19.16
1000.59 − 49
19.13
1019.72 − 50.

Which comes out

0."8 short.

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Summation of Curve for Comet A.

Adding ~~division~~ values. ~~Zero~~ Count point = 001,

True values. (Corrected by -0."09)

~~0~~

	0	— 0
	19.12	— 1
	19.12	
	38.24	— 2
	19.13	
	57.37	— 3
	19.16	
	76.53	— 4
	19.21	
	95.74	— 5
	19.25	
	114.99	— 6
	19.32	
	134.31	— 7
	19.41	
	153.72	— 8
	19.47	
	173.19	— 9
	19.58	
	192.77	— 10
	19.71	
	212.48	— 11
	19.87	
	232.35	— 12
	20.10	
	252.45	— 13
	20 41	
	272.86	— 14
	20.72	
	293.58	— 15

24	293.58	— 15
	20.95	
12	314.53	— 16
	21.07	
7	335.60	— 17
	21 14	
17	356.74	— 18
	21.26	
10	378.00	— 19
	21 36	
	399.36	— 20
	21 45	
	420.81	— 21
	21 54	
	442.35	— 22
	21.60	
	463.95	— 23
	21 65	
	485.60	— 24
	21 68	
	507.28	— 25
	21 70	
	528.98	— 26

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Observations for Long and Lat of Pmd

Obns made Sat. Oct 22.

200 ft east of the telegraph Office in a line perpendicular to front of building.

Obns taken by sound of bell run by clock in Anguilla station.

Watch comparisons at 9 P.M.

Eng. (Kt m)	Time sent from Anguilla	Ang. watch	Thus
	8 45 00	8 44	48.5 approx
	46 "	45	48.– "
	47 "	46	47.– "
	48 "	47	47.2
	49 "	48	47.2
	50 "	49	47.2

Levels on Theodolite

Ob. glass				
	W	0. and	5.6	out from mark near station center
		E. and	6,3	
		0	7,0	
	E	0	5,0	
			7.8	
	N	0	4,3	
			4.8	
	S	0	7,3	

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Pmid. Obs^ns for Long. & Lat. Oct 22.92

Time Obs^ns

2 Cassiopeae
+56°.0

Bell.
30.2
15.3
59.6 (about 28^m 39^s by watch)
45.2
30.2 (about 30^m " ")

Compass 11°50'
A 178 43 00
B 358 43 10

Cassiopeae
+60°.1

04.9 (38^m by watch
55.0
45.1 (±20.3)
36.4
27.2 (ob 41^m " ")

Compass 10° 57'
A 177 52 55
B (357) 53 00

β Androm.
+35.0

26.2
56.0
27.0 (± 0.3)
57.3
28.7 (ob. 53^m 0^s by watch)

Compass 11° 28
A 178 21 00
B 358 21 10
(~~obs^ns~~ lower (aff) Hor. wire
alt. 39 - 22

β Androm +9^m
?

19.2
39.2
09.8
41.0
11.8 (= 11^h 02^m short)

Compass 13°48'
A 180 38 50
B 360 39 00
(on upper aff. Hor. wire)
alt 38 42.5

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Pano. Obs^ns for Long & Lat. Oct. 22, 92

Limbs.

Ob. end	N	0/2	6.4
	S	0/2	6.3
	E	0/2	6.2
	W	1/2	5.0
		0/2	7.9
		0/2	8.0
			4.7

Lat. Obsns

2 Eridani

by Bell.	by Watch.			Gr. Sc.
06^s	10	44	40	2.366
	11	16	15	2.376
10^s	11	17	40	2.379 −
24^s		18	55	.377 +
		20	00	.376
		20	50	.371 −
		21	40	.369
04^s		22	30	.365 −

2 Arietis.

Time Obs^n 30.8 C.W. (ab. 32^m.0 by Watch) Comp. 5°30'

A 172 26 50

352 27 00

				Gr. Sc
13^s	11	35	40	− 7.836
03		37	30	.873 +
00^s		39	27	.903 Subtract 2^s from time of each Obs^n
		40	45	.922
		41	46	.933
		43	30	.946 = 57° 11.5 alt.
		45	10	.9525
		46	15	.946 +

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Prov Obs^ns for Long & Lat. Oct, 22, 92

Set Obs^ns

2 Arietis Continued

by bell	by watch			Zr. Serus
~~D~~	11	47	40 -	7.941+
24^s		48	45	.930
		49	57	.914
		50	53	.901 -
		51	52	.884
~~58^s~~		53	20	.858 = 57° 08′.0
08		55	30+	Compass 14° 16′
			A	181 07 10
			B	361 07 15

δ Hydrae −69.2

11.0 ab. $2\frac{1}{2}^m$ Comp. 12° 12′

20.2 A 179 09 55

30.0 ab 4.50 B 359 09 50

40.8

50.0 = $12^h 06^m 08^s$ ab.

Same

11.0 Cl. $12^h 10^m 30^s$ ab. Comp. 11°.46′

178 31 10

358 31 15

12.13.

Time of 1st Mark of Mira (as before)

$12^h 23^m 16^s.7$

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Approx Position of Chilcaya given by Capt Mc of post. Pole, 70°55'W x −16°7'.00 S

Oct 24, Monday

Watch.		Aug Clock	
3 07	26,8	3 07	01.0
8	.8	8	4
9	.7	9	4
10	.7	10	4
11	.6	11	4
12	.6	12	4

Watch		Parfs watch	
3 23	00	3 23	52 [?]
24		24	53
25		25	53.2
26	0.6,−	27	00
27	06.4	28	00

Sand (top) of soil at end of mole is 6ft 4 in / above water.

Chilcaya 2nd Oct 26. 1892

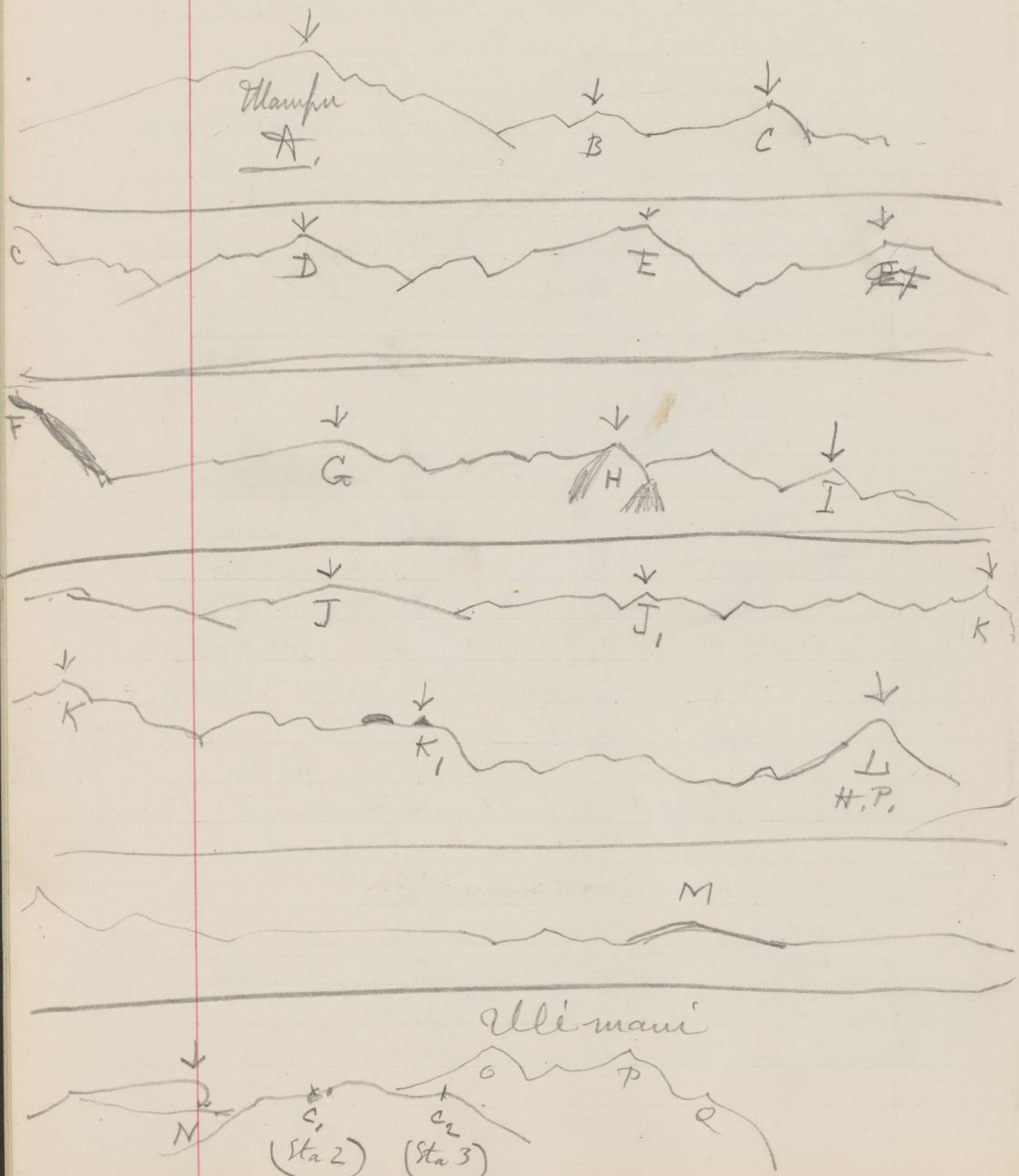
Dist 7 ft 5 in from center cairn.

Levels on May Mind. Ornt N 4.2
5.6
S 6.7
3.0
E 4.2
5.5
W 4.9
4.8

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Bot. Angles from near Chief



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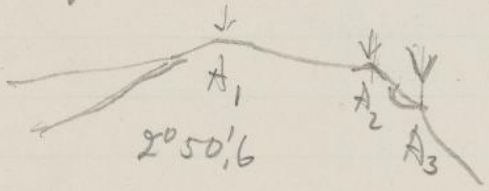
Sights, Sta 1, Oct 26
~~from Sta 1, Chief Hill~~

8, 32 AM.

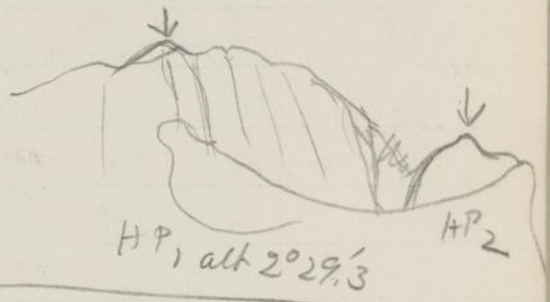
A_1 [a]	038	02	53
A_2	037	53	15
A_3	037	48	30
HP, [b]	318	33	50
HP_2	318	10	41
B_1 [c]	291	11	42
B_2	290	11	54
C_1	294	10	00
C_2	290	42	41
A_3	037	47	59

Notes

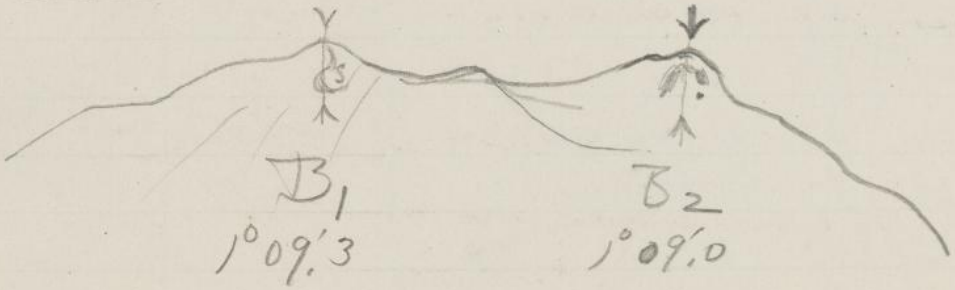
a. Шампи. = A.



b. Инаупатоси – H.P.



c. Шёпаний = B.

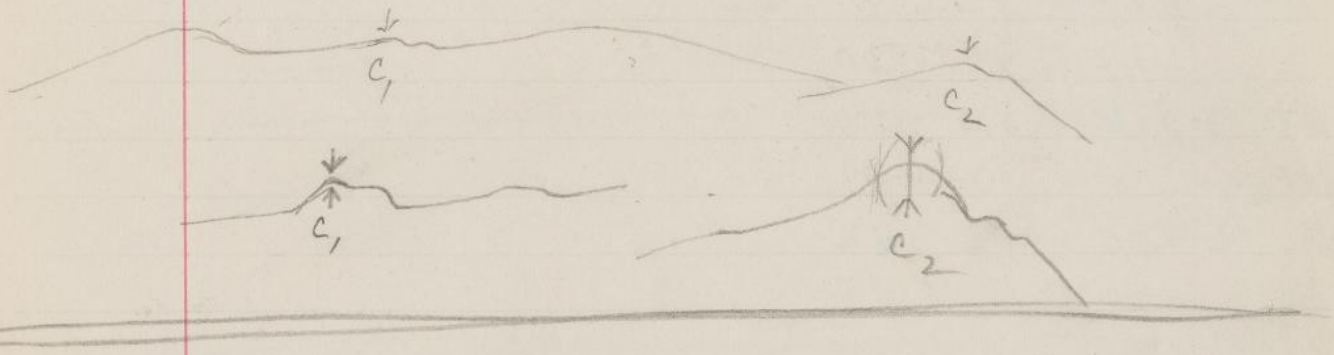


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Oct 26, 92 Chillaya

Oconsisto (= Sta Anna) Hill



Lurlo.

Dead
N 6,7
3.1
S 5,5
4,3
E 6.0
3.8
W 6,2
3.6

A_1	127	58	05 (4)	8.338
A_2	127	48	15 (2)	
A_3	127	43	16 (4)	
HP_1	48	28	58 (4)	7.727+
HP_2	48	05	42 (2)	
B_1	21	07	00 (4)	5.336
B_2	20	07	16 (4)	5.320
C_1	24	05	11 (4)	4.626
C_2	20	37	48 (4)	4.419
A_3	127	43	17 (4)	
A_1				8.344



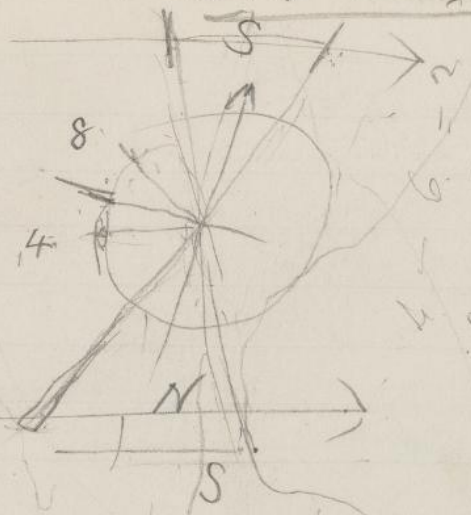
Lurlo.
N 5.1
4.9
S 7.0
3.0
E 3.3
6.8
W 9.1
0.9

10.30

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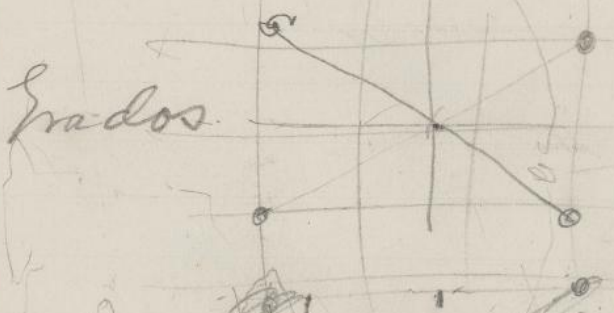
Oct 26, 92. Chihilaya





28.4
27.8

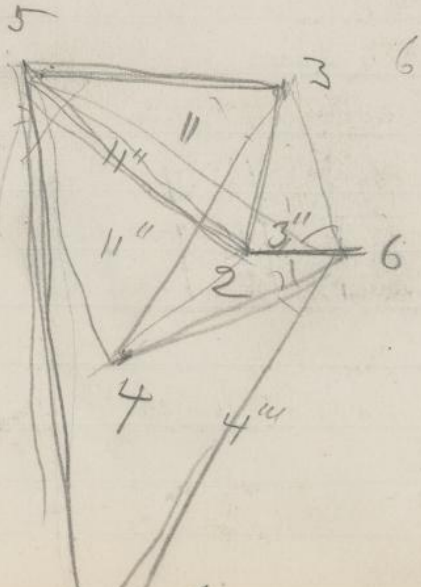




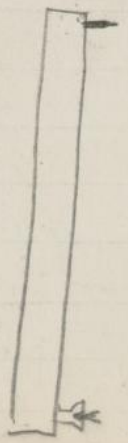
1 / 1400

180 00 00
2 = 89 00 00
6 = 44 30 00
7 = 47 30 00

6 - 2 · 3 = 180° +



20/10 5"



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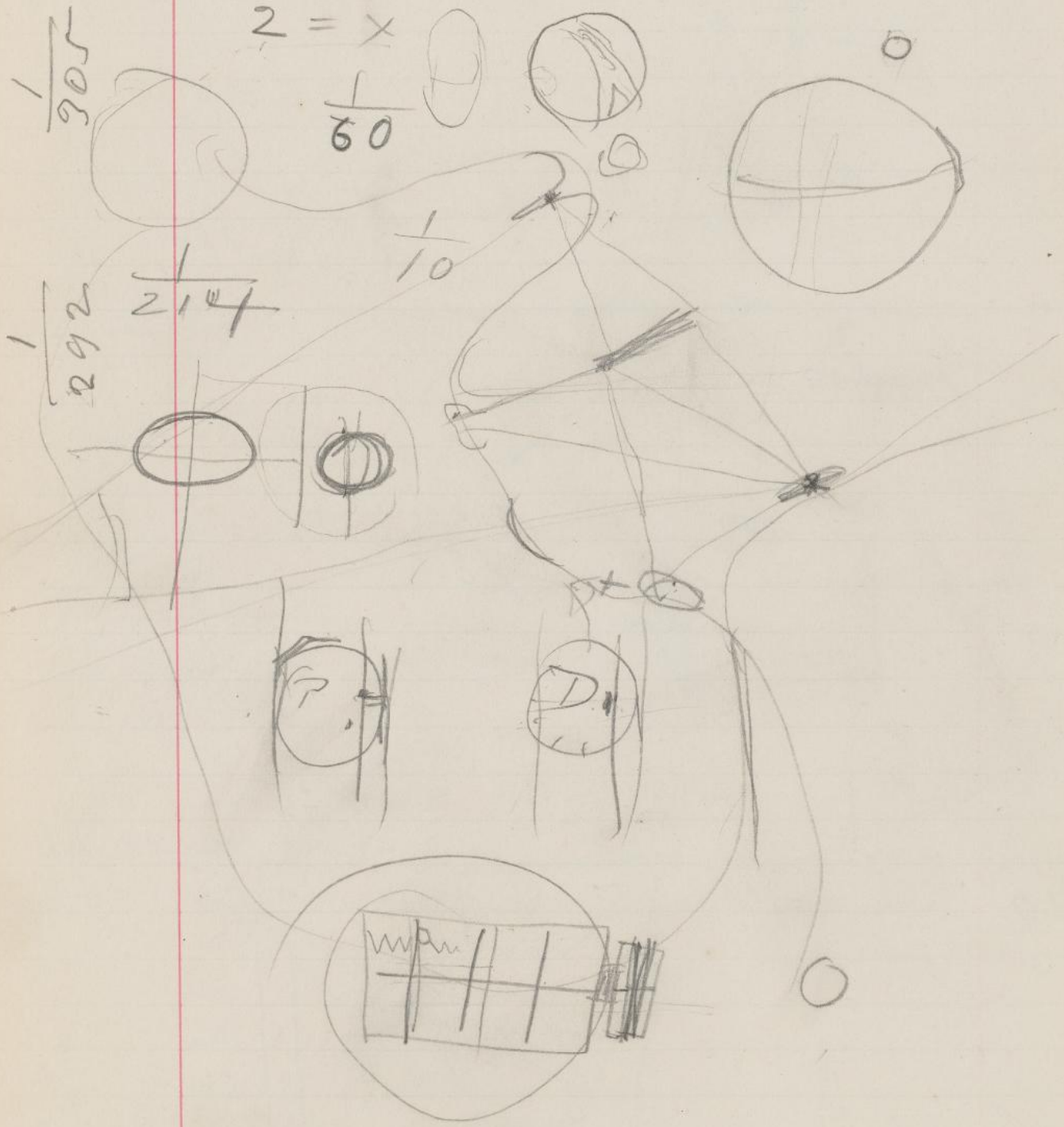
$x^2 + 2x + 2y + \dots = \dots$

$2 = x$

$\frac{1}{60}$

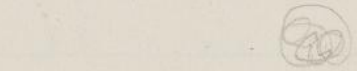
$\frac{1}{10}$

$\frac{1}{214}$



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Nov 1, 1892.

Mail Oct. 26, 92.

Copied from Pt Loma Chilileza Hill ab

8.10 25-3.0

10° 25-4. 10.0 23.0

19 0 9.5 22.5

10 0 9.0 22.0

28 0 9.0 22.0

19 0 9.0 22.0

Illimani

168.9 8.5 21.5

348.9 9.0 20.0

" 9.0 22.0

168.9 9.5 22.0

8.25 169.6 9.928

29

8.32 28

25-4. 169.6 11.0 23.0

349.6 10.0 22.5

Illimani

8.35 26.2 25-4.0

11.0 23.5

96°2 10.0 23.0

8.40 276°3 Mag inclination

5.628

29

32

24

00

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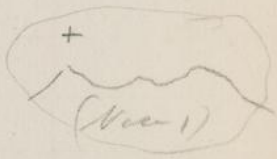
1892phae.proj..389D

Nov. 1, 1892.

276.3	25-4.0	6.0	19.0
96.3		5.0	18.0
96.3	25-6.0	6.5	19.5
276.3	"	13.5	26.0
96.3	"	12.0	24.5
96.3	25.5	10.0	23.0
276.3	"	13.0	26.0
96.3	"	9.5	22.0
27.6.3	"	13.0	25.5

Illiani (my indication)

8.5-2	276-3	5-602
		41
	(Sund)	10
		04
		5-96



8.56	25.5			
276.3	25.4	13.0	25.5	
96.3	"	9.5	22.0	
276.3	"	13.5	26.0	
9.00	249.0	25.3	13.0	25.0
	69.0	"	6.0	19.0
		relevelled		
	69.0	25.3	10.0	22.5
	249.0	"	10.5	23.0
	69.0	"	7.0	19.5
	249.0	"	10.5	23.0
	69.0	"	7.0	19.5
	249.0	"	10.3	23.0

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Nov. 1892.

9.05 Kenwina Potosi

249.0	9.038	
	40	
	39	
	38	
	39	

9.14 25-31.

249.0	6.5	19.0
69.0	6.5	19.0

254

69.0	7.0	20.0
249.0	10.5	23.0
69.0	7.0	19.5

9.21	169.6	25-4	7.0	19.5
	349.6	"	9.5	22.0
	169.6	"	7.0	20.0
	349.6	"	10.5	23.0
	169.6	"	7.0	20.0

9.28 Allianza 9.941

41

41

48

43

9.36 256.0

169.8	10.5	23.0
349.8	11.5	24.0
169.4	10.5	23.0
349.6	11.5	24.0

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1892phae.proj..389D

Nov. 1, '92.

9.40	B	175.1	8310
	C	178.9	8699
	D	185.3	9027
	E	191.6	10279
	F	195.1	10182
	G	204.9	9170
	H	209.7	9710
	I	213.3	9559
	J	219.4	9142
	J'	225.0	8680
	K	232.2	9109
	K_1	239.7	7221
	M	260.0	6491
	N	269.4	5100

10.13 254.0

269.8	12.0	24.5	
89.8	9.5	22.0	
269.8	11.5	25.0	
89.8	9.0	21.5	
169.8	9.5	22.0	
349.8	10.0	22.5	
169.8	9.5	22.0	
10.19 349.8	10.0	23.0	
276.2	25.4	11.5	24.0
96.2	"	8.0	21.0
276.2	"	11.5	24.0
96.2	"	8.5	21.0

Illinois indistinct

276.2 5.590 (good 5.609)

.600 " .603

5.90

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Nov. 1, '92.

	276.2	25-4.0	7.0	19.5-
	96.2	"	6.0	18.5-
	276.2	25-4.0	11.0	23.5-
	96.2	"	6.5-	19.0
	276.2	"	11.5-	24.0
	96.2	"	6.0	19.0
	276.2	25-4.0	9.0	21.5-
	96.2	"	5.5-	18.5-
10.36	69.0	25-4.	6.0	19.0
	249.0	"	9.0	21.5-
	69.0	"	6.0	19.0
	249.0	"	9.0	21.5-
Acacia Polaris		249.0		9.0 5 6
				43
				48
				48
				57
				58
	249.0	25-4.	12.0	24.5-
	69.0	"	9.0	22.0
	249.0	"	12.0	24.5-
	69.0	"	9.0	22.0
10.46		349.6	25-4.	9.5- 22.0
		169.6	"	9.5- 22.0
		349.6	"	10.0 22.5-
		169.6	"	9.5- 22.0
10.51	Altair	169.6		9.941
				940
				46
				40
				41
				44

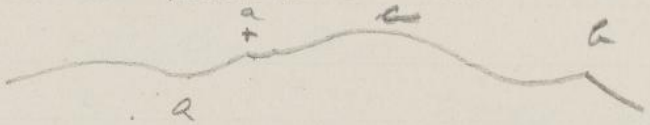
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Nov. 1, '92.

169.6	254.0	10.0	23.0
349.6	"	"	"
169.6	"	"	"
349.6	"	"	"

Collimation Santa Anna



a

11.00	o 1	273.3	4.35-87
			96
			86
			86
	o b		4.41 35-
			12
			17
254	273.3	13.0	25.35-
	93.3	10.0	22.0
	e 1		
254	93.3	11.0	23.35-
	273.3	13.0	25.5
	93.2		0.6 85-
			83
			90
	e b		0.522
			25
11.15			26

b

276.2	254.	12.0	24.0
96.2		6.0	18.35-

Reloaded

12.46	96.2	254.	13.35-	25.35-
	276.2	"	7.0	19.0

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1892phae.proj..389D

Nov. 1, 92.
Rekeyed.

276.2	25-4	10.0	22.5-
96.2	"	13.0	25.5-
96.2	25-3	12.0	24.0
276.2	"	7.0	19.0

c

294.2 4.825

b

276.8 Keying my hand 4.298
290
97
95
97
97

1.02	276.8	25-3	6.0	18.5-
	96.8	"	6.5-	19.0
	276.8	25-5	7.0	19.0
	96.8	"	10.5-	23.0
	276.8	"	7.0	19.0

d

148.2	25-5-	7.0	19.5-
328.2	"	7.0	19.0

d

327.2 9.000
02
01

327.2	25-5-	10.0	22.5-
147.2	"	10.5-	23.0

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1892phae.proj..389D

Nov. 1, '92.

Cairn 72.9 Top cairn 1.0 ft above
Lens Theodolite 78.1 "

	e h		
282.0	25-57	9.5	22.0
102.0	"	13.5	25.5

Reversed

102.0	25-57	11.5	24.0
282.0	"	12.5	24.5
102.0	25-4.	10.0	22.5
282.0	"	10.5	23.0

Level of Leads. Depth feet at end of Pier e h

1.29 282.0 14.4.70

75
75
76
78
78

282.0	25-4.	10.0	22.5
102.0	"	10.0	22.5

1.42 Summit of Cairn 1 ft 8 in above ridge leading towards South Arm Hill. The ridge is 2 ft above the surface of the hill to the West of it & 1 ft above ridge running S.

Barometer in Lens.

2.46 Theom 70.0 18.991

Minimum

Further end about base line 178.8 e h
Surface Mercury 1 in higher than centre of lens. End Pier as above 281.9

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Nov 1, 92.

Mic. to Objective 14 ft 11 in
" - Cairn 7 6

Barometer on Rock

4.5-1 63.0 19.036

Castle 11 ft 3½ in above lake.

Soft Chil		8.20	12940
	Rhodia	11.00	13270
Soft	"	1.20	
Pinta		3.30	13600

Chiriaco

H. P. Milumae, Maruata. Rhimani.

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1892phae.prqj..389D

Nov. 1, '92.
N. Luminosity Santa Anna Hill
Obs. Oct. 28, '92.

8.50 a b

25-3,	10°		8.5	22.0
	190		11.5	24.5
	100		11.5	24.5
	280		8.5	22.0

Allegheny

8.53	81.5	25-3.	10.0	23.5
	261.5	"	9.0	22.5
	81.5	"	9.0	23.0
	261.5	"	9.5	23.0



a 81.5 6.926
25
27
26
20
21

b 6.910

25-3.	81.5	11.0	24.5
	261.5	10.0	23.0
	81.5	11.0	24.5
9.05	261.5	10.0	23.0



c 82.2 6.431
30
31

25-3	82.2	12.0	25.0
	262.2	11.0	24.5

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1892phae.proj..389D

Nov 1, '92,

	82.2	11.5	24.5	
	262.2	11.0	24.5	
9.12	25.3	216.7	11.5	24.5
		36.7	9.5	23.0
	25.2	216.7	11.0	24.5
		36.7	6.5	20.0
		216.7	11.0	24.5
		36.7	6.0	20.0

a b c

Ulmani

a 217.1 6.734
30
26
29
30
32

b 216.8 6.562
Rain & cloudy
" "
" "
59
79

c 218.4 6.677
86
81

25.2	217.1	6.0	19.0
	37.1	3.0	17.5
25.3	37.1	6.5	19.0
	217.1	12.5	25.0
	37.1	6.5	19.5
9.38	217.1	12.0	25.0

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1892phae.prqj..389D

Nov. 1, 92.

9.40 156.3 253.

Rebuilded

9.45	156.3	252	6.0	19.0
	336.3	"	8.5	22.0
	156.3	"	8.5	21.5
	336.3	"	8.5	21.5
	156.3	"	9.0	22.0
Urania Potsi	156.9			13.425
				22
				22
				21
				28
				22

251.	156.9	9.0	22.0	
	336.9	9.5	22.5	
	156.9	11.0	24.0	
	336.9	6.0	19.0	
	156.9	11.0	24.0	
10.04	336.9	6.0	19.0	
10.30	251.	90.0	6.5	19.5
		270.0	8.0	21.5
		90.0	6.5	20.0
		270.0	8.5	22.0

D	90.0	685-0
		40
E	92.0	7.815
F	95.2	8.008
F_1	95.6	8.073
G_2	101.3	8.170
H_2	107.7	8.455
I_2	118.7	9.232

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Nov. 1, 92.

B	85.0		5.877
N	207.0		5.733
	210	10.0	23.0
	30	12.0	25.0
	210	10.0	23.0
	30	11.0	24.0

10.58 of

Rounded Hill near Chililayo

15.0	of	25.1.	6.0	19.0
195.0		"	3.0	17.0
15.0		25.3.	6.0	19.0
195.0		"	5.0	18.5
15.0		25.5.	10.0	23.0
195.0		"	8.5	21.5

15.1	of	2.238	
		38	
		38	
	oh	1.958	
		59	
		58	
	ef	3.198	
		96	
		94	
	eh	2.994	
		97	
195.0		93	

195.0		25.5.	13.0	26.0
15.0		"	13.0	26.0
195.0		25.6.	9.5	22.5
15.0		"	12.5	25.0
195.0		"	9.0	22.0

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1892phae.proj..389D

Nov. 3, '92.

Chililaya Hill

212.8	25.4.	7.0	20.5
32.8	"	12.0	25.0

Rekevelled

212.8	25.4.	9.0	22.0
32.8	"	9.0	22.0
212.8	"	9.5	22.5
32.8	"	9.0	23.0

e h

Chililaya La

212.8		57.060	
		61	
		61	
		61	
		62	
		61	
212.8		12.0	25.0
32.8		12.0	25.0
212.8		12.0	25.0
32.8		12.0	25.0
101.0	25.4.	12.5	25.5
281.0	"	12.5	25.5

Santa Anna other station

100		57.830	
		30	
		28	
100	25.3.	11.0	24.0
280		11.0	24.0
100		10.0	23.0
280		10.5	23.5

Seems like 3 in below summit of Rock.

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1892phae.proj..389D

Nov. 3, '92.

11.48 246.8 25.3. 9.0 22.5

66.8 " 9.0 22.5

Summit Santa Anna o/h

245.1 13.426

41

39

245.1 25.3. 10.5 23.5

65.1 " 10. 23.0

11.55 Barometer on Santa Anna (IV)

12.08 5-6.0 18,016

José N. Zanna, Calle de Zuraiza N. 23.

Baron de Chirico

8.40 a.m. 5-6.0 19.000

Temp. 69.0 11.5-7 Outside air

Temp. baron in Room at Sea Bay

66.0 19.5-5.0 Cistern 3 ft

above floor of room.

Alto 14300 Sta. Notch 14380

3.05 75.0 18.467

Notch Station Oct. 31, '92.

o/h

10° 25.5. 13.0 25.6

100 " 12.0 24.0

190 " 7.0 19.5

280 " 10.0 22.5

21.5 " 11.0 23.0

201.5 " 10.5 23.0

" " "

Albiani

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Nov. 3, '92,

201.6 a 9.861
60
51
56
59

A Copy

Pumo - Sat. Oct. 22. Prof's watch —
Arquipa. Watch

8	37	00 (61?)	8	3.4	57,5
	39			36	57.2
	41			38	57,0
	42			39	56,2
	43			40	56,0
	44			41	55,5
	45			42	55,2
	56			53	55
	57			54	54
	58			55	54,2
	59			56	54,0
9	00			57	53,7
	40			37	57.3 (52,27?)

Barom at Cumbre in Rd to Juyay
17.244 - Att 41.5. St 44.0

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Copy of time comparisons to made by Dkr at Argentine Station. Puno

from Dk's note book

Sat Oct 22. Set clock 6h 55m 00 P.M.
Ch 7h 05m 00s Clock 7.. 05.. 00..

7..14 Regulated clock (this done not involving stopping it.)

Chron.		Clock	
7	25 59.7	7 26	00.0
	30 59.5	31	00.0
	48 57.3	49	00.7

Started signals at 7 59 00
Stopped " " " 10
" ——— " " " 48

Chron		Clock		
8	13 56	8	14	00
~~25 00~~		8	35	10 (stopped
		"	"	50 started
		9	59	10 stopped
		"	"	51 Started
		9	38	00 "
		10	00	10 Stopped ..
		"	"	50 Started

Watch
10 05 40 = 10 06 00

Ch W = 8s.0
plotted 8.7

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Enquiza Station Comparisons.
for Pano (copy.)

Sun. Oct. 23.

	Watch				Clock		
Oct 22d	21h	21	00	AM	22d 21h	22	16
	21h	23	00	" "		24	16

Regulated clock

	Chron.			Clock			Watch	
Oct 22d	21h	26	50.5	22d 21h		28	00	
Ch>W = 7s.0		30	07.0					30 00
						35	17	34
7.0		36	07.0					36 00
		40	37					40 30
		41	07					41 00
		43	07					43 00
		~~46~~	~~00~~	22d 21h		47	18	46 00
		47	37					47 30
		48	07					48 00

plotted 6s.0

Watch used here was one belonging to the jeweller — Tanning, and considered the best one he had.

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Arequipa Station Comparisons.
(Intermed) (Copy)

Tues. Oct. 25.

Sta Clock			Watch		
4	35	16.0	4	35	00
4	36	16.0	4	36	00

Fri. Oct 28.

Sta. Clock.			Watch		
4	11	00	4	06	06
	15	00		10	06

at 4..17 Stopped clock & set it by watch and & regulate it.

4	18	00	4	18	00

Sat. Oct 29. Started signals at 8..06..00 & ended 8..16..00

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Arequipa Station Comparisons.

Sun. Oct. 30. (as I understand it. the clock was found stopped at 2.h7)

Sta Clock	Watch
2 44 00	2 44 21.5

7.50 P.M. Sta Clock has stopped twice today.
Set it by watch at 7h 59m 00

To

Begin. Signals	8	15 00
end		30 00
Started		36 00
Stopped		51 00
"	9	25 00 for the night.

Sta Clock	Watch
9 28 00	9 27 53.5
30 00	29 53.5
41 00	40 53.0

Sat. Nov 12. 8h 35m Sid. Art. Time, Time sent by land by Obs directly from his watch (in to Pay)
Obs Watch 8h 37m 00.0 Watch 8h 58m 09.7

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Adjustment of Inst ⅜ (Nov 26.92)

2 Inst. adj: as needed,

1st Value of 1 div. of level used on transit Inst at Obs'y for time work

2nd Elev. or depress. of horiz. wire in theodolite.

Value of a level div.

50.0 div on Sr Sc of Th = 4.d8 of this level

1" = 0.49 of a div;

.49) 50.00 (102
49
100

50 div. = 102" = 4.d8 of level

48) 102 (2".125 = 0.d1 on level
96
60 0.d4 = 8".5
48

1.d0 S.S. = 20".6 = 0.d96 of transit level

0.96) 20.6 (21".56
192
140
96
440
384
560

1.d0 Transit Level = 21".5
0.4 = 8".6

1892phae.proj..389D

Time Obs^ns in the Angelina Just.

Date Oct.	Dec	Error (fast)	Level	Order	
19.4	+14.6	2^m 07.1	0	2	Page 44, Time Error 84"
19.4	+30.2	13.1	0	M.L. 1	Clock error 2^m 10^s,6 aR = 0^s.6
19.5	-57.8	17.1	0	3	In M.T. 2^m 10^s.3
20.3	+09.4	12.7	E. +0.4	M.L. 1	Page 44. Time Er 81"
20.4	-47.5	18.1	0	L 2 L	Clock error 2^m 14^s.1 (aR 0.05) M.T. 2^m 13^s.7
21.3	+62.1	12.6	W+0.1	2	Page 44
21.3	+37.6	13.6	"	M.L. 1	Clock error 2^m 14^s.8 (aR 0.1-)
21.3	+09.4	14.4	"	3	Time Er 15" M.T. 2^m 14^s.4
22.5	+49.5	04.8	E. +0.3 or 0.4	3	Page 45
22.5	+40.5	08.0	E. +0.4, 0.5, 0.9	2	Clock error 2^m 15.6 (aR. 0.7)
22.5	+03.7	14.5	E. +0.6, 1.0, 1.4.	L 1	Mer. Er 2' 00"
22.6	-74.6	46.0	E. +2.2 or 2.0	L 4	M.T. 2^m 15^s.2
25.4	+41.7	16.1	0	3	Page 42. Time Error 63^s W.
25.4	+28.5	16.3	0	5	no level error
25.4	+14.6	16.5	0	4	Clock error fast 2^m 19^s.7
25.4	-30.2	21.4	0	L 2	aR. Resid. 0^s.5
25.3	-81.9	46.5	0	M.L. 1	M.T. 2^m 19^s.3
26.3	-16.3	22.1	0	L 1	Mer. Er. 0 1, Clock 2^m 22^s.1 of this is no level cor. Mer " M.T. 2^m 21^s.7

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3 32.0 − 2 10.3 = 1m 21.7

S > M.J. = 3m 34.5.0 } dif = 1m 20.3
I > S = 2m 13.7 }

3 36.6 − 2 14.4 = 1m 22.2

3 39.2 − 2 15.2 = 1m 24.0

3 46.6 − 2 19.3 = 1m 27.3

3 48.8 − 2 21.7 = 1m 27.1

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Time Obs^ns at Arequipa Observatory.

Date.	Dec	Error (fast)	Level	Order	
Oct 31.5	+58.6	2^m 32.4^s	0	4	Page 43. Mend. Error 30"
31.4	+14.6	34.1	0	2	Two bis error
31.5	−07.9	34.8	0	3	Clock error. fast 2 35.3
31.4	−30.2	34.6	0	L1	Av. Rmd 0.6
31.5	−57.8	37.3	0	6	
31.5	−77.9	44.4	0	5	m.T. 2^m 34.9
Nov. 1.4	+60.1	32.− (1w)	0	L3	Page 45
1.4	+55.9	38.0	E. +10.0^d	1	Clock error 2^m 31.4^s (aR 0.5)
1.4	+35.0	31.1	0	4	Mend. 0"
1.4	+05.3	31.− (1w)	0	5	
1.4	−18.6	36.5	E. +10.0^d	2	m.T. 2^m 31.0^s
1.5	−57.8	32.3	0	6	
3.3	−47.5	39.2	0	mL1	Page 45, Clock error = 2^m 39.2 m.T. 2^m 38.8
4.3	+14.6	41.1	0(?)	2	Page 45, Mer = 03." Lw, = 0.^d0
4.3	−30.2	40.9	0	mL1	Clock error = 2^m 41.4 (aR = 0,6)
4.4	−77.9	43.1	0	3	m.T. 2^m 41.0
5.4	+45.9	45.1	0	mL1	Page 46
5.5	+23.0	44.0	?	4	Mer. 27" L=0 Mer 0 L E+1.^d2
5.4	+14.6	45.2 (2w)	?	2	2^m 46.^s0 2 43,8
5.5	−57.8	2^m 47.5	?	3	(av.R, 0.7) (aB, 0.^s7) m.T. 2^m 43.4 or 45.6
15.4	+35.0	3 08.1	?	5	Page 46.
15.4	+28.5	11.4	0 (Mend?)	mL1	m = 0.3 for rest m = 2,1
15.4	+14.6	11.6	0 (Mend?)	2	m 1/10 to E
15.4	+04.9	10.0	?	4	Clock error 3^m 11.^s9 (av. R = 0.16)
15.4	−18.6	12.1	?	m 3	m.T. 3^m 11.^s4

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1892phae.proj..389D

4 01.2 − 2 34.9 = 1^{m} 26.3^{s}

4 04.1 − 2 31.0 = 1^{m} 33.1^{s}

4 09.5 − 2 38.8 = 1^{m} 30.7

4 12.4 − 2 41.0 = 1^{m} 31.2

4 16.3 − 2 43.4 = 1^{m} 32.9^{s} or
45.6 = 30.7

4 39.3 − 3 11.4 = 1 27.9

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1892phae.proj..389D

Computations.

Investig. of error in Merid. for Oct. 23d-24.

Dec Slips	Taken Merid Error 30"	Resd Error 0.4	Actual Errors.	63" M.Er.	Result	Resid δ
+ 41,7	+ 2.2	0.4	first 2 16.1	+ 4.6	20,7	+ 0,96
+ 28,5	+ 1,6	0,5	2 16,3	+ 3,4	19,7	− 0,04
+ 14,6	+ 1,1	0,5	2 16,5	+ 2,3	18,8	− 0,94
− 30,2	− 0,6	0,6	2 21,4	− 1,3	20,1	+ 0,36
− 81,9	− 12,9	1,7	2 46,5	− 27,1	19,4	− 0,36
					19,74	266 / .53

.53

When Resd reads 0, adding it W + 0,1 might help.

For M. Err

Dec	Error
41,7	2 16,3
28,5	21,4
14,6	46,5
−82.	

3 | 84.8

28,3

5,1 / 25,2 } 30,2

+ 28,5	+ 1,6	2,2	14,6
− 30,2	− 0,6	12,4	
− 82	− 13,0		

17
21
17
34
357

Take Av. of $\frac{5,1}{2,2}$; $\frac{25,1}{12,4}$; $\frac{30,2}{14,6}$ = 2,3 , 2,0 , 2,1

Av. = 2,1 = 63" Merid. Error.

− 24 · 0,4

16,1	− 8,4 =	07,7
16,3	10,5	5,8
16,5	10,5	6,0
21,4	12,6	8,8
46,5	35,7	10,8

Oct 26,3 M. Er.

−16,3 2 22,1 0

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Computations.

Investigation of Errors for Obs^ns taken Oct. 31.5

Dec	Error	Mer Zen 30"	Zen 0.4		+0.1	+0.2	−0.1	−0.2	
+58.6	32.4	+ 3.6	0.3	36.0	35.6	35.2	36.4	36.8	+ .84
+ 14.6	34.1	+ 1.1	0.5	35.2	35.1	35.0	35.3	35.4	+ .04
− 07.9	34.8	+ 0.2	0.6	35.0	35.0	35.0	35.0	35.0	− .16
− 30.2	34.6	− 0.6	0.6	34.0	34.1	34.2	33.9	33.8	− 1.16
− 57.8	37.3	− 2.5	0.8	34.8	35.1	35.3	34.5	34.2	− .36
− 77.9	44.4	− 8.4	1.3	36.0	36.8	37.6	35.2	34.4	+ .84
									3 40
				av.	35.76				av. Resid .57

	+ 0.1			− 0.1				
35.6	+ 6	+ 3	36.4	+ 14	+ 13		13	
35.1	+ 1	− 2	35.3	+ 3	+ 2		21	
35.0		− 3	35.0	0	− 1		13	
34.1	− 9	− 12	33.9	− 11	− 12		26	
35.1	+ 1	− 2	34.5	− 5	− 6		273	
36.8	+ 18	+ 15	35.2	+ 2	1			
	+ 17	37	35.1	+ 3	35			
35.3		60		+ .05				

Bk ar. 35.2 av Resid 0.6

92.4	17	+ 2	9	4.2	5	3	0.6			
84.1	6	+ 1	7	4.7	2	1	3.5	2.9	15	
4.8	− 2	+ 0	−	4.9	− 4	−	4.7	1.2	12	
4.6	36	+ 2	18	4.3	17	8	4.9	2	−	
7.3	7.1	+ 5	14	6.0	42	8	8.6	3.7	18	
14.4				10.2			18.6	10.0	2.0	

m error −30"					
−1.2			6.3	=	−7.5
	42	21			
3.0			10 5		− 7.5
	16	16			
4.6			12.6		− 8.0
	6	−			
5.2			12.6		− 7.4
	46	23			
9.8			16.8		− 7.0
	13.0	26			
22.8		21	27.3		− 4.5

No 6

This suggests that Eberhart looked the first many times a large circle error

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Computation

Obs^ns 1 Oct 19.4

Mean.

+14.6	2^m 07.1	6,0	10,0	+1.1	1.7	3.6	0.5	1	
−30.2	13,1	4,0		−0,6	1.9		0.6		3
−57.8	17,1			−2.5			0.8	2	

Av^s = 3,5, 2,1, 2,8 | Av = 2.8 times 30" = 84"

2	07.1	+ 3.1	= 2^m 10.^s2	−4
	13,1	− 1.7	11.4	+8.
	17.1	− 7.0	10.1	−5
			1.7	3 | 17

2^m 10.^s6 // 0.6 Av. Revised.

Obs^ns for Oct 20.3 Mean.

+ 9.4	2^m 12.7	{+ 0.^d4 = (0.^s5)	12,2	5,9	+0,7	2.2 = 2,7 · 30"	
−47.5	2^m 18.1		18.1		−1.5	= 81"	

12,2 + 1,9 = 2^m 14.^s1
18,1 − 4,1 = 2 14.^s0
} 2^m 14.^s1

Obs^ns for Oct 21.3 +

+62.1	2^m	12,6	W + 0.^d1 = + 0.^s1 =	12.7	1,0	1.8	+4.2	2,2	3 5
+37,6		13,6	" + 0,1	13,7	0.8		+2,0	1.3	
+09.4		14,4	" + 0.1	14.5			+0.7		

Div. 0.5 0,6 0,5 Av = 0,5

12.7	+ 2.1	= 2^m	14,8
12,7	+ 2,0		14,7
14,5	+ 0.4		14.9
		2^m	14.^s8

15^4

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Computations

Obs^ns of Oct 22,5

+ 49,5	2	04,8	E+3 or 0,4	=0,3 − 0,3 =	04,5		+2,6 × 4 = +10,4
+ 40,5		08,0	E+4, 5, 9	0,4		35,8	+2.2 × 4 = 8,8 9.0 = 4. = 2′ 00″
+ 3,7		14,5	E+6. 10. 14	0.5			
− 74.6		46.0	E+22 or 2,0	1.1 − 5,7	40.3		−6,4 = −25,6

			M. Cor	L. C.		
2	04.8	+10.4 =	15.2	−0.2	15,0	−0,6
	08,0	+08,8	16, 8	−0,3	16.5	+.9
	14,5	+02,4	16.9	−,8	16,1	+,5
	46.0	− 25,6	20.4	− 5,5	14.9	−.7
					2,5	27
					15.6	0,7

Obs^ns for Nov. 1,4

+60.1	(2 nw) 32.0 (1w)			32,0	+,6	Meridl 0″
+55.9	38,0	E+10, d 0 −7.5	0,29	30,5	−,9	
+35.0	31,1			31,1	−.3	
+05,3	31,0 (1w)			31,0	−,4	
−18,6	assume 4 36,5	E+10,0 d	0.6 15,0	31,5	+.1	
−57,8	32.3			32.3	+9	
				2,4	6 32	
				31,4	0.5	

Obs^ns for Nov. 4,3

+14,6	41,1 S	−0,2	+1.1	1.7		+0.1 =	41.2	0.2
−30,2	40.9		−0.6		9.5	−0,1 =	40.8	0.6
−77.9	43,1	+2,2	−8.4	7.8		−0,8 =	42.3	.9
							4.3	3 1.7
	Σ/3 (−0,1	+0,3	+0,2) = +0,1				Ow = 41.4	0,6

Obs^n for Nov 3.3 m = 0″ L = 0,0

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Computations of Obs^ns for nov 5.4 - 5.5

+ 45,9
+ 23,0
+ 14,6
− 57,8

45,1 −1,1 44,0 +1,2 45,2 (2w) +2,3 47,5 +0,1 +3,5 +2.4

0,4	+2,4	1,0		
0,5	+1,4		+1.3	
0,5	+1,1	0,3	3,9	4.9
0,8	−2,5	3,6		

27"

−1,0
+4,0
+0.7
+0.1
+1,0
+0,5
6 | 5.3
0,9

45,1	+ 2,2 =	47,3	+13	
44,0	+ 1,3 =	45,3	− 7	
45,2	+ 1,0 =	46,2	+ 2	
47,5	− 2,2 =	45,3	− 7	
		24.1	29	
		46,02	0.7	

other way

R.						div.	0"
.1	43,9 =	45.1 − 1,2 = 3 × 0,4	0,1			−11	
1,3	42,5 =	44,0 − 1,5	0,5	,1	.4	+1.	6 av = 3 × 0,4
1	43,7 =	45,2 − 1,5	0,5	,0 ,3		12	
13	45,1 =	47,5 − 2,4	0,8			+8	
28	15,2						
0.7	43,8						

Obs^ns for nov 15,4

3^m	5						
+35,0	08,1	L⊙?	8,1				
1.7 +28,5	11,4	[⊙m?			+1,9 = +4,0	div.	
(0,3) 0.6 1.1 +14,6	11,6	[⊙m?	1.9		1,2	1.6	
+04,9	10,0	L⊙?	10,0	4.0	+0,7 +1.5	2,0	2,0 } = 2,1
−15,6	12,1	L?	12,1	2,1	0,8	2.6	
					−0.1 −0,2		

08,1 + 4,0	= 12,1	3	11,4	0,2	1.7	0.6 div = 0,3	+0.6	= 12,0
10,0 + 1,5	= 11,5	3	11,6		1,1		+0,4	12,0
12,1 − 0,2	= 11,9	1						
	25							
3^m	11.8	(0,2)						

So m Lacz

12,1	+,2
12,0	+1
12,0	+1.
11,5	−4
11,9	0
−5	5 | 8
11,9	(0,16)

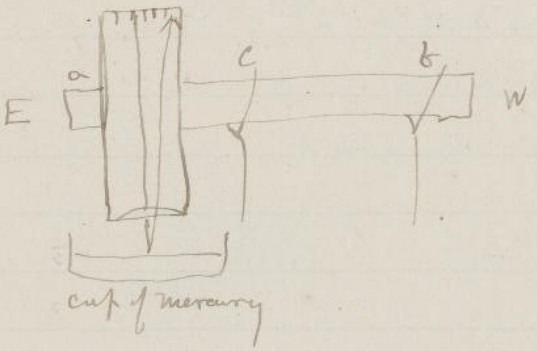
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Wed. Jan. 4. 93.

Index. error in level of Transit. Inst.

Looking S.



Level and rest not both over the Y's but one at a & one at b. Hence as diam a is greater than bc (judging from its effects) and as a-c-b is not perfectly straight

We have the following.

Leveling with Obj. end ◁ S the Reflec in Mere. is displaced 0.85 of the int.

Leveling with Obj. end ◁ N the Reflec in Mere is displaced 0.50 of thread int.

That means that the error due ◁ enlargement of diam a = 0.675 of a th. Int. and error due ◁ bending of a-c-b is 0.175

But as Inst is always leveled with O and ◁ south, its error will always be 0.85.

I find by experiment that

$.85 - .50 = 0.35 = 3.5^{d}$ div. of the level.

$0.85 = \frac{17}{20} 30 = \frac{510}{7} = 7.3^{d}$ of level.

Hence. Level index error is W + 7.3^{d}

Suppose total error is $\frac{\text{Th. Inst.}}{2} = 0.175 = 1.5^{d}$ of level = $4'(0.4)$

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Computation,

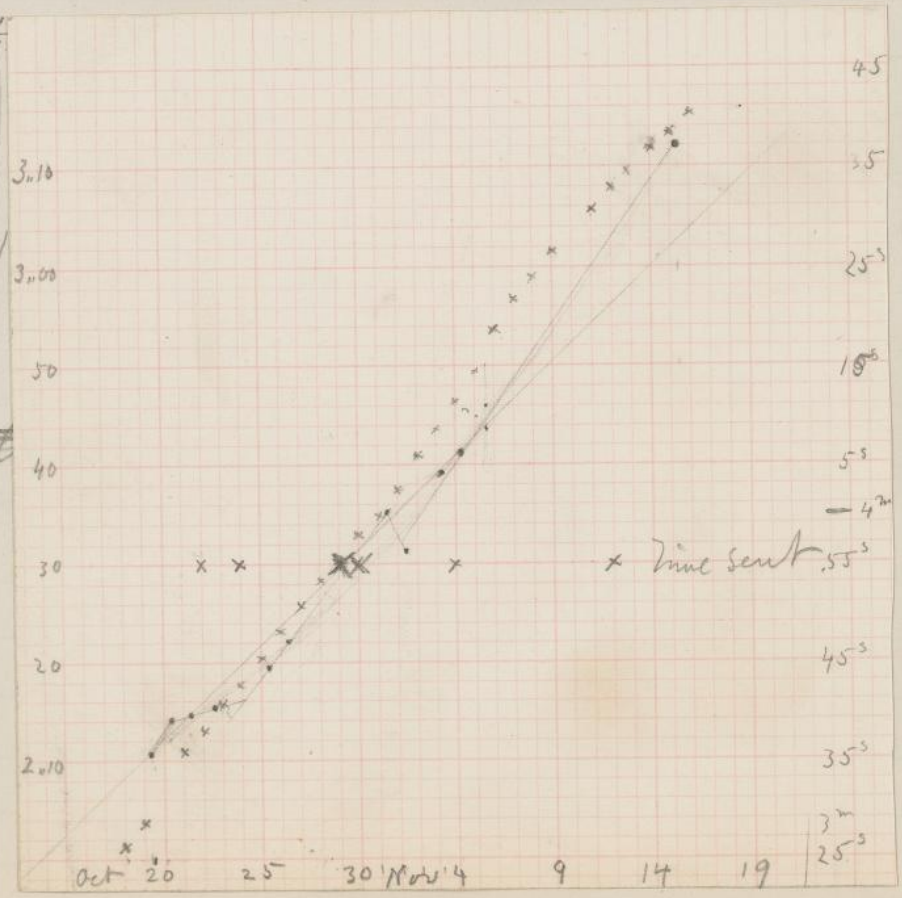
Obs^ns of Oct 25.4 Le page 42

Const. Corr 7.3

						m.e. 30°		
	16.1	+ 7.3	= 23.4	1.4	0.6	2.3	7	
	16.3	8.5	24.8	0.8	0.5	1.6	14	poor
	16.5	9.1	25.6	7.3	1.7	4.3	13	
-30.2	21.4	11.5	32.9	43.7	12.3	3.6	6	
-81.9	46.5	30.1	76.6		4	11.8	40	
						3.0	10	

	16.1	+ 1.6	= 17.7	0.6	0.6	= 1.0	7	
	16.3	+ 2.0	18.3	0.2	0.5	0.4	13	
	16.5	+ 2.0	18.5	5.3	1.7	3.0	13	
	21.4	+ 2.4	23.8	29.5	12.3	2.5	8	
	46.5	+ 6.8	53.3		4	6.9	41	
						1.7	10	

16.1
16.3 0.2
16.5 0.2
21.4 4.9
46.5 25.1



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List of Clock Comparisons between the M.T. & Sid clocks.

Date		Sid. clock.			Mean Time A.					M.T. M[illegible] behind
Oct. 18	(1)	14h	46m	05.56	00h	52	00,0	42.39	3	25,7
	(2)	14	48	06,0	"	54	00,0	44	40.2	3 25,8
19		13	57	56,5	00	00	00,0	54	28,0	3 28,5
		14	58	06,5	01	00	00,0	54	37.9	28,6
		01	41	54	~~23~~ 11	42	00	38	23,4	3 30,6
~~20~~		02	01	57	12	00	00	56	26.4	5 30,6
		02	55	06	12	53	00	49	35,1	5 30,9
		12	15	39	22	14	00	12	07.3	3 31.7
		12	21	40	22	20	00	18	08.3	3 31,7
20		11	05	27	21	00	00	01	57.5	3 35,5
21		14	05	57	00	00	00	02	21,1	3 35,9
		15	47	14	01	41	00	43	37.7	3 36.3
		20	55	05	06	48	00	51	28,1	3 36,9
22		20	57	03	06	46	00	53	24.4	3 38.6
		02	45	01	12	33	00	41	21.4	3 39.6
		02	48	~~01~~	12	36	~~00~~	44	21.9	3 39.1
		10	33	18	20	20	00	29	38.1	3 39.9
23		14	13	55	00	00	00	10	14,2	3 40,8
24		14	50	59	00	33	00	47	16.2	3 42.8
		15	10	02	00	52	00	06	19.3	3 42,7
		12	32	34.5	22	11	00	28	49.4	3 45,1
		12	39	36,0	22	18	00	35	50.6	3 45.4
25		15	05	00,	00	43	00	01	14.4	3 45.6
26		15	32	03	01	06	00	28	14,7	3 48.3
		15	52	06	01	26	00	48	18.0	3 48.0
27		15	35	02	01	05	00	31	11.7	3 50,9
		15	43	03	01	13	00	39	12.4	3 50.6

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List of Comparisons between M.T. & Sid. Clocks.

		Sid. Clock.			Mean Time Clock				M.T. Clock behind		
Oct.	28	15	39	01.-	01	05	00	35	07.7	3	53.3
		15	46	01,6	01	12	00	42	08.9	3	52.7
	29	15	44	59,5	01	07	00	41	04.5	3	55.0
		15	52	01,0	01	14	00	48	05.7	3	55.3
	30	16	11	02,7	01	29	00	07	04.8	3	57.9
		16	14	03,0	01	32	00	10	05.3	3	57.7
		19	38	37	04	56	00	34	38.8	3	58.2
	31	15	52	58,0	01	07	00	48	57.9	4	00.3
Nov.	1	15	44	55	00	55	00	40	52.2	4	02.8
		14	18	39	23	25	00	14	34.0	4	05.0
		Sid. Clock — moved + hrs & gained 15 m.)									
		14	31	42	23	38	00	27	36.1	4	05.9
	2	15	25	51	00	32	00	21	45.0	4	06.9
		17	26	11	02	32	00	22	04.9	4	06.3
		11	11	07	20	14	00	06	59.2	4	07.8
	3	15	57	55	01	00	00	53	46.2	4	08.8
	4	16	21	57,5	01	20	00	17	46.0	4	11.5
	5	15	42	50	00	37	00	38	35.4	4	14.6
		15	48	51	00	43	00	44	36.4	4	14.6
		15	54	52	00	49	00	50	37.4	4	14.6
	6	16	19	56,2	01	10	00	15	37.4	4	18.8
		16	25	57,2	01	16	00	21	38.4	4	18.8
	7	16	13	54,2	01	00	00	09	32.4	4	21.8
		16	37	58	01	24	00	33	36.3	4	21.7
	8	15	17	43	00	00	00	13	19.1	4	23.9
		15	29	45	00	12	00	25	21.1	4	23.9
		15	36	46,1	00	19	00	32	22.3	4	23.8
		15	47	48	00	30	00	43	24.1	4	23.9
	9	16	51	57	01	30	00	47	30.6	4	26.4
		17	00	58,5	01	39	00	56	32.1	4	26.4

4 h 10
3.35
+ 35 5.7 d.

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List of Comparisons between M.T. & Sid. Clocks.

1892	Sid. Clock			Mean Time Clk.					
Nov. 11	16	28	49.3	00	59	00	24	18.5	4 30.8
	17	15	57.2	01	46	00	11	26.2	4 30.8
	17	25	59.2	01	56	00	21	27.8	4 31.4
12	16	20	46	00	47	00	16	13.1	4 32.9
	16	32	48	00	59	00	28	15.1	4 32.9
	12	20	04.2	20	43	00	15	29.6	4 34.6
13	15	21	32	23	40	00	16	55.3	4 36.7
14	07	25	11	15	41	00	20	33.1	4 37.9
15	16	24	40	00	39	00	20	01.4	4 38.6
	20	08	17	04	22	00	03	38.0	4 39.0
16	16	56	43	01	07	00	52	02.6	4 40.4
17	17	06	32	01	13	00	02	00.1	4 31.9
	17	12	35	01	19	00	08	01.0	4 34.0
	01	29	57	09	35	00	25	22.5	4 34.5
20	17	54	34	01	49	00	49	55.5	4 38.5
	18	11	4	02	07	00	07	58.5	3 05.5

N.B. Clocks changed. Put fast last 25

Other Comparisons with Sid. Clock

	Sid Clock			Chron.					
Oct 18	19	35	05.8	05	40	00.0		31 27.2	3 38.6
23	14	27	00	Chron.	00	12	53.5	23 09.6	3 50.4
24	15	12	00	Mr Watch	00	53	33.	07 52.4	4 07.6

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Computations.

The clock errors as found are worthless
Take Oct 31 & Nov 1. as test cases.
From insufficient experiment the constant
clock error may be W + 1.6 or W + 7.3

Oct 31 W + 1.6

+58.6	32.4	+ 1.1	= 33.5	2.6	+ 3.6	2.5	1.0	+ 4.8	= 37.0	× 1.1	38.3	× 1.3	
+14.6	34.1	2.0	36.1	0.9	+ 1.1	0.8	1.1	+ 1.2	1.5	37.3	37.6		
−07.9	34.8	2.2	37.0	0.1	+ 0.3	0.4	0.1	+ 0.3	0.4	37.3	37.4		
−30.2	34.6	2.5	37.1	3.4	− 0.6	1.9	1.5	− 0.7	0.8	36.4	36.3		
−57.8	37.3	3.2	40.5	9.0	− 2.5	5.9	1.5	− 2.8	3.3	37.7	37.2		
−77.9	44.4	5.1	49.5	16.0	− 8.4	12.0	5 | 4	− 9.2	11.2	40.3	38.3		
				2 | 11.2			1.1			14.5			
										37.85			

Nov 1. see page 45

+60.1	32.0
+55.9	30.5
+35.0	34.1
+05.3	31.0
−18.6	31.5
−57.8	32.3

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Dates

in which time was sent from Arequipa R.R. Sta.

1892 Oct. 22.4 Sat. to Puno,
~~Oct~~ 24.4 Mon " "
29.3 Sat " La Paz
30.4 Sun " " "
Nov 04.3 Fri " " "
12.3 Sat " " "

Comparisons of M.T. Clock with M.T. Watch-Chron

Date	M.T. Clock			Ch. or W.			slow Chron	slow Watch
Oct. 18	5	45	11.8	Ch.	45	00.0		
	5	47	11.8		47	00.0		
19	12	56	00	W.	55	58.5		
20	21	06	00	W	05	59.5		
21	0	00	00	W	59	59.5		0m 00s.5
	1	43	00	"	42	59.5		0.5
	6	46	00	"	46	59.5		0.5
22	6	49	00	"	48	46.0		14.
	12	34	00	"	47	46 !!		14
	20	21	00	"	20	46		14
23	00	04	00		03	42.5		17.5
	00	08	00	Ch.	07	50.3	0m 09.7	
	00	15	00		14	50.3	9.7	
	00	19	00	W	18	42.5		17.5
				W 0.4	22	00	Ch 22.09.7	
24	00	36	00	W	35	36		24
	00	38	00	Ch	37	43.5	16.5	
	00	40	00		39	43.5	16.5	

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Comparisons of W.Y. Clock with W.Y. Chron. & Watch.

Date	W.Y. Clock						Chron slow	Watch slow	
M.T. 24 Cont'd			$0^h.7$	Ch > W =		$0^s.6$			
			$0^h.8$	"		"			
			$0^h.6$	"		"			
	01	00	00	Ch	59	43.5	16.5		
	22	20	00		19	40.3	19.7		
				Ch > W =		$13^s.0$			
	22	33	00	Ch	32	40.3	19.7		
25	00	41	00	"	40	39.7	20.3		
		42	00	"	41	39.7	20.3		
		46	00	W	45	24.5		35.5	
		49	00	Ch	48	39.7	20.3		35.4 at $1^h 40^m$
	2	38	00	W	37	24.8		35.2	34.9 at 0^h
26	1	10	00	Ch	09	33.7	26.3		42.4 at 0^h
		13	00	W	12	17.2		42.8	42.8 at $1^h 13^m$
		27	00	Ch	26	33.7	26.3		7.4 in $23^h.6$
			(1.5)	Ch > W =		$16^s.0$			
27	00	57	00	Ch	56	28.3	31.7		
	1	03	00	"	02	28.3	31.7		
	1	08	00	W	07	10.8		50	
			(1.2)	Ch > W =		18.3			
28	00	58	00	Ch	57	23.5	36.5		
	1	00	00	W	59	08.5		57.5	$-9^s.0$ in $24^h = \frac{3^s}{8}$ per hour
			(1.0)	Ch > W =		$15^s.0$			$= 0^s.375$ per h.
	1	14	00	W	13	08.5		57.5	i. $28^d 0^h$ $\Sigma_{W} - 51.1$
		16	00	Ch	15	23.5	36.5		
29	00	56	00	Ch	55	14.5	45.5		$29^d 0^h$ $\Sigma_{W} = -60^s.1$
		59	00	W	57	59.5		$1^m 00^s.5$	
			(1.0)	Ch > W =		$15^s.0$			
(see note)			(1.0)	Ch > W =		$15^s.0$			

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Comparisons of M.T. Clock with M.T. Chron & Watch

Date	M.T. Clock	Chron. W.	Comp.^{s}	slow Chron	slow Watch
Oct 30	01 30 00	Ch. 29	09.7	50.3	
	01 33 00	32	09.7	50.3	
	(4.^{h}7)	Ch > W = 4.^{s}0			
	(4.7)	Ch > W = 4.^{s}0			
	04 52 00	Ch 57	09.0	51.0	
	4 53 00	W 52	04.8		55.^{s}2
31	01 10 00	Ch 09	05.7	54.3	
	1 11 00	W 09	59.5		60.5
	(1.^{h}2)	Ch > W = 05.^{s}2			
Nov. 1	00 58 00	W 56	49.5		1.^{m} 11.^{s}
	1 00 00	Ch 59	00.5	59.5	
	(1.^{h}0)	Ch > W = 11.^{s}7			
	2 15 00	W 13	49		1 11.^{s}
	(2.^{h}2)	Ch > W = 11.^{s}5			
	9 35 00	W 33	48		1 12
	9 38 00	Ch 36	57.9	1.^{m} 02.^{s}1	
	23 18 00	W 16	42.9		1 17.1
	23 23 00	Ch 21	54.6	1 05.4	
2	00 17 00	W 15	41.9		1 18.1
	0 18 00	Ch 16	54.6	1 05.4	
	0 25 00	Ch 23	54.4	1 05.6	
	02 31 00	Ch 29	53.8	1 06.2	
	2 34 00	W 32	41.9		1 18.1
3	01 02 00	W 00	34.4		1 25.6
	1 04 00	Ch 02	47.3	1 12.7	
4	01 23 00	Ch 21	40.3	1 19.7	
	1 25 00	W 23	27.2		1 32.8

4.9 55.2
1.2 60.0
13.7 4.8
20.3

Call it
30^d 0^h ξ = 54.1
31^d 0^h ξ = 59.7

As there is error here I call Watch just 60.^{s}0 slow.

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Comparisons of M.T. Clock and W.T. Chron. and Watch.

Date	M.T. Clock	Chron W. —	slow Chron	slow Watch
Nov. 5	00 44 00	W 42 15		1m 45s
	00 46 00	Ch 44 32.5	1m 27.5	
6	01 12 00	W 10 07.2		1 52.8
	1 14 00	Ch 12 22.3	1 37.7	
7	01 04 00	W 02 04.1		1 55.9
	1 08 00	Ch 06 15.4	1 44.6	
	1 22 00	W 20 04.1		1 55.9
	1 25 00	Ch 23 15.4	1 44.6	
8	00 17 00	Ch 15 05.5	1 54.5	
	00 21 00	W 18 57.5		2 02.5
9	01 32 00	W 29 50.5		2 09.5
(10th omitted)	1 34 00	Ch 31 55.9	2 04.1	
11	00 56 00	W 53 32.5		2 27.5
	01 00 00	Ch 57 37	2 23	
	01 48 00	W 45 32.5		2 27.5
	1 50 00	Ch 47 36.5	2 23.5	
12	00 48 00	W 45 23.0		2 37.0
	00 52 00	Ch 49 24.6	2 35.4	
	0 61 00	Ch 58 24.6	2 35.4	
	10 55 00	W 52 21.2		2 38.8
13	20 55 00	W 52 18.1		2 41.9
	20 57 00	Ch 54 18.2	2 41.8	
13	23 42 00	W 38 46		3 14
	23 47 00	Ch 43 07.5	2 52.5	
14	15 42 00	Ch 39 00.5	2 59.5	
15	00 41 00	W 37 39.8		3 20.2
	00 42 00	Ch 38 57.0	3 03.0	
	64 17 00	W 13 38.4		3 21.6
	4 20 00	Ch 16 55.6	3 04.4	

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(Mis) Watch Error Oct 22.

The diff. between the two standard clock forms a pretty straight line from Oct 20 & Nov. 1. The chronometer line is comparatively straight during that period. The watch line — at no time straight, may be neglected in this process. I would then from the above considerations I conclude that during that time the Time Obs^ns in the Transit Inst. at H.C.O. Arequipa should give a straight line. Therefore I draw a straight line through them, giving the following errors:—

Oct	22..	0^h	M.T. Clock slow	$1^m\ 23.^s7$
"	25..	0^h	" "	25.6
"	28..	0^h	" "	27.5
"	30..	0^h	" "	28.8

Also

Oct	23^d	0^h	M.T. Clock slow	1^m 24.3
	26..	0^h	" "	26.2
	29..	0^h	" "	28.1
	31..	0^h	" "	29.4

We have then

Oct 22.

Oct	22^d	0^h	Mis Watch slow	$1^m\ 37.^s7$
"	23	0^h	" " "	/ 38.3

without change in rate between these times.

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(Mis) Watch Error Oct 25.

		M.C. slow
Oct 25d 0h Mis Watch behind M.C.	34.9	1m 25.6
26 0h " " " "	42.4	1m 26.2

Therefore

Oct 25

Oct. 25d 0h Mis Watch slow	2m	00.5
" 26 0 " " "	2m	08.6

As nearly as I can tell the rate was constant.

Mis Watch Error for Oct 28.

Oct 28d 0h Watch behind ~~slow~~ M.C.	51.1	M.C. slow	1m 27.5
" 29. 0h " " "	60.1	" "	1m 28.1

Therefore.

Oct 28

Oct 28d 0h Watch slow	2m	18.6
" 29 0 " "	2m	28.2

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Mr Watch Error for Oct 30d

Owing to a great change in rate of the watch this rate is difficult to get. A Comparison was taken at Oct 30, 4h.9 and on Oct 31d 1h.2, Calling the rate constant we have

		M.C. slow
Oct 30d 0h	Watch behind M.C.	54.1 / 1m 28.8
" 31d 0h	" " " "	59.7 / 1m 29.4

Therefore

Oct 30d 0h Watch slow 2m 22.9
" 31d 0h " " 2m 29.1

At 4h.9 (Oct 30) this is all right but as the rate was probably not constant, the minus error of the clock could be decreased by about 1s at 14h.

Mr Watch Error for Nov. 12. 93

From Nov 10 15h the Sid. C., Chron, & Watch agree fairly well in making a curve, which would indicate that during that interval the M.C. ran slower for a time & then faster. With both the Sid. Cl. & the Chron this digression on Nov 12th amounts to almost exactly 2s. Therefore I assume that the line of time Nov 10 is subject to the same curve and should be corrected by 2s on Nov 12d. This makes the M.C. 1m 30.5 slow on that date:

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Mr's Watches Error for Nov. 12. 92

The Comparisons with the M.T.C. are as follows.

Nov 12. $0^h.8$ Watch behind, $2^m 37^s.0 + 1^m 30^s$ to get error of watch

" " 10.9 " " 2 38.8

" " 20.9 " " 2 41.9

Therefore :—

Nov 12.	$0^h.8$	Watch slow	3^m	$07^s.0$	Error discovered Sept 18, 1893.
	10.9	"	3	08.8	
	20.9	"	3	11.9	

Probable Chronometer error for Oct 22.

Chron behind M.C	M.C. slow	Chron. slow
Oct 22d 0^h $2^s.0$	1^m $23^s.7$	1^m 25.7
" 23 0^h $10^s.0$	1^m $24^s.3$	1^m 34.3

Rate probably constant.

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21 22 23 24 25 26 27

Time telegraphed
Observations
7 to 12
Puno
3 PM.
Chililaya
8 PM.
8 to 12
La Paz

Comp's at RR. Sta.

Sid. Clock ahead

01m 40s

True time ahead

01m 20s

Mean Time Clock standard

Clock comparisons at Arg. Sta.

Ch. Chron. slow

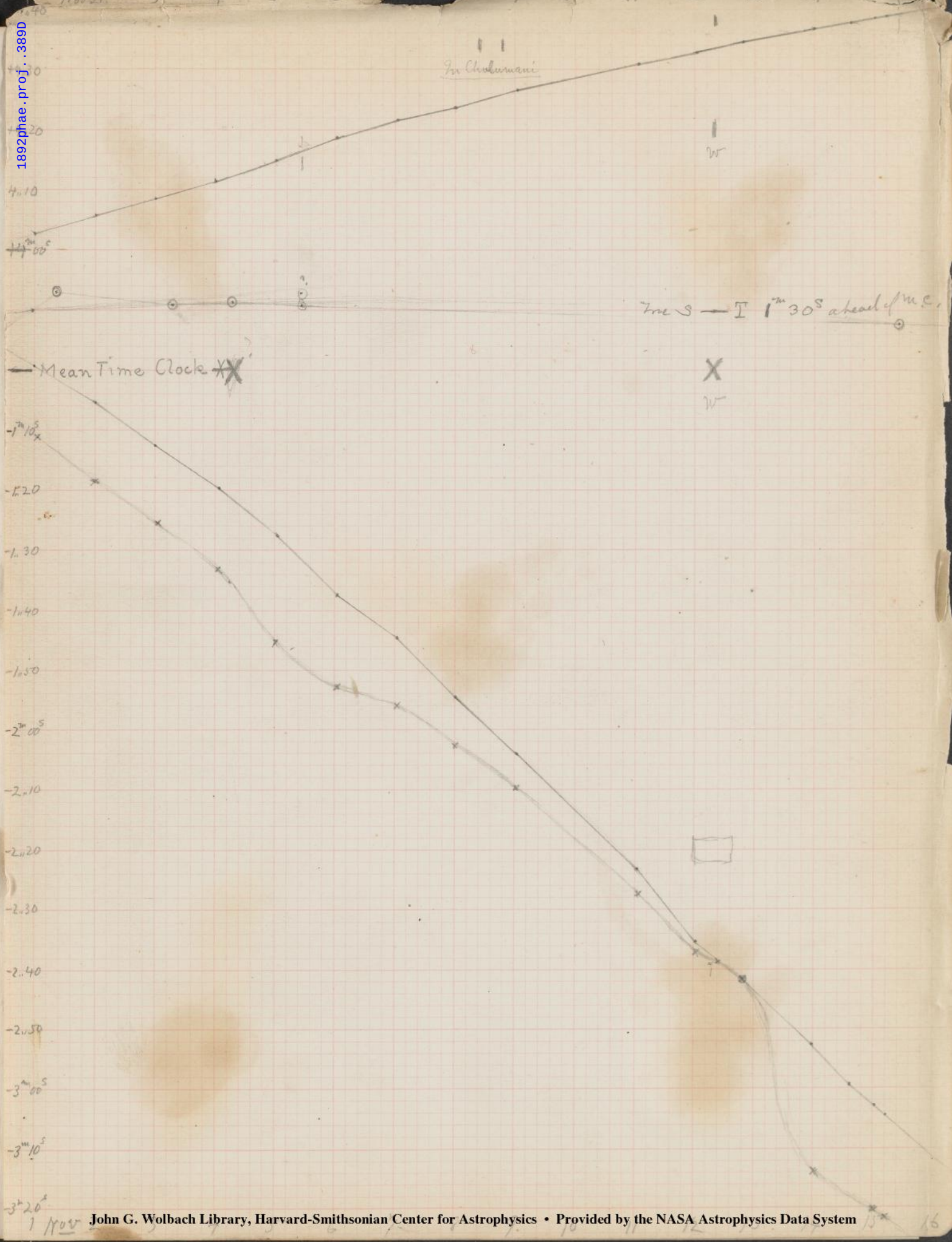
Watch slow

Repeaters
large scale

Special Remarks

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Study of Watches on Bolivian Trip

Copied from Notes.

~~Study of Station Clock~~ Bolivia

while sending signals to ~~Lima~~ Arequipa

Copy

of all comparisons.

Sat. Oct. 22. Arequipa Clock Prof's Watch

8	37	01	8	34	57,5	3,5	-3
	39	"			57,2	3,8	-1
	41	"			57,0	4.0	+1
	42	"			56,2	4.8	2
	43	"			56,0	5,0	+3
	44	"			55,5	5,5	4
	45	"			55,2	5,8	5
	56	"			55		16
	57	"			54		17
	58	"			54,2	6.8	18
	59	"			54,0	7.0	19
9	00	"			53.7	7.3	20
	40	"			57,2	53,5	10 6.8
					(52.2)? (47.2)?	5.4	Arr 8h 46m.8

At same time - Ds Watch - slow

Ds watch

—	—	01	— —	48,5	12.5
		"		48 short	13
		"		47	14
		"		47.2	13.8
		"		47.2	13.8
		"		47.2	13.8

} at 9h 00m

34) 305 (9
306
-1

12	24	01.0	12	23	16.7	44.3

30.5

Time Int 3h.4 , 30.5 || per hour watch gitting behind 9s.0

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Mon. Oct 24.

Ang. Clock			A&D's Watch			Watch ahead
3	07	01,0	3	07	27.2 26,8	25.8
	8	01,0		8	26.8	25,8
	9	01,0		9	26,7	25,7
	10	01,0		10	26,7	25,7
	11	01.0		11	26,6	25,6
	12	59,0		12	24,6	25.6

At $3^h\ 09.^m5$ Err = 25.7

Comparison between A&D's Watch & Prof's watch.

Mon, Oct. 24.

A&D's Watch			Prof's Watch			Prof's Watch ahead
3	23	00	3	23	52	52.5?
	24	00		24	53	53 !
	25	00		25	53,2	53,2 !
	26	06		27	00	54,0 ?
	27	06,4		28		53,6 !

Ang. Clock not stopped.

Wed. Oct 26 Astronomical Observations at Chilliaya.
$8^h\ 36^m$ to $10^h\ 07^m$

Wed, Oct. 26 Comparison between A&D's watch & Prof's Watch.

A&D's watch			Prof's Watch			Prof ahead.
10	14	00	10	15	57,2	1^m 57.2
		30		16	27,0	1 57,0
	15	03		17	00	57.

Thurs Oct. 27. A&D Watch stopped - Set 1.7 ahead of Prof's watch at $20^h\ 22^m\ 30^s$

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Study of Watches on Bolivian Trip.

Sat. Oct. 29. A&Ds Watch — Prof's Watch N.G. slow
0h 30m 46.7 — 23h 40 00

Sat Oct 29 Comparison of A&Ds watch with Anguisa Clock

Ang. Clock		A&Ds Watch			
8h 06	01,0	8	09	20.–	3 19.0
7			10	20.2	19.2
8			11	20.1	19.1
9			12	20.1	
10			13	20.1	abt 8 10
11			14	20.1	Er = 3m 19s.1 ahead
12			15	20.1	
13			16	20.1	
14			17	20.0	
15			18	19.9	

(watch by which Long. station clock is (i.s. the regulator clock was set by the old clock)

Sun. Oct. 30. Ds Watch is 3m 10 to 12s ahead of time sent by telegraph

---

Sat. Nov. 12. Comparison of Futurum Ds watch and Ms watch as ~~beat~~ telegraphed by land from Anguisa.

Ms Watch			Ds watch		
8	35	00	8	56	10.–
	36	"		57	09.7
	37	"		58	09.7
	38	"		59	10.0 3
	39	"	9	00	09.8 1
	40	"		01	09.5 2
					5 |3.7
8	57		8	58	9.7 4

last 2m 09s.7

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Part of the Work at Arequipa Sta. Clock - during Trip.
by L. G. D. (See page 32)

Sat. Oct 22

Sta. Clock	Chron.	Ch. slow in Sec^s
7 05 00	7 05 00	
14		regulated clock without stopping it.
26 00.0	25 59.7	00.3
31 00.0	30 59	1.0
49 00.7	48 57.3	3.4
8 14 00	8 13 56	4.0

	Watch	Watch losing	Watch slow	Clock slow
10 06 00	10 05 40	20.0	98.0	78^s.0
Next A.M. 21 22 16	21 21 00	76.0	99.2	23.2
24 16	23 00	76.0	99.3	23.3

Regulated Clock

	Chron.	Watch 7.^{s}0 behind Chron. 7 loses^s Ch. slow
21 28 00	21 26 50.5	6:9.5

	Watch	Watch slow.
21 35 17	21 34 00	77.0
2.3 47 18	46 00	78.1

Tues Oct. 25 Comparisons between this Watch and Sta Clocks.

Sta. Clock	This Watch	Sta. Clk. heard (1) stopped or (2) last min hand moved^s watch ahead
4 35 00	4 35 16.0	16^s
= 3.0 36 00	36 16.0	16.^{s}

watch behind

Fri. Oct. 28 4 11 00	4 06 06.^{s}	4^m 54^s
15 00	10 06	4^m 54^s
4 17	Stopped clock to set and regulate it.	
4 18 00	4 18 00	

-4 5 10
1 18
3 52
+1 17
5 09

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Work on Angwin Sta. Clock by L. G. D.

Sun. Oct. 30. Clock found stopped (so he says)

Ang. Clock			His Watch		
2	44	00	2	44	21,5

Clock found stopped in running, set it at

7	59	00	7	59	00 (so he says)
9	28	00	9	27	53,5
	30	00		29	53,5
	41	00		40	53,0

Sat. Nov. 12 Time telegraphed by land from ~~Dutton~~ His Watch
See page 66.

Mes. Nov. 1. Sta Clk 2 39 00 = Watch 3 05 46. Clock may have stopped before this comparison & been started by one of the clerks

Notes.

Ask Ayres what time he sent me on mon. Oct 24. & about the clocks stopping next day, or his correcting it.

Ask Ayres if the clock stopped before the 2.7 Comp

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Errors of Sta. Clock. Aneg.

Oct. 22.

$10^h 06^m$ ov Clock slow $78^s.0$
21 24 ov " " 23.3 (:)
11 18 $= 11^h.3$ 54.7

11.3) 54.7 | 4.84 per hour

452
950
904
460

78.0
.5
78.5
4.8
73.7
4.9
68.8
4.8
64 0

~~Error~~

Hour	Error
$10^h.0$	78.5
11.0	73.7
12.0	68.8
13.0	64.0

Oct 30 $8^h.0$ dif .0.
" 32 3.1 Clock slow $26^m 46^s$

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Discussion of Chron. rate Oct 22, 93

between 10^h & 21^h

Projection of subsequent rate of chron. gain
$10^h.0$ Error $1^m 29^s.3$ slow
21.0 " / 33.3 "

1st comparison with Watch gives
10.0 Error 1^m 29.9 Slow
21.0 " / 32.4 "

Drawing rate of Sta. Clock & then dif. to Chron gives
$10^h.0$ Error $1^m 31.8$ Slow
$21^h.0$ " / 32.7 "

Repeating 1st Comparison we get
$10^h.0$ Error 1^m 31.6 Slow
21.0 " / 32.5 " Therefore 1st Comp. was in Error

This may be assumed as correct since on page 54 we find that the Chron was about 12^s behind the M.T.C. ~~Sun~~ Oct 18, and about 10^s behind it on Oct 23. Therefore its rate was very small at some intermediate time,

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Puno Observations.

Reduction to Sid. Time.

At beginning 9RM watch was about 12^s behind clock
At end $12^h 24^m$ " " " 44^s " " "
by — more exactly.

at $9^h 0^m$ watch 13.8^s behind
at 12.4 " $44^s.3$ "
3.4 30.5 or 9^s per hour
or 1^s in 6.7^m $0^s.3$ in $2^m.2$

Watch behind at
14^s $8^h 58^m$ to $9^h 05^m$.

14,5 at 9 05,5
6,7
9 12,2

Between	Clock ahead of Watch
8h58 and 9h05	14^s
9h05 " 9h12	15^s
9h19	16
9h25	17
9h32	18
9h39	19
9h45	20
9h52	21
9h59	22
10h05	23
10h12	24
10h19	25
10h25	26
10h32	27
10h39	28
10h45	29
10h52	30
10h59	31
11h05	32
11h05 + 11h12	33

Between	Clock ahead
$11^h 12^m$ and $11^h 19^m$	34
11h25	35
11h32	36
11h39	37
11h45	38
11h52	39
11h59	40
12h05	41
12h12	42
12h19	43
12h25	44

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Pond Observations

Reduction to Ang. Obsy. local Sid. Time,

# wds																	
	Obj.	W	0	5.6	E	0	7.0	N	0	7.8	S	0	4.8
			ε	6.3		ε	5.0		ε	4.3		ε	7.3

2 Cassiop

10	27	30.2	
	28	15.3	
	28	59.6	
	29	45.2	
	30	30.2	
5		300.5	
		60.1	

Clock time 10 29 00.1
Clock slow 01 16.3
M.T. (Time) 10 30 16.4
A.S.T. 00 38 17.5

Comp.	Circle
11°50	178 43 05

10 29 00.1
Comp 11°50' A 178 43 00 B 358 43 10

γ Cassiop

10	38	04.9	
	38	55.0	
	39	45.1 (±?)	
	40	36.4	
	41	27.2	
5		228.6	

Clock Time 10 39 45.7
" slow 01 15.4
Time M.T. 10 41 01.1
A.S.T. 00 49 04.0

Comp	Circle
10°57	177 52 58

10 39 45.7
Comp 10°57' A 177 52 55 B (357) 53 00

β Androm

10	51	26.2	
	51	56.0	
	52	27.0 (± 0.3)	
	52	57.3	
	53	28.7	
5		135.2	

Clock Time 10 52 27.0
" slow 01 14.4
Time MT 10 53 41.4
A.S.T. 01 01 46.4

Comp.	Circle	Alt
11°28	178 21 05	39°22

10 52 27.0
Comp. 11°28 A 178 21 or B 358 21 10 Alt 39°22
Below lower Hor. Wire.

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Pmo Obs ns

B Androm.	11	00	09.2	Clock time	11	01	10.2	
		00	39.2	" slow		01	13.6	
		01	09.8	True M.T.	11	02	23.8	
		01	41.0	A.S.T.	01	10	30.2	
		02	11.8	Comp	Circle		alt	
			51.0	13h 48	180	38	55	38, 42.5
	11	01	10.2					

Comp. 13h 48 A 180 38 50 B 360 39 00 alt 38 42.5

Levels

N	E	6.4 6.3	S	E	6.2 6.5	E	E	5.0 7.9	W	E	8.0 4.7

For Lat.

Long Pmo 6m 08s E / Aug.

	Clock Time	Clk slow	True M.T.	Aug. Sid. Time	Pmo Sid Time	Mer. Dist in R.A.
2 Eridani	11 15 06	72s	11 16 18	1 24 27	1 30 35	3m 11s −
	2,366					2, 366
	11 16 47	72s	17 59	1 26 08	32 16	1 30 −
	2,376					376
	11 18 10	72s	19 22	1 27 31	33 39	0 07 −
	2,379 −					379 −
					Due 33m 46s	+
	11 19 24	72s	20 36	1 28 45	34 53	1 07 +
	2,377 +					377 +
	11 20 35	72s	21 47	1 29 57	36 05	2 19 +
	2,376					376
	11 21 25 −	72s	22 37	1 30 47	36 55	3 09 +
	2,371					371
	11 22 15 −	72s	23 27	1 31 37	37 45	4 00 −
	2,369					369
	11 23 04	72s	24 16	1 32 26	38 34	4 48
	2,365 −					365 −

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74

Puno Obs^ns

Lat. Obs^ns

2 Aristis.

Due 2 01 08

Clk. 11^h 32^m 30.8^s | Clk slow 1^m 11.5^s | True M.T. 11^h 33^m 41.8^s || A.S.T. 01 41 53.3

Comp 5^m 38^s A$ 172 26 50 B 352 27 00 = 172 26 55

Clock Time	Clk Slow	True M.T.	Aug. Sid. Time	Puno Sid Time		
11 36 13	71^s	11 37 24	1 45 36	1 51 44	9	24
7.836						
11 38 03	71^s	39 14	1 47 26	53 34	7	34
7.873+						
11 40 00	70^s	41 10	1 49 23	55 31	5	37
7.903						
11 41 23	70^s	42 33	1 50 46	56 54	4	14
7.922						
11 42 24	70^s	43 34	1 51 47	57 55	3	13
7.933						
11 44 08	70^s	45 18	1 53 31	59 39	1	29 −
7.946 = 5-1° 11.5				Due 1 08		+
11 45 48	70^s	46 58	1 55 12	2 01 20	0^m	12^s
7.9525						
11 46 54	70^s	48 04	1 56 18	02 26	1	18
7.946+						
11 48 19	70^s	49 29	1 57 43	03 51	2	43
7.941+						
11 49 24	70	50 34	1 58 48	04 56	3	48
7.930						
11 50 36	69^s	51 45	1 59 59	06 07	4	59
7.914						
11 51 32	69^s	52 41	2 00 56	07 04	5	56
7.901−						

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Pamo Obs ns

For Lat.

	Clock Time	Clk slow	True M.T.	Aug. Sid. Time	Pamo Sid Time.	mer. Dist +
2 Aristis	11 52 31	69s	11 53 40	2 01 55	2 08 03	6m 55s
	7.884+					
	11 53 58	69s	11 55 07	2 03 22	09 30	8 22
	7.858 = 51° 08.0					

Clk. 11 56 08.0 Clk slow 1m 09.1 True M.T. = 11h 57m 17.1

Comp 14°16′ A 181 07 10 B 361 07 15 A.S.T. = 2 05 32.5

Av = 181 07 13

δ Hydrae	12 03 11.0	Clock Time	12 05 30,4
	04 20,2	" Slow	01 08,2
	05 30,0	True Time	12 06 38.6
	06 40,8	A.S.T.	02 14 55,6
	07 50.0	Comp	Circle
	5 | 2.0.	12 " 12	359 09 53
	12 05 30,4		

Comp 12°12′ B 179 09 55 A 359 09 50

Clk. 12 11 11,0

Comp. 11.46 B 178 31 10 A 358 31 15

Clock Time 12 11 11.0. Av = 358 31 13

" Slow 01 07.7

True Time 12 12 18.7

A.S.T. 02 20 36,6

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computations.

M. T.S Duduce & Sid, [Oct. 22.]

10	30	16.4	10	44.7	00	38	17.5
10	41	01.1	12	40.3	00	49	04.0
10	53	41.4	8	42.4	01	01	46.4
11	02	23.8	31	18.0	01	10	30.2 $-10^h+8^m+6.^s4$
11	33	41.8	23	35.3	01	41	53.3 $-10^h+8^m+11.^s5$
11	57	17.1	9	21.5	02	05	32.5 $-10^h+8^m+15.^s4$
12	06	38.6	5	40.1	02	14	55.6
12	12	18.7	1	42 02.3	02	20	36.6

10	30	16.4	~~00~~	38	17.5		
4	45	20		10	44.7		
15	15	36			1.8		
14	05	30.7	00	49	04.0		
10	30	16.4		12	40.3		
	2	30.4			02.1		
00	38	17.5	01	01	46.4		
12	12	18.7		8	42.4		
4	45	20			1.4		
16	57	39	01	10	30.2		
14	05	30.7		31	18.0		
12	12	18.7			5.1		
	2	47.2	01	41	53.3		
2	20	36.6		23	35.3		
00	38	17.5			3.9		
1	42	02.3	02	05	32.5		
		16.8		9	21.5		
02	20	36.6			1.5		
			02	14	55.5		
				5	40.1		
					0.9		
			02	20	36.5		

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Mag. Dec. in Pmo.

Circle	Comp	Rdg at comp. 0°
178 43 05	11 50	166 53 05
177 52 58	10 57	166 55 58
178 21 05	11 28	166 53 05
180 38 55	13 48	166 50 55
172 26 55	5 38	166 48 55
181 07 13	14 16	166 57 13
359 09 53	12 12	166 57 53
358 31 13	11 46	166 45 13

(50+)8)128(257

166 51 32 + 30

Circle Reading at compass 0 = 166 52 02

53.1	1.1
56.0	4.0
53.1	1.1
50.9	1.1
48.9	3.1
51.2	0.8
57.9	5.9
45.2	6.8
Av. 52.0	8)23.9
	3.0 Av. Resid.

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Long. of Puno

Obs^ns

Copied from pages 72-5

Level A (Assume 0^h 20^m)

2 Cassiop (2.3) +55.9	00 38 17,5	E end Elw. $0^d.09$ = 00" W high 25" =	W + 25"	
	178 43 05	‖ Dne 0^h 34^m 26.1 (Cor + 4^s.8)	CW E 33"	
* ρ Cassiop. (2.3) +60.1	00 49 04,0	W end Elw. $0^d.40$ = 5" W high 25" =	W + 30"	
	177 52 58	‖ Dne 0^h 50 15.6 (Cor + 5^s.3)	CW E 33"	
β Aurigae (2.2) +35.0	01 01 46.4	W end Elw $0^d.98$ = 12" W high 25" =	W + 37"	
	178 21 05	alt 39.22 ‖ Dne 1^h 03^m 44.2 (Cor + 4^s.5)	CW E 33"	
do	01 10 30.2	W end Elw $1^d.20$ = 16" W high 25" =	W + 41"	
	180 38 55	alt 38.42,5 (Cor + 4^s.6)	CW E 33"	

Level B (1.20 assume)

2 Arietis (2.1) +23.0	01 41	53.3 Cw. W end Elw. $2^d.30$ = 30" W high 25" =	W + 55"	
	172 26 55	‖ Dne 2^h 01^m 08.2 (Cor + 5^s.5)	CW E 33"	
do	02 05	32.5 Cw W end Elw $2^d.64$ = 34" W high 25" =	W + 59"	
	181 07 13	(Cor + 5^s.8)	CW E 33"	
* δ Hydrae (4.2) -69.2	02 14 55,6	W end Elw $3^d.00$ = 39" E high 25" =	W + 14"	
	359 09 53	‖ Dne 2^h 19 55,0 (Cor - 4^s.5)	CW W 33"	
do	02 20 36.6 Cw	W end Elw $3^d.2$ = 42" E high 25" =	W + 17"	
	358 31 13	(Cor - 4^s.3)	CW W 33"	

Level not taken

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Level corrections

Level A		W	0	5.6	E	0	7.0	N	0	4.8	S	0	4.8
Ob. first			E	6.3		E	5.0		E	4.3		E	7.3
Level B	N	0	6.4	S	0	6.2	E	0	5.0	W	0	8.0	
		E	6.3		E	6.5		E	7.9		E	4.7	

Level error $= \frac{O_E - O_W}{2} = \frac{E_E - E_W}{2}$ for A, error $= \frac{2.7}{4} = 0.68^d$

for B error $= \frac{6.2}{4} = 1.55^d$

For direction of error take point of compass under which the greater of the two Readgs is offset O.

for A. E end of axis is elevated 0.68^d

" B W " " " " " $\underline{1.55}$

Change in 1^a $= 2.23$

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Values of Level divisions &c.

and constant error of instrument which is in use on the Bolivian survey.

Gradienter Screw $1.^{d}0 = 20.''6$

In each instrument 1.0 means the smallest graduated division

Suspended Level $1.^{d}0 = 13.''1$

Striding Level $1.^{d}0 = 41.''2$

Transit Instrument Level $1.^{d}0 = 21.''5$

Jan 22.93 Present (and presumably past)

Collimation error 33″

Center wire being to the right when suspended level is below tube

Level error of Horizontal Axis 25″

Circle end high.

Circle end has always been to the left when suspended level was below tube.

(It will be noticed that the level and collimation errors help each other

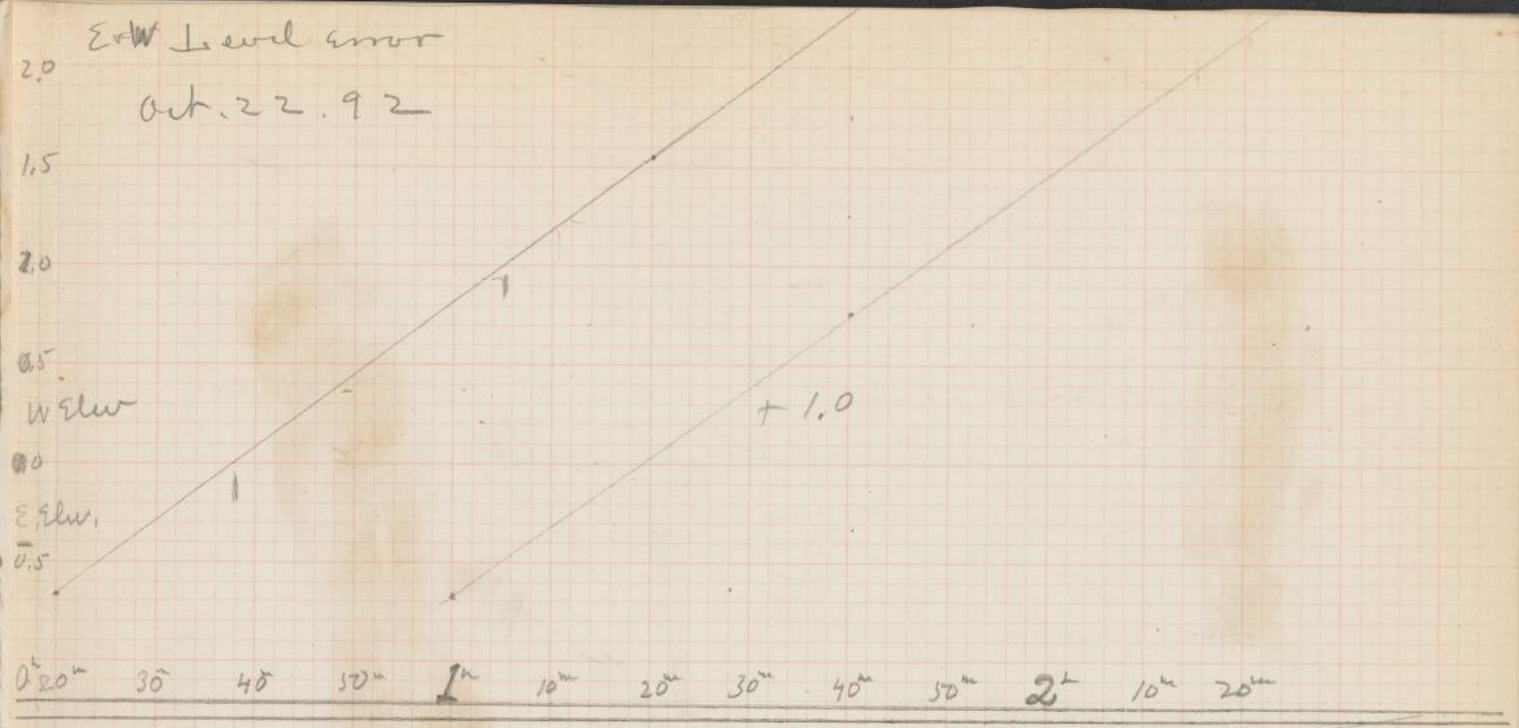
N.B. West end was high for Northern stars & East end was high for southern stars

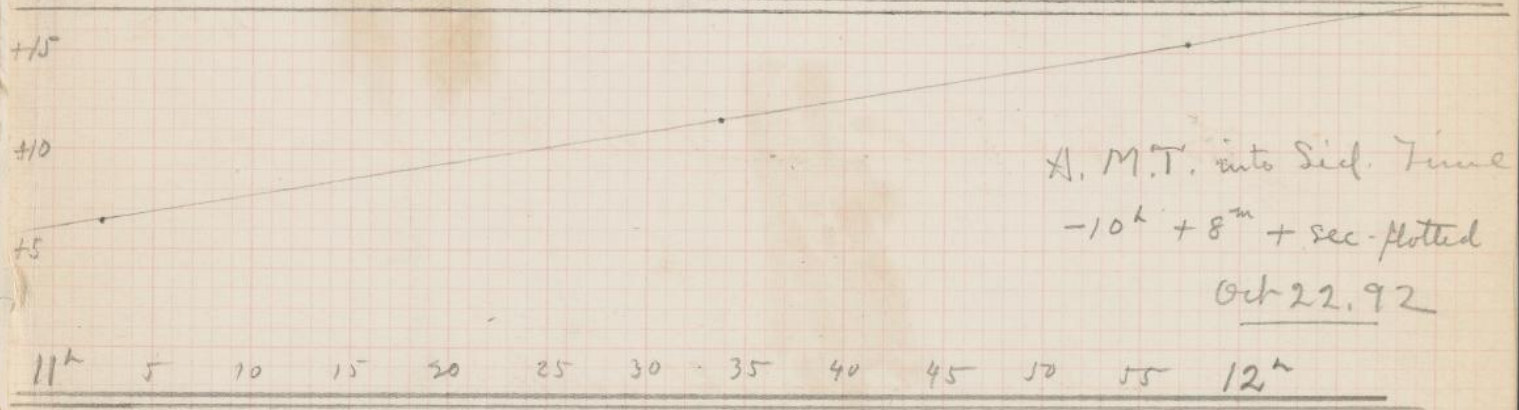
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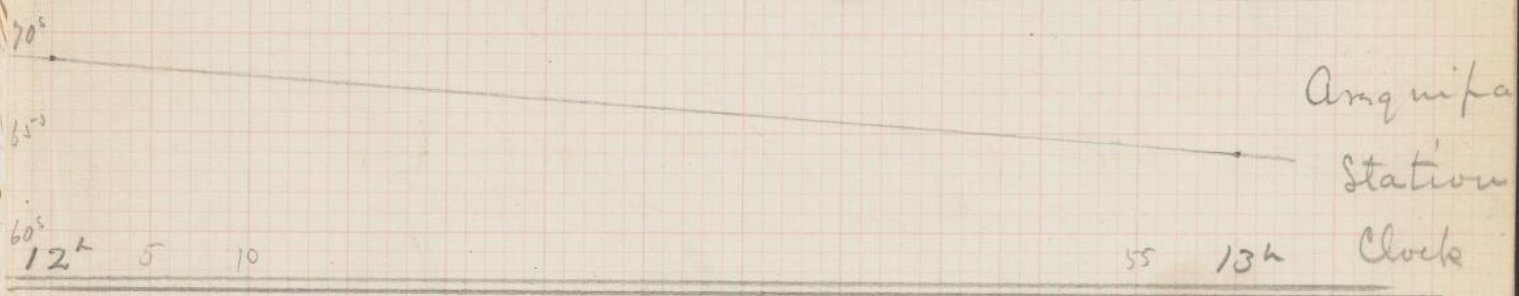
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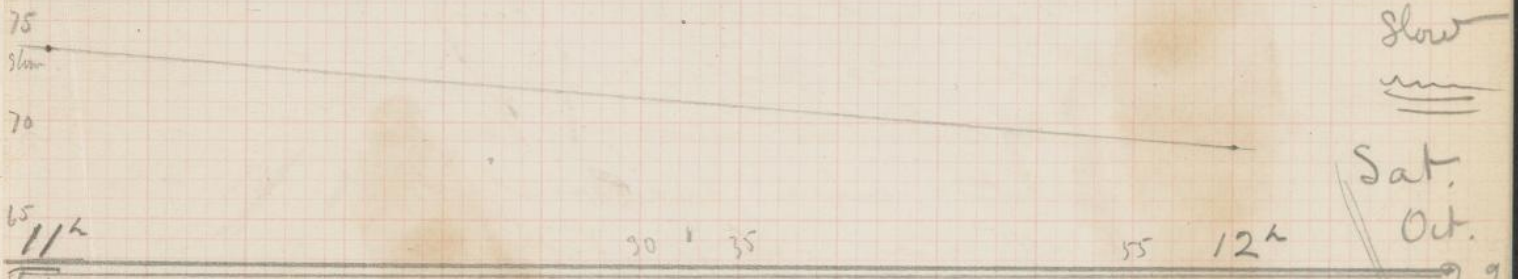
E & W Level error

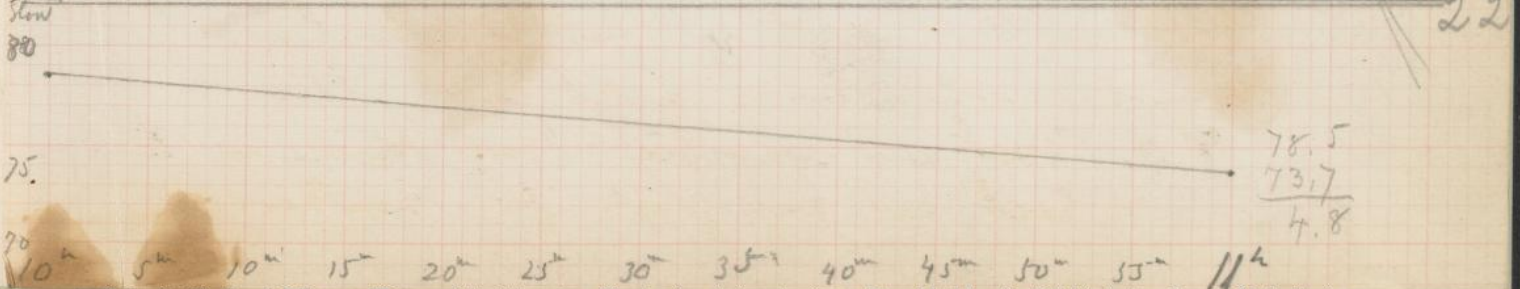
Oct. 22. 92











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Computation

Formulas

Collimation

Always 33″

In Equa. $\frac{33}{15}$ = time error

Required correction is $\left(\frac{33}{15 \cos Dec}\right)$ Sec

Cor. Addition for N Stars

Cor. Subtraction " S "

or

$\frac{2.2}{\cos Dec}$ secs

Level

Assume 10″

$\frac{10 \cos z}{15 \cos Dec}$

$z = (D - \phi)$

Required Correction is $\frac{10 \cos (D - \phi)}{15 \cos D}$

for N Stars	For S Stars
W + = Cor Add	E + = Cor. Sub.
E + = Cor Sub.	W + = Cor Add

or

$\frac{0.667 \cos (D - \phi)}{\cos D}$

Meridian

Assume 30″

$\frac{30 \sin z}{15 \cos Dec}$

or

$\frac{30 \sin (D - \phi)}{15 \cos D}$

or

$\frac{2 \sin (D - \phi)}{\cos D}$

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Computations

Zenith. $\phi = -16.4$

Dec	Calc	Limb	$z = D - \phi$	Coef.	Calc Cor	Rec Cor	Total Cor
+55.9	Cen. Eq.	W + 25"	72.3	$\frac{25}{15} = 1.67$	+ 3.9	+ 0.9	+ 4.8
+60.1	"	W + 30	76.5	$\frac{30}{15} = 2.00$	+ 4.4	+ 0.9	+ 5.3
+35.0	"	W + 37	51.4	$\frac{37}{15} = 2.5$	+ 2.7	+ 1.8	+ 4.5
~~+23.0~~	"	W + 41	"	$\frac{41}{15} = 2.73$	+ 2.7	+ 1.9	+ 4.6
+ 23.0	"	W + 55	39.4	$\frac{55}{15} = 3.67$	+ 2.4	+ 3.1	+ 5.5
"	"	W + 59	"	$\frac{59}{15} = 4.00$	+ 2.4	+ 3.4	+ 5.8
- 69.2	W "	W + 14	- 52.8	$\frac{14}{15} = 1.00$	- 6.2	+ 1.7	- 4.5
"	"	W + 17	"	$\frac{17}{15} = 1.13$	- 6.2	+ 1.9	- 4.3

	+55.9	60.1	35.0	23.0	−69.2
Log 2.2	0.3424	0.3424	0.3424	0.3424	0.3424
log cos D =	$\bar{1}.7487$	$\bar{1}.6977$	$\bar{1}.9134$	$\bar{1}.9640$	$\bar{1}.5504$
" Cor in Sec =	0.5937	0.6447	0.4290	0.3784	0.7920
	3.9	4.4	2.7	2.4	6.2

	55.9	60.1	35.0	35.0	23.0	23.0	−69.2	−69.2
(log D/φ)	$\bar{1}.4829$	$\bar{1}.3682$	$\bar{1}.7651$	$\bar{1}.7651$	$\bar{1}.8880$	$\bar{1}.8880$	$\bar{1}.7815$	$\bar{1}.7815$
	0.2227	0.3010	0.3979	0.4362	0.5647	0.6021	0.0000	0.0531
	$\bar{1}.7056$	$\bar{1}.6692$	0.1630	0.2013	0.4527	0.4901	$\bar{1}.7815$	$\bar{1}.8346$
(log D)	$\bar{1}.7487$	$\bar{1}.6977$	$\bar{1}.9134$	$\bar{1}.9134$	$\bar{1}.9640$	$\bar{1}.9640$	$\bar{1}.5504$	$\bar{1}.5504$
	$\bar{1}.9569$	$\bar{1}.9715$	0.2496	0.2879	0.4887	0.5261	0.2311	0.2842
	0.9	0.9	1.8	1.9	3.1	3.4	1.7	1.9

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Longitude of Puno

Obsns Copied from page 78

2 Cassiop	00 38 22,3	Due 0 34 26,1	
+55.9	178 43 05	(mε = 30″ ; C = 3ˢ.3)	
✱ γ Cassiop	00 49 09,3	Due 0 50 15.6	
+60.1	177 52 58	(mε = 30″ Cor = 3.9)	
β Androm.	01 01 50,9	Due 1 03 44,2	
+35.0	178 21 05	(mε = 30″, Cor = 1ˢ.9)	
do	01 10 34,8		
	180 38 55		
2 Arietis	01 41 58,8	Due 2 01 08,2	
+23,0	172 26 55	(mε = 30″, Cor = 1ˢ.4)	
do	02 05 38,3		
	161 07 13		
✱ δ Hydrae	02 14 51,1	~~Due 2 19 55,0~~ 2 43 57,7	En page 90
~~-69.2~~	359 09 53	(mε = 30″ Cor = 4ˢ.3)	
ε -68.8			
do	02 20 32,3		
	358 31 13		

Method:- estimate approx circle readings for meridian and reduce stars to that point and then plot them on large scale.

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Computation:

~~2 Cassiop~~ 30″ = 3″.3 | 38 22.3 | 178 43 05
34 26.1 | 35 48
3 56.2 | 178 07 17

30′ = 3ᵐ 18ˢ
5′ 33ˢ
35′ 00″ = 3ᵐ 51.ˢ0
30″ = 3.3
15″ = 1.65
3 .3
35′ 48″ = 3ᵐ 56.25

190
1.65
.25

~~γ Cassiop~~ Dec 0 50 ~~15.6~~

Assuming a diff in long of 10ᵐ in Lau

2 Aurigæ 1 52.0 172°.45 (Dec 2ʰ 01.1)
2 15.6 181.10
23.6 8.65

2 Cassiop
2 Cas. 1 61 08.2 1.″4
0 34 26.1
1 26 42.1
α 38 22.3
2 05 04.4
178.7 2.8 3.3 84 4.24
30′ = 3.ᵐ3 84
178.7 65.06
177.3 9.29
1.°4 55.8
0.5 2.8

δ Hydræ 2 2 2 2

178.95
177°.75′
Bacchium
δ Hydræ
γ Cassiop
2 Cassiop
2 Aurigæ
Time
2ʰ 09.6 Ref 2 01.1
10 1ʰ 55.3
1 59.6 5.8

1.40 45 50 55 2ʰ 05 10

2 Cas. 1 61 08.2
β Cas. 1 03 44.2
57 24.0
1 01 50.9
β × 1 59 14.9
anchor 1 10 34.8 + 57″ +
× 2 07 58.8

181.1
App. Transit 2ʰ 09.ᵐ6
Dec ang 2 01.1
8.ᵐ5

2 Cas 1 61 08.2
γ Cas 0 50 15.6
1 10 52.6 dif
0 49 09.3
2 00 01.9 (177.9)
30″ = 3.ˢ9
30′ = 3.ᵐ9 γ Cassiop

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Computation:

~~2 Cassiop~~ 30" = 3".3 | 38 22.3
34 26.1
3 56.2

178 43 05
35 48
178 07 17

30' = 3m 18s
5' 33s
35' 00" = 3m 51.0s
30" = 3.3
15" = 1.65
3 .3
35' 48" = 3m 56.25

1.90
1.65
.25

~~γ Cassiop~~ Due 0 50 ~~15.6~~

Assuming a diff. in long of 10m as has

2 Aurigæ 1 52.0 172°.45 (Due 2h 01.1)
2 15.6 181.10
23.6 8.65

2 Cr. 1 61 08.2
3 Aur. 1 03 44.2
57 24.0
1 01 50.9
3 × 1 59 14.9
mean 1 10 34.8 + 57" +
× 2 07 58.8

δ Hydræ 2 24.9 179.15 (Due 2h 19m.9)
2 34.5 178.50 18m.8
2 06.1 179.2
2 15.7 178.5

2 Cassiop
2 Cr. 1 61 08.2
0 34 26.1
1 26 42.1
38 22.3
2 05 04.4

178.7 2.8 3.3 8.4
30' = 3m.3 8.4 9.24
m8.7 65.06 0.29 .8
177.3 1.4 55
0.5 2.8

1h 52m.0 to 2h 15m.7 and 172.5 to 181.1
App. transit 2h 09m.6
Diff ang 2 01.1
8m.5

2 Cr. 1 61 08.2
γ Cas 0 50 15.6
1 10 52.6 diff
0 49 09.3
2 00 01.9 (177.9)
30" = 3s.9
30' = 3m.9s γ Cassiop

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Computation.

Reduce all times to Mer. 179.°00

α Cassiop 178 43 05

16 55

+56

Due 00 34 26,1

Transit of Mer 179.00

γ Cassiop 177 52 58

1 07 02

+60.

Due 00 50 15,6

30″	=		3.s3
30′	=	3m	18s
15′	=	1	39s0
1	=		6.6
1	=		6.6
17′ 00″	=	1m	52s.2
5″	=		0.6
16 55		1	51.6
	00	38	22.3
	00	40	13.9

30″	=		3.s9
30′	=	3m	54s.0
30′	=	3	54.0
1′	=		07.8
6′	=		46.8
02″	=		06,2
1° 07′ 02″		8m	42s.8
	00	49	09.3
	00	57	52.1

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1892phae.proj..389D

Oct 22 9h 5h 10h 15h 20h 24h

M's Watch Slow

-1m 35s Oct. 22 -1m 35s

-1m 40s -1m 40s

Oct 22 0h 5h 10h 15h 20h 24h

Chronometer Slow

-1m 25s

-1m 30s

-1m 35s

Oct. 22

A

B

* Projected from curve - with probability of needing thrusting worn in line with new line B

Oct 25 0h 5h 10h 15h 20h 24h

M's Watch Slow

-2m 00s

-2m 05s

-2m 10s

Oct. 25

Oct. 28 0h 5h 10h 15h 20h 24h

M's Watch Slow

-2m 20.0s

-2m 25s

-2m 30s

Oct. 28

Oct. 30 0h 5h 10h 15h 20h 24h

M's Watch Slow

-2m 20s

-2m 25s

-2m 30s

Oct 30

Nov. 12 0h 5h 10h 15h 20h 24h

M's Watch Slow

-3m 05s

-3m 10s

-3m 15s

Nov. 12

Slow 1m 10s

Clock Slow

Slow

-50s

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1892phae.proj..389D

Computation.

α Arietis 181 07 13

2 07 13

Dec 2 01 08,2

30″ = 1.″4

30′ = 1ᵐ 24,ˢ0

1 30′ = 4 12,0

1 02.8

6′ 16.8

15″ = .7

2 07 15 = 5 56.3

02 = −0.1

2 07 13 = 57 56,2

2 38.3

01 59 42,1

δ Hydrae 179 09 53

30″ = 4.ˢ6

09 53

−69.

Dec 2 19 55,0

1′ 00 = 0ᵐ 09.ˢ2

9 00 1 22.8

10′ 00″ = 1 32,0

07″ = 0 01.1

09′ 53″ = 1 30.9

2 14 51.1

2 16 22,0

δ Hydrae 178 31 13

28 47

20′ 00″ = 3 04,0

8′ = 1 13.6

30″ = 04.6

15″ = 02.3

2′ = 00,3

28′ 47″ = 4 24.8

2 20 32.3

2 16 07.5

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1892phae.proj..389D

Computation.

Dec	Due			Came			Error				s		
+60	00	50	15,6	5 7	52,1	+ 7^m	36,5	108.7		3.9	0.6	=	181
+56		34	26.1	40	13,9	+ 5	47.8		313.2	3,3	1.4		224
+35	1	03	44,2	04	18,8	+ 0	34.6			1.9)			
"		"		04	18,9	+ 0	34.7				0.5		204
+23	2	01	08,2	00	19,4	− 0	48.8	102.0		1.4			
"		"		5 9	42,1	− 0	86.1				6.0		
−69	2	19	55.0	16	22,0	− 3	33.0	153		−4.6			025
"		"		16	07,5	− 3	47.5						

200 times 30" = 100' = 1° 40'

All above is R.A. from not plotting in all stars on chart page 85 the mistake was made. In plotting the rest in δ Hydrae disagrees badly with the rest & must be subject to Error

Investigate δ Hydrae

The new meridian is 177° 15'
" " Time (for 2 meteors) 1ʰ 55,3
Due 2 01,1
Approx. Longitude of Pisa 5.8

Jan 25, 93

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1892phae.proj..389D

Computation

The star called δ Hydrae was really ε or ζ.

as the star is probably ζ we may reduce ζ & δ as a check on each other,

δ 1875.0 to 92.0 ζ (mag 5.2)

δ		ζ	
2 19 31.6	x -69 13 44	2 43 37.2	x -68 08 32
+1.056	+16.451	+0.890	+15.157
17	17	17	17
7392	115157	623	
1056	16451	89	
~~+7.9 52~~	279.667	15.13	
+18.0	N 4' 40"	37.2	
31.6		52.3 +1	

2h 19m 49.6 + 0.1 gives place in Sun. list in Nautical Al.

Mean place 2 19 49.7

for Oct 22 = 2 19 57.0

Cor + 5.3

Mean place 2h 43 52.4

Cor +05.3

R.A. Oct 22 = 2 43 57.7

Reduce all the Obs^ns to moment of Aretas,

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Computation. from Page 84

2 Cassiop	2 Arietis	2	01	08.2	+55.9	30″ = 3.3		
	2 Cass.	0	34	26.1				
		1	26	42.1				
		0	38	22.3				
		2	05	04.4		178	43	05
ρ Cassiop	2 Arietis	2	01	08.2	+60.1	30″ = 3.9		
		0	50	15.6				
		1	10	52.6				
		0	49	09.3				
		2	00	01.9		177	52	58
β Andromed	2 Arietis	2	01	08.2	+35.0	30″ = 1.9		
		1	03	44.2				
		0	57	24.0				
		1	01	50.9				
		1	59	14.9		178	21	05
		1	10	34.8				
		2	07	58.8		180	38	55
2 Arietis		1	41	58.8		172	26	55
+23.0 30″=1.5 4		2	05	38.3		181	07	13
ε Hydrae	2 Arietis	2	01	08.2	-68.1	30″ = 4.3		
		2	43	57.7				
	Cor −		42	49.5				
		2	14	08.2				
		1	32	01.6		179	09	53
		2	20	32.3				
			42	49.5				
		1	37	42.8		178	31	13

94 or foot

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1892phae.proj..3000

92

Computation.

Reduce each star roughly to new Meridian $17^{h}\,15^{m}\,00^{s}$

γ Cassiop
+60.1

17 52 58
15 00
— 37 58

30" = 3.9

30'	=	3m 54.0
1'	=	07.8
6	=	46.8
1	=	7.8
38' 00"	=	4 56.4
−02"		− 6.3
		− 4 56.1
		2 00 01.9
		1 55 05.8

2 Cassiop
+55.9

17 8 43 05
7 15
1 28 05

Call 30" = 3.5

1° 00 00	=	7m 00.0
15' 00	=	1 45.0
5		35.0
5		35.0
3		21.0
05	=	.6
		10 16.6
		2 05 04.4
		1 54 47.8

30" = 3.3

30'	=	3m 18.0
30	=	3 18.0
15	=	1 39.0
10	=	1 06.0
3	=	0 19.8
05	=	0 00.6
1° 28 05	=	− 9m 41.4
		2 05 04.4
		1 55 23.0

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1892phae.proj..389D

Computation.

α Andromedæ 178 21 05
7 15
1 06 05

30″ = 1.9

30′ = 1m 54.0
30′ = 1 54.0
6′ = 22.8
05″ = 0.3
−1 06 05 = −4 11.1
1 59 14.9
1 55 03.8

β Andromedæ 180 38 55
7 15
3 23 55

30′ in = 1m 54.0
2 30 in = 9 30.0
3° 15′ in = 57.0
10 in = 38.0
3 25 in = 12 59.0
− 1 = 3.8
12 55.2
− .3
− 12 54.9
2 07 58.8
1 55 03.9

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1892phae.proj..389D

Computation

Skip (for now) 2 ascites & try —

ζ Hydrae 17.8 31 13

7 15

+1 16 13

wrong star

30" = 4.3 2m 15 = 2 09.3

30'

1° or ov = 8m 36.0

15' ov = 2 09.0

1 · ov = 8.6

15" = 2.1

1 16 15 = 10 55.7

1 37 42.8

1 48 38.5

As this star is about 6m east (which is star diff. in R.A. between ε & ζ) this star is evidently not the right one

Therefore try ε Hydrae.

Reduc. of ε Hyd

Reduction of ε Hydrae mag 4.2

2 37 40.3 +0.883 | Dec −68.8

+15.0 17

2 37 55.3 6181 30" = 4.5

Cor & data + 5.3 883

RA. 2 38 00.6 15.081

Annit + 1 01 05.2

Cor — 36 52.4

2 14 51.1

— 36 52.4

1 37 58.7 — 179 09 53

2 20 32.3

— 36 52.4

1 43 39.9 — 178 31 13

+ 10 51.7

1 54 35.6

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1892phar.proj..3000

Computation.

Thenson m Lan of stars highly reduced.

+60,3	1	55	05,8
+55,9	1	55	23,0
+35,0	1	55	13,8
−68,8		54	35,6

$28^s,2$

2 Cassiop. doubtful.

N.B. ε Hyd.

1 16 13

1° 00 00	=	9m	10s,0
15′	=	2	15,0
1	=	0	09,0
15″	=	0	02,2
		11	26,2
1		43	39,9
1		55	06,1

Thenid 177 15 seems very exact.

Dec of ε Hyd = 68 43 47 (1892,0)
SPD = 21 16 13
for the date SPD = 21 16 25 ±

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1892phae.proj..389D

Computation

2 Arietis 172 26 55
177 15
4 48 05

30" = 1.s4
30' = 1.m4 × 8 = 11.m2

4°	00	00	= 11m 12.s0
	30'	00 =	1 24.0
	15	00 =	0 42.0
	3	00 =	0 08.4
		05 =	0 00.2
4	48	05 =	13 26.6
			1 41 58.8
			1 55 25.4

181 07 13
177 15
3 52 13

3°	00	00	= 8m 24.s0
	30		1 24.0
	15		42.0
	5		14.0
	2		5.6
		15	.7
3	52	15	10 50.3
			2 05 38.3
F_1			1 54 48.0
F_2			55 25.4
			913.4
av			1 55 06.7

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Computation.

Ellythne 2

179	09	53
177	15	
1	54	53

$30'' = 4.5$

1^0	00	00^m	$00^s.0$
	30′	$= 4$	30.0
	15	2	15.0
	3		27.0
	6		54.0
	1		09.0
1	55	$00 = 17$	15.0
	− 07		− 1.1
1	54	$53 = 17$	13.9
		1 37	58.7
		1	55 12.6

Now then we have

+60.1	1	55	05.8	6
57.9			23.0 ✱	
35.0			03.8	4
"			03.9	4
23.0		55	25.4 } 06.7	7
"		54	48.0 }	13
−68.8	1	55	12.6	6
			6.1	6 ⌊40
				7

Approx Time 2 01 08 / 1 55 07 / 6 01.5

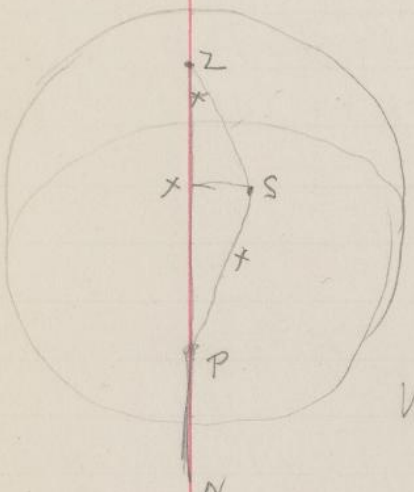
✱ by assuming $30'' = 3.^s5$ instead of $3.^s3$ we reduce the instant of transit to 1 54 47.8, The error here then probably lies in the error of Mer. Cor.

Closer approx. to Long is $6^m\ 01^s$

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Regiomontus Computations
Formulas.



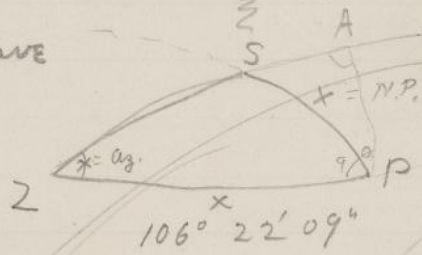
SP = N.P.D.

PZ = 90° + 16° 22′ 09″ = 106° 22′ 09″

SZP = 177° 15′ 00″ – Circle reading.

Required SPZ

We have



Sin S : Sin Z :: Sin ZP : Sin SP

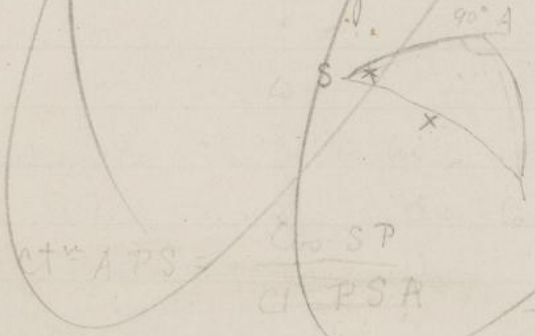
(Sin SP)

1. $\text{Sin } S = \frac{\text{Sin } Z \text{ Sin } ZP}{\text{Sin } SP}$

2. PSA = 180° – S

The triangle PSA is Right

required APS

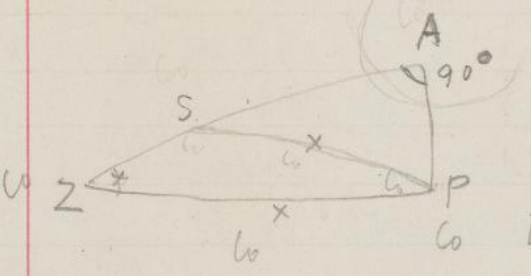


3. Cot APS = Cos SP / Cot PSA

4. Angle SPZ = 180°

1092phae.proj..3890

Rigorous Computation Formulas



In APZ get AP of ∠APZ
In APS " ∠APS
then SPZ = APZ − APS

We have
Cos ZP = Ctn AZP Ctn APZ Hence

Formulas

1. $\text{Ctn APZ} = \frac{\text{Cos ZP}}{\text{Ctn AZP}}$

2. $\text{Sin AP} = \text{Sin ZP Sin AZP}$

3. $\text{Cos APS} = \text{Tan AP Ctn SP}$

4. $\text{SPZ} = \text{APZ} - \text{APS}$

There are 8 angles to work out.

Data

No	ZP	SP	AZP	Name
1	~~106° 22' 09"~~	29° 51' 46"	100° 37' 58"	γ Cassiop.
2	~~106 22 09~~	34 . 02 56	1 28 05	α Cassiop
3	~~106 22 09~~	54 56 46	1 06 05	β Androm
4	~~106 22 09~~	54 56 46	3 23 55	"
5	~~106 22 09~~	67 02 34	4 48 05	α Arietis
6	~~106 22 09~~	67 02 34	3 52 13	"
7	~~73 37 51~~	21 16 25	1 54 53	ε Hydrae
8	~~73 37 51~~	21 16 25	1 16 13	"

data

Should be 105 49 00 for 1 to 6
and 74 11 00 for 7 & 8

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1892phae.proj..389

Δ 1 – γ caniops

$$\operatorname{ctg} \angle P Z = \frac{\cos Z P}{\operatorname{ctg} \angle Z P} = \frac{\cos 106° 22' 09''}{\operatorname{ctg} 000\ 37'\ 58''}$$

105 49 00

$\log \cos 106° 22' 09'' = \bar{1},449979$ n $\quad \bar{1}.435462$

$- \log \operatorname{ctg} 000° 37' 58'' = 1,956859 \quad 1.956859$

$\log \operatorname{ctg} \angle PZ = \bar{3},493120$ n $\quad 3.478603$

$\angle PZ = 89° 49' 18''$ ~~90 10 42~~ 90 10 21

1/∠PZ

$$\sin \angle P = \frac{\sin 106° 22' 09'' \cdot \sin 000\ 37'\ 58''}{\sin}$$

$\log \sin 106° 22' 09'' = \bar{1},982030 \quad \bar{1}.983238$

$+ \log \sin 000° 37' 58'' = \bar{2},043136 \quad \bar{2}.043136$

$\log \sin \angle P = \bar{2},025166 \quad \bar{2}.026374$

$\angle P = 000° 36' 26'' \quad 000\ 36\ 32$

1/∠P

$\cos \angle PS = \text{tang} \angle P \cdot \operatorname{ctg} SP$

$\log \text{tang} \angle P \ (000° 36' 26'') = \bar{2},025238 \quad \bar{2}.026398$

$+ \log \operatorname{ctg} SP \ (29° 57' 46'') = 0,240967 \quad 0.240967.$

$\log \cos \angle PS = \bar{2},266205 \quad \bar{2}.267365$

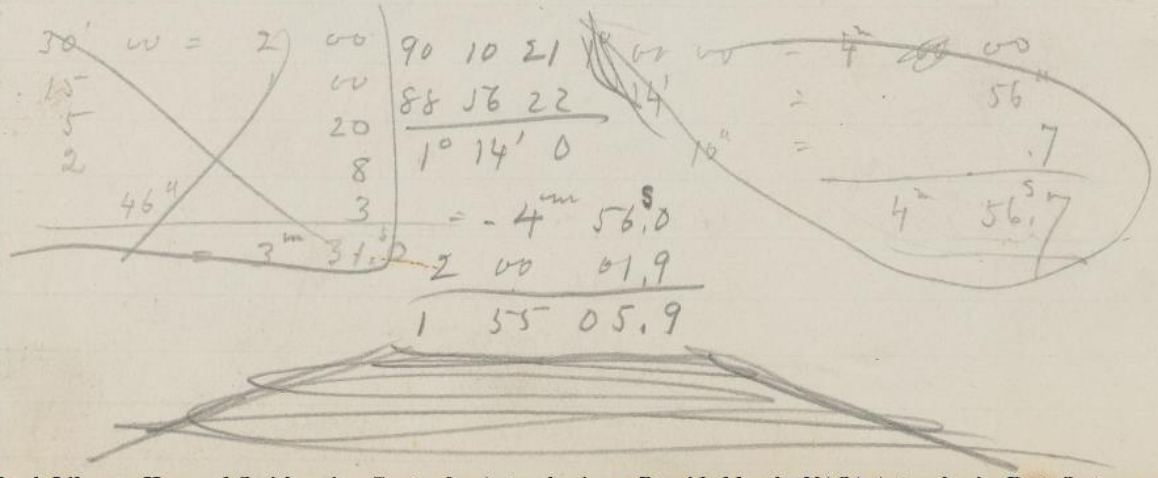
1 ∠PS

$\angle PS = 88° 56' 32'' \quad 1\ 03\ 38$

88 56 22

	$\angle PZ$	$= 89° 49' 18''$	90 10 42
$-$	$\angle PS$	$= 88° 56' 32''$	88 56 32
	SPZ	$= 00° 52' 46''$	1 14 10

SPZ



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1892phae.proj..389D

△ 2 – α cassiop

$$\operatorname{cotg} A\,P\,Z = \frac{\cos Z\,P}{\operatorname{cotg} A\,Z\,P} = \frac{\cos 106°\,22'\,09''}{\operatorname{cotg}\ 1°\,28'\,05''}$$

log cos 106° 22' 09"	= $\bar{1},\,744997$	$\bar{1}.435462$
− log cotg 1° 28' 05"	= $1,\,591283$	1.591283
log cotg A P Z	= $\bar{3},\,858696$	$\bar{3}.844179$
		90° 24 01

2/A P Z

$$A\,P\,Z = (89°\,35'\,10''\,n) = 90°\,24'\,50''$$

$$\sin A\,P = \sin Z\,P \cdot \sin A\,Z\,P = \sin 106°\,22'\,09 \cdot \sin 1,28'\,05''$$

log sin 106° 22' 09	= $\bar{1},\,982030$	$\bar{1}.983238$
+ log sin 1° 28' 05"	= $\bar{2},\,408570$	$\bar{2}.408570$
log sin A P	= $\bar{2},\,390600$	$\bar{2}.391808$
		131
		391939

1/A P

$$\cos A\,P\,S = \tang A\,P \cdot \operatorname{cotg} S\,P = \operatorname{tg} 1°24'31'' \cdot \operatorname{cotg} 34°\,02'\,56$$

log tg 1° 24' 31"	= $\bar{2},\,390756$	$\bar{2}.391939$
+ log cotg 34° 02' 56"	= $0,\,170215$	0.170215
log cos A P S	= $\bar{2},\,560971$	$\bar{2}.562154$
		2 05 29
		87 54 31

2/A P S

A P Z =	90° 24 50"
− A P S =	87 54 53"
	2 29 30

2/S P Z

S P Z = 2° 29' 57"

	8m
	1 56,0
	2,0
	9 58.0
	2 05 04,4
	1 55 06.4

6m 01.1s

2° = 8m

29' = 1. 56,0

57" = 3,8

9 59.8

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1892phae.proj..389b

Δ 3 — β Androm.

$$\operatorname{cotg} A\,P\,Z = \frac{\cos ZP}{\operatorname{cotg} A\,Z\,P} = \frac{\cos 106^\circ 22' 09''}{\operatorname{cotg} 1^\circ 06' 05''}$$

$\log \cos 106^\circ 22' 09'' =$	$\bar{1},449979\,n$	$\bar{1}.435462$
$-\log \operatorname{cotg} 1^\circ 06' 05'' =$	$-1,716126$	1.716126
$\log \operatorname{cotg} A\,P\,Z =$	$\bar{3},733853\,n$	$\bar{3}.719336$
		$90\ 18\ 01$

3/ A P Z

$A\,P\,Z = 89^\circ 41' 23''\,n$ (~~$90^\circ 18' 37''$~~)

$$\sin A\,P = \sin ZP \cdot \sin AZP = \sin 106^\circ 22' 09' \cdot \sin 1^\circ 06' 05'$$

$\log \sin 106^\circ 22' 09'' =$	$\bar{1},982030$	$\bar{1}.983238$
$+\log \sin 1^\circ 06' 05'' =$	$\bar{2},283788$	$\bar{2}.283788$
$\log \sin A\,P =$	$\bar{2},265818$	$\bar{2}.267026$
		$+75$
		267101

3/ A P

$A\,P = 1^\circ 3' 24''$

$$\cos APS = \text{Comp } A\,P \cdot \operatorname{cotg} S\,P = \log 1^\circ 3' 24'' \cdot \operatorname{cotg} 54^\circ 56' 46''$$

$\log 1^\circ 3' 24'' =$	$\bar{2},265864$	$\bar{2},267101$
$+\operatorname{cotg} 54^\circ 56' 46'' =$	$\bar{1},846096$	$\bar{1}.846096$
$\log \cos APS =$	$\bar{2},111960$	$\bar{2},113197$
		$0\ 44\ 37$
		$89\ 15\ 23$

3/ A P S =

$A\,P\,Z = 90^\circ 18' 37''$ — $90\ 18\ 01$

$-\ A\,P\,S = 89^\circ 15' 31''$ — $89\ 15\ 23$

$S\,P\,Z = 1^\circ 03' 06''$ — $1\ 02\ 38$

3/ S P Z

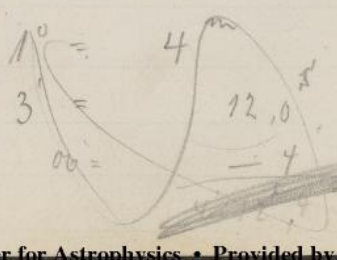
$= 4\ 08.0$

2.5

$-\ 04\ 10.5$

$1\ 59\ 14.9$

$1\ 55\ 04.4$



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Δ 4 – β Androm.

$$\operatorname{ctg} A\,\underline{P}\,Z = \frac{\cos Z\,\underline{P}}{\operatorname{ctg} A\,Z\,\underline{P}} = \frac{\cos 106°\,22'09''}{\operatorname{ctg} 3°\,23'\,55''}$$

$\log \cos 106°\,22'09'' = \bar{1},449979\,n$ — $\bar{1}.435462$
$- \log \operatorname{ctg} 3°\,23'\,55'' = \underline{1,226307}$ — $\underline{\bar{1}.226307}$
$\log \operatorname{ctg} A\,PZ = \bar{2},223672\,n$ — $\bar{2},209155$

4/ A Z — $A\,PZ = 89°\,2'\,28''\,n$ ($90°\,57'\,32''$) — $90\;55\;38$

$$\sin A\,\underline{P} = \sin Z\,\underline{P} \cdot \sin A\,Z\,\underline{P} = \sin 106°\,22'09'' \cdot \sin 3°\,23'\,55''$$

$\log \sin 106°\,22'09'' = \bar{1},982030$ — $\bar{1}.983238$
$+ \log \sin 3°\,23'\,55'' = \underline{\bar{2},772919}$ ✓ — $\underline{\bar{2}.772919}$
$\log \sin A\,P = \bar{2},754949$ ✓ — $\bar{2},756157$ — 707

4/ A P — $A\,P = 3°\,15'\,39''$ ✓ — 864

$$\cos A\,\underline{P}\,S = \operatorname{tang} A\,\underline{P} \cdot \operatorname{ctg} S\,\underline{P} = \operatorname{tg} 3°\,15'\,39'' \cdot \operatorname{ctg} 57°\,56'\,46''$$

$\log \operatorname{tg} 3°\,15'\,39'' = \bar{2},755652$ — $2,755652$
$+ \log \operatorname{ctg} 57°\,56'\,46'' = \underline{\bar{1},846096}$
$\log \cos A\,PS = \bar{2},601748$ — $\bar{2}.756864$ — $\underline{\bar{1}.846096}$ — $\bar{2}.602960$ — $2°\;17'\;50''$ — $87\;42\;10$

4/ A P S — $A\,PS = 87°\,42'\,27''$

$A\,PZ = 90°\;57'\;32''$ ✓ $90\;55\;38$
$- A\,PS = 87°\;42'\;27''$ — $87\;42\;10$
$3\;13\;28$

4/ S P Z — $S\,PZ = 3°\;15'\;05''$ — $12\;52$ — 1.9 — $-12\;53.9$

$3° = 12^m$
$15' = 1^m$
$03 = 0,2^s$
$13,0^s$

$2\;07\;58.8$
$1\;55\;04.9$

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1892phae.proj..389D

105 49 00

Δ S — α Arietis

$$\operatorname{cotg} A\,P\,Z = \frac{\cos \angle P}{\sin A\,Z\,P} = \frac{\cos 106^\circ 22' 09''}{\operatorname{cotg} 4^\circ 48' 05''}$$

$\log \cos 106^\circ 22' 09'' = \bar{1},449979\,n$ — $\bar{1}.435462$
$-\log \operatorname{cotg} 4^\circ 48' 05'' \quad -1,075746$ — 1.075746
$\log \operatorname{cotg} A\,P\,Z = -\bar{1},374233\,n$ — $\bar{1}.359716$
$A\,P\,Z = -88^\circ 38' 38''\,n$ — $91^\circ 18' 41''$ — $91^\circ 21' 22''$

5/A P Z

105 49

$\sin A\,P = \sin Z\,P \cdot \sin A\,Z\,P = \sin 106^\circ 22' 09'' \cdot \sin 4^\circ 48' 05''$

$\log \sin 106^\circ 22' 09'' = \bar{1},982030$ — $\bar{1},983238$
$+\log \sin 4^\circ 48' 05'' \quad -\bar{1},922744$ — $\bar{1}.922744$
$\log \sin A\,P = -\bar{1},904774$ — $\bar{1}.905982$
$A\,P = -4^\circ 36' 23''$ — $4^\circ 37' 10''$

5/A P

$\cos A\,P\,S = \tan A\,P \cdot \operatorname{cotg} S\,P = \tan 4^\circ 36' 23'' \cdot \operatorname{cotg} 67^\circ 02' 34''$

$\log \tan 4^\circ 36' 23'' = \bar{2},906177$ — $\bar{2},907395$
$+\log \operatorname{cotg} 67^\circ 02' 34'' = \bar{1},626957$ — $\bar{1}.626957$
$\log \cos A\,P\,S = -\bar{2},533128$ — $\bar{2}.534346$
$A\,P\,S = 88^\circ 2' 39''$ — $88^\circ 02' 19''$

5 A P S

$A\,P\,Z = 91^\circ 21' 22''$ — $91^\circ 18' 41''$
$A\,P\,S = 88^\circ 2' 39''$ — $88^\circ 02' 19''$
$3^\circ 16' 22''$

5 S P Z

$\angle P\,Z = 3^\circ 18' 43''$ — $= 12^h\ 1^m\ 04,0^s$
$1,5$
$13\ 05,5$
$41\ 58,8$
$55\ 04,3$

$1^\circ = 4^m$
$30' = 2^m\ 00^s$
$6' = 24^s$
$36' = 2^m\ 24^s$ close enough. Direct

$3^\circ = 12^m$
$18' = 1^m\ 12^s$
$43' = 2^m\ 52^s$

Good

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1892phae.proj..389D

Δ 6 – α Circini

$$\operatorname{cotg} A\,P\,Z = \frac{\cos \angle P}{\operatorname{cotg} A \angle P} \cdot \frac{\cos 106^\circ 22' 09''}{\operatorname{cotg} 3^\circ 52' 13''}$$

$\log \cos 106^\circ 22' 09'' = \bar{1},449979\,n$		$\bar{1}.435462$
$-\log \operatorname{cotg} 3^\circ 52' 13'' = 1,169742$		$\bar{1}.169742$
$\log \operatorname{cotg} A\,P\,Z = \bar{2},280237\,n$		$\bar{2}.265720$
$A\,P\,Z = 88^\circ 54' 28''\,n\,(91^\circ 5' 32'')$		91 03 23

δ A P Z

$$\sin A\,P = \sin \angle P \cdot \sin A\,Z\,P = \sin 106^\circ 22' 09'' \cdot \sin 3^\circ 52' 13''$$

$\log \sin 106^\circ 22' 09'' = \bar{1},982030$		$\bar{1}.983238$
$+\log \sin 3^\circ 52' 13'' = \bar{2},829299$		$\bar{2}.829299$
$\log \sin A\,P = \bar{2},811329$		$\bar{2}.812537$
$A\,P = 3^\circ 42' 47''$		3 43 25

δ A P

$\bar{2}.813455$

$$\cos A\,P\,S = \tan A\,P \cdot \operatorname{cotg} 67^\circ 02' 34''$$

$\log 3^\circ 42' 47'' = \bar{2},812231$		$\bar{2}.813454$
$\log \operatorname{cotg} 67^\circ 02' 34'' = \bar{1},626957$		$\bar{1}.626957$
$\log \cos A\,P\,S = \bar{2},439188$		$\bar{2}.440405$
$A\,P\,S = 88^\circ 25' 29''$		1 34 47

δ A P S

88 25 13

$A\,P\,Z = 91^\circ 5' 32''$		91 03 23
$-\ A\,P\,S = 88^\circ 25' 29''$		88 25 13
		2 38 10
		= 8
$S\,P\,Z = 2^\circ 40' 03''$		2 32 00.7
		− 10 32.7
		2 05 38.3
		1 55 05.6

δ S P Z

2° = 8ᵐ
40 = 2 40ˢ
03" = 00,2

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Computation.

With corrected Dec. Lat.

γ Cassiop	~~0~~	~~49~~	~~09.3~~		
+60,1	02	00	01,9		
		− 4	56,7		
	01	55	05,2	/ 55	05,9
γ Cassiop	2	05	04,4		
+55,9		− 9	59,8		
	01	55	04,6	/ 55	06,4
β Cruchron,	01	59	14,9		
+35,0		− 4	12,4		
	01	55	02,5	/ 55	04,4
(2)	2	07	58,8		
		13	00,3		
	1	54	58,5	/ 55	04,9
α Arietis (1)	01	41	58,8	C.W.	
+23,0		13	14,8		
	1	55	13,6	/ 55	04,3 C.W.
(2)	2	05	38,3	C.W.	
		− 10	40,2		
	1	54	58,1	/ 55	05,6 C.W.
				/ 54	50,6
				1 54	50,7 Corr

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Computation.

approx. Lat & me in working out these triangles

2 Enid, 2,379
2 ariet, 7,953
5,574

557.4
20.6
33444
111.48
6 | 1148.24
191' 22".4
3° 11' 22" = Dif. Z.

2 Enid, −57 46 53
2 ariet. +22 57 26
3 11 22
26 08 48
2 | 31 38 05
15 49 03
approx Lat Pmo

approx Lat. of Pmo 15° 49'

N.P.D. 105 49 00
S.P.D. 74 11 00

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Computed nos 7 & 8 - page 99. Using 74° 11' 00" = ZP
(instead of 73 37 51)

(ε Hydrae)

$$\operatorname{ctg} APZ = \frac{\cos ZP}{\operatorname{ctg} AZP} - \frac{\cos 74^\circ 11' -}{\operatorname{ctg} 1^\circ 54' 53'}$$

$\log \cos 74^\circ 11' 00 = \bar{1},435462$
$- \log \operatorname{ctg} 1^\circ 54' 53'' = \bar{1},475857$
$\log \operatorname{ctg} APZ = \bar{3},959605$

7/APZ
$APZ = 89^\circ 28' 40''$

$\sin AP = \sin ZP \cdot \sin AZP = \sin 74^\circ 11' 00 \cdot \sin 1^\circ 54' 53''$

$\log \sin 74^\circ 11' 00 = \bar{1},983238$
$+ \log \sin 1^\circ 54' 53'' = \bar{2},523902$
$\log \sin AP = \bar{2},507140$

7/AP
$AP = 1^\circ 50' 32''$

$\cos APS = \tan AP \cdot \operatorname{ctg} SP = \operatorname{tg} 1^\circ 50' 32'' \cos 21^\circ 16' 25'$

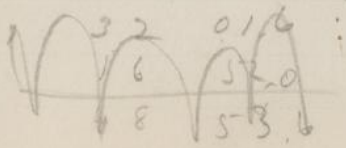
$\log \operatorname{tg} 1^\circ 50' 32'' = \bar{2},507369$
$+ \log \operatorname{ctg} 21^\circ 16' 25'' = 0,409656$
$\log \cos APS = \bar{2},917025$

7/APS
$APS = 85^\circ 15' 41''$

1	57	58.7
	16	52.0
1	54	50.7

$APZ = 89^\circ 28' 40''$
$- APS = 85^\circ 15' 41''$
$SPZ = 4^\circ 12' 59''$

4°	16^m
$12'$	48^s
$59''$	$4.$
	$16^m 52.^s 0$



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1092phae.proj..3890

Δ 8 — Ekliptica

$$\operatorname{ctg} A\,P\,\Upsilon = \frac{\cos \Upsilon P}{\operatorname{ctg} A\,\Upsilon\,P} = \frac{\cos 74^\circ 11' 00}{\operatorname{ctg} 1^\circ 16' 13''}$$

$\log \cos 74^\circ 11' 00 = \bar{1}.435462$
$- \log \operatorname{ctg} 1^\circ 16' 13'' = 1,654150$
$\log \operatorname{ctg} A\,P\,\Upsilon = \bar{3},781312$
$A\,P\,\Upsilon = 89^\circ 39' 13''$

8/A P Υ

$\sin A\,P = \sin \Upsilon P \cdot \sin A\,\Upsilon\,P = \sin 74^\circ 11' 00 \cdot \sin 1^\circ 16' 13''$

$\log \sin 74^\circ 11' 00 = \bar{1},983238$
$+ \log \sin 1^\circ 16' 13'' = \bar{2},345740$
$\log \sin A\,P = \bar{2},328978$
$A\,P = 1^\circ 13' 20''$

8/A P

$\cos A\,P\,S = \operatorname{tg} A\,P \cdot \operatorname{ctg} S\,P = \operatorname{tg} 1^\circ 13' 20'' \cdot \operatorname{ctg} 21^\circ 16' 25''$

$\log \operatorname{tg} 1^\circ 13' 20'' = \bar{2},329093$
$+ \log \operatorname{ctg} 21^\circ 16' 25'' = \bar{0},409656$
$\log \cos A\,P\,S = \bar{2},738749$
$A\,P\,S = 86^\circ 57' 32''$

8/A P S

$A\,P\,\Upsilon = 89^\circ 39' 13''$
$A\,P\,S \;\; 86^\circ 57' 32''$
$S\,P\,\Upsilon = 2^\circ 37' 41''$
47

~~37 42.8~~ 1 43 39.9
10 30.7 10 30.7
~~1 48 13.5~~ 1 54 10.6
40
1 54 50.6

$2^\circ = 8^m$
$37' = 2^m 28^s$
$41' = 2.7$
$10^m 30.7^s$

$10^m 30.7^s$
40.6
11 10.7

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Graphic Method of Solving Time Obs^ns

Stars (reduced to instant of 2 Arietis) Iner at 2 01 05.2

					30"
ζ Cassiop.	+60.1	1	55	05.9	3.9
2 Cassiop.	+55.9	1	55	06,4	3.4
β Anchorn	+35,0			04.4	1.9
"	"			04.9	1.9
2 arietis	+23.0			04,3 Cld.	1.4
5 "	"			05.6 Cld.	1.4
ε Hydrae	-68.8	1	54	50.7	4.4
"	"	1	54	50,6 Cld.	4.4

The Iner is probably nearly 17° 14'

It is necessary to work out the time error produced by Iner. Er. of 30" for the last two stars

formula ε (in Sec^s) = $\frac{2 \sin (D - \phi)}{\cos D}$

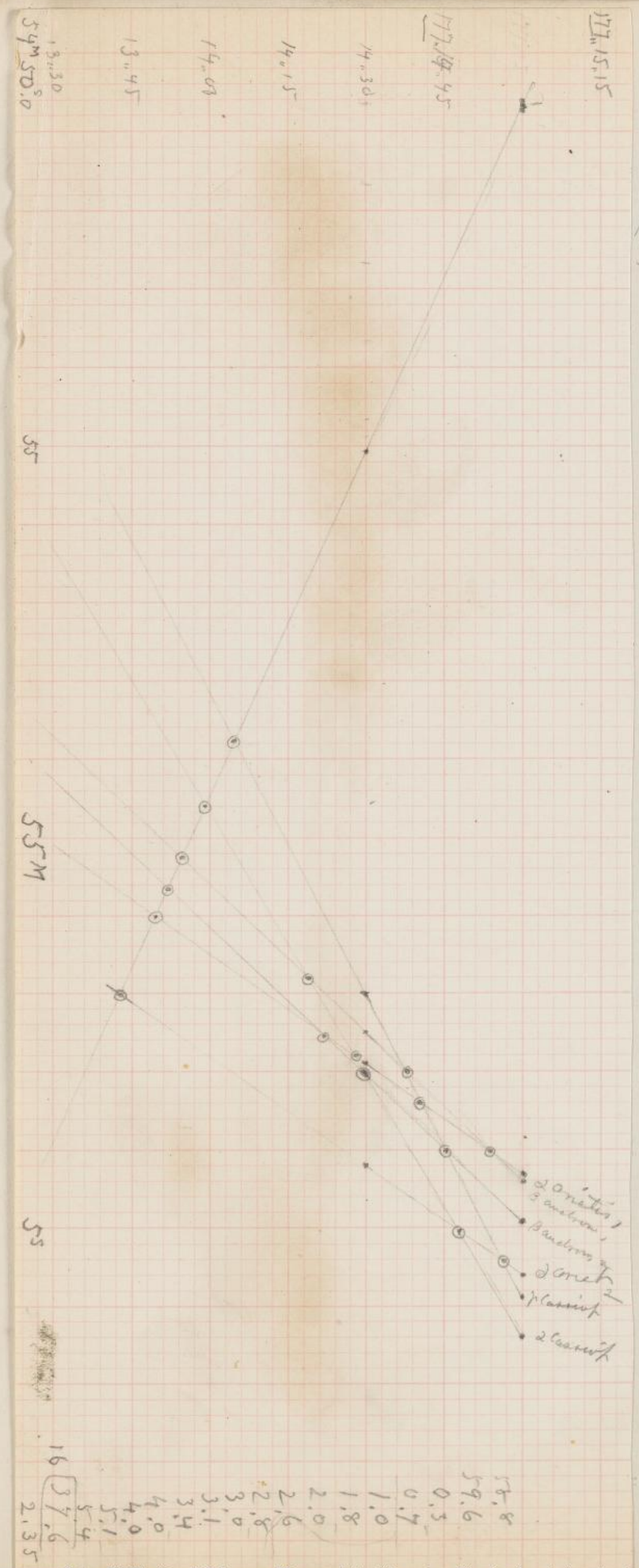
2 Arict	ε Hyd.
D = + 23.0	D = - 68.8
ϕ = - 15.8	ϕ = - 15.8
z = 38.8	z = 53.0
log 2 = 0,3010	0,3010
" sin z = Ī.7970	Ī.9023
0.0980	0,2033
" Cos D = Ī.9640	Ī.5583
0.1340	0,6450
1,36	4,42

500 / 4 / 1.50 / 24

β

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Method of least squares (?)

	Rds	wts		WT.
1h 54m 55s +	15.9	5	+3.9	2.4
	16.4	5	-0.5 +3.4	0.5 2.4
	14.4	5	+2.0 +1.9	1.5 2.4
	14.9	5	-0.5 +1.9	0 2.4
	14.3	1	+1.4	0.5 1
	15.6	1	+1.4	5.6 1
	60.7	5	-4.4	2.4
	60.6	1	-4.4	1

Applied to intersections.

	wt
-1.2	5 ✓
-0.4	5 ✓
+0.3	5
0.7	5
1.0	5
2.0	5

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1892phae.proj..389p

Computation,

	1			-1 A	-2 B.	C -3
3	15,9	2.4	3,9	12.0	8,1	4,2
3	16,4	2.4	3,4	13,0	9,6	6,2
3	14,4	2.4	1,9	12.5	10,6	8.7
3	14,9	2.4	1,9	13.0	11,1	9,2
1	14,3	Cw1	1,4	12.9	11,5	10 1
1	15,6	Cw1	1,4	14,2	12,8	11 4
3	00,7	2.4	- 4,4	05.1	9,5	13.9
1	00.6	Cw1	- 4,4	05.0	9,4	13,8
18						

Ein Obs ms m, J wms, Wt 3.

		+1	-1			A	B	
15,9	4,7	12,0	36.0		27		243	57
15,9	4,7	12,0	39.0	A	57		288	12
15,9	4,7	12,0	37,5		42		318	18
14,4	3,2	13,0	39.0		57		333	33
14,4	3,2	13,0	12,9		18		11.5	15
14.4	3,2	13,0	14,2		31		12,8	28
14,9	3,7	13,0	15,3		~~61~~		285	15
14,9	3,7	13,0	05,0		180		94	6
14,9	3,7	13,0	198.9		473		180.4	184
14,3	3,1		11.05				10.02	~~10.2~~
15,6	4,4		11,1					
00,7	10 5							
00,7	10 5							
00,7	10 5							
00,6	10 6							
18 | 18,2	84 4							
11.2	(3)							
182								
192								
18 | 374								
21								

C

	46
12,6	14,4
18,6	8 4
26,1	9
27,6	6
10,1	11
11 4	24
41 7	147
13 8	144
18 | 1619	569
9,0	

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1892phae.proj . 389D

Computations

	B	Corr 0.1	D = B + 0.1	E = B − 0.1	F = B − 0.2	offset Polaris Lick Comb 25″
3	8.1	0.4	8.5	7.7	7.3	−0.5
3	9.6	0.3	9.9	9.3	9.0	−0.4
3	10.6	0.2	10.8	10.4	10.2	−0.6
3	11.1	0.2	11.3	10.9	10.7	−0.6
1	11.5	0.1	11.6	11.4	11.3	−0.7
1	12.8	0.1	12.9	12.7	12.6	−0.7
3	9.5	−0.4	9.1	9.9	10.3	+3.5
1	9.4	−0.4	9.0	9.8	10.2	+3.7

D			E		F	
255	48		−6.6		7.5	
297	6		−18		2.4	
324	21		+15		12	
339	36		+30		27	
116	15		+15		15	
129	28		+28		28	
273	30		0		15	
90	11		−1		4	
1823	195	9.9	173	9.8	206	
10.2			1.0			

In page 167

Reg.	A	B	C	D
Dec	+58.0	+35.0	+23	−69
Wt.	10	10	2	6
Sec	8.5	10.1	12.1	9.9

Best time then is $1^h\ 54^m\ 59.^s9$

" Meridian " is 177 15 00 − 1′ 03″

which equals 177 13 57.

Stars due 2 01 08.2

" came 1 54 59.9 in Sid. Time

Long. of Pmo 6 08.3

Reduction to telegraph Pmo = −0.1 s

Long. Tel. W. of Pmo 6h 08.s2

Avg. Resid 1.s0

177.14 − 166 52 = 10° 22′ = Mag Dec at Pmo.

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1892phae.proj..289D

Lat. Obs^ns in Pmo may be plotted directly from the last column on pages 73-5

In plotting these curves 2 aniotis makes a good curve but in 2 Eridani the obs^ns are quite irregular and the resulting ~~matrix~~ is not so certain

To get 2 aniotis 795.27 / 20".6 Divs
2 Eridani 237.87 / " " "
557.4
20.6 20.5 in bitter

33444
11148
60 | 11482.44
60 | 191' 22".4
Diff. 3°. 3° 11' 22".4

2 Eri. -57 46 45.6 2 aniot: +22 57 08.3
+26 08 30.7 + 3 11 22.4
2 | 31 38 14.9 26 08 30.7
15 49 07.5 Lat. Pmo Telegraph Office

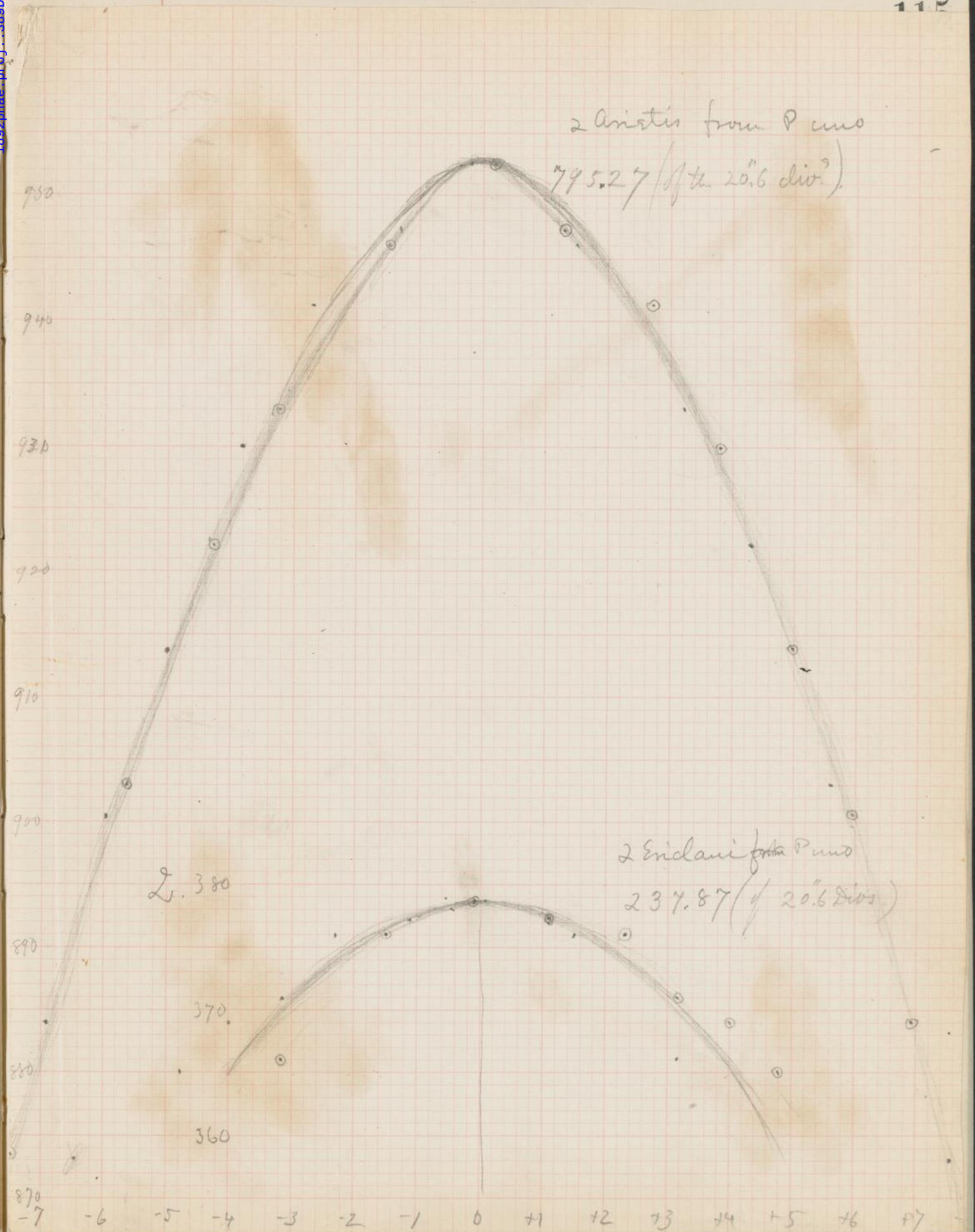
557.4
20.5
11482.4
-55.7
11426.7

3° 10' 82".4
55.7
3 10 26.7
22 57 08.3
26 07 35.0
57 46 45.6
2 | 31 39 10.6
15 49 35.3

(More correct lat. of Pmo March 14.93)

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1892phae.proj..000D

Results of Observations in Puno.

Location of telegraph office at north end of main station.

E of Arq. H.C.O.

Long. $6^{m}\ 08^{s}.2$

Lat. $-15\ 49\ 07.5$

Mag. Dec. N 10° 22′ E

Date of Obs.ⁿ 1892, Oct 22ᵈ $11^{h}.2$

A.G.D. Jan 28. 1893.

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1892phae.proj..3890

Watches between Paso & La Paz

Sat Oct 22	$8^h 47^m$	Prof's watch behind	$2^m 05^s.4$	(Standard is the Arg. Sta. Clock
	9 "	Do " "	0 13.8	
	12 24	" " "	0 44.3	
Mon Oct 24	3 09	" " ahead	$25^s.7$	
	3 26	Prof's watch ahead of A.E.D's	53.4	
Wed. Oct 26.	Obs^ns at 8 h 36 to 12.07			
	10 15	Prof's watch ahead of A.E.D's	$1^m 57^s.0$	
Fri. Oct 28	8 22 A.M.	Set D's watch which had stopped, set 1.7 ahead of Prof's		
Sat Oct 29	8 10 (PM)	A.E.D's watch ahead	$3^m 19^s.1$	(any clk uncertain N.G.)
Sun Oct 30	9 — P.M.	A.E.D's watch ahead	$3^m 10^s$ to 12^s	

Ayres says that:-
Mon. Oct. 24 time sent by Arg. clk which had not stopped
(Louis thinks it had stopped by Tuesday Oct 25th + that it is probable
that from Tues Oct 25 to Fri. Oct 28 we can get its rate)
Sat. Oct 29. Arg. clk had stopped & was set by old station clk
before sending signals. Arg. Clk had stopped during
the night between Sat. 29th & Sun the 30th

From Obs^ns on Oct 22. I get that D's watch was losing $4^s.3$ per hour
$26^d 10^h - 22^d 12^h = 4^d - 2^h = 94^h$. Loss in $94^h = 6^m 44^s$
Oct 22d 12h watch slow $1^m 50^s$. Watch slow Oct 26d 10h / $8^m 34^s$
which is too much.

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From page 67. we get.

Sat Oct 22 $21^h\ 28^m$ Chron slow $69^s.5$ by Sta Clock.
21 35 His Watch " 77.0 "

Tues. 25th His Watch ahead of Ang. Sta Clk 16^s at $4^h.6$
Fri 28 " " behind " " " $4^m 37^s$ at $4^h.2$

Mon Oct 24 $3^h 09^m$ time sent to Paris.

$3^d = 24 \times 3 = 72^h.0$
$3^d - 0^h.4 = 73^h.6$ change in ~~short~~ rate

Oct 25 His watch slow at $4^h.6$ by $2^m 02^s.2 = 122^s.2$
" Oct 25. $4^h.6$ Ang Clock was slow 138^s

Oct 28. His Watch slow at $4^h.2$ by $2^h 20^s.3 = 140^s$
∴ Oct 28. $4^h.2$ Ang clock was fast $294^s - 140^s = 154^s$

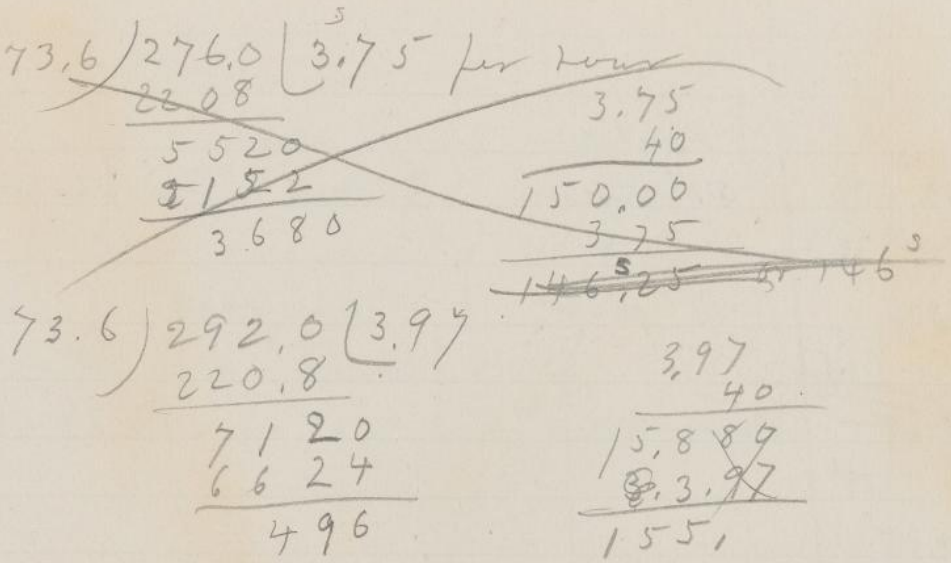
Change in $73^h.6$ $= +138 + 154 = 292^s$

Oct 22. $12^h.09^m$ Ang. Clk slow 68^s
Clock 42^s ahead of Watch 42
∴ Watch slow $110^s = 1^m 50^s$
Prop " $1^m 52^s + 1^m 50^s = 3^m 42^s$ slow
$22^d\ 12^h.15$ to ~~$24^d\ 3^h.15$~~ $= 24^h + 15^h = 39^h.0$
~~23~~ 24
27.15

N.B.
Oct 22

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Hence
Oct 24. $3^h 09^m$ (P.M.) Any clock was fast $155 - 138 = 17^s$

Hence
Oct 24. $3^h 09^m$ Dis watch was 43^s fast.
Prof " " $1^m 36^s$ "

N.B.
Oct 24

(over)

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1892phae.proj..389b

		D's watch	Prof's watch	
Oct 22. 12.^{h}5		$1^m 50^s$ slow	$3^m 42^s$ slow	Prof gaining $1^m 52^s$
	39.^{h}0			$2^m 45^s$
Oct 24. 03.^{h}15		43^s fast	$1^m 36^s$ fast	Prof ahead 53^s
	31.^{h}1			$1^m 04^s$
Oct 25 10.25		losing day		Prof ahead $1^m 57^s$
	58.^{h}1			
Oct [illegible] 20.35				D stopped & set 2^s ahead of Prof
	60.^{h}5	fast 46^s		
Oct 30. 9.^{h}0		~~fast~~		

N. B. If then we take the ~~curve~~ rate of D's watch as constant we have for its error:—

Oct 25^d 10^h

Oct 25^d 10^h 15^m D's watch fast 165^s gaining $3^s.92$ per hour.

~~hour~~ gain $2^m 33^s = 153^s$ in 39^h

39.0) 153.(3.92 per hour.
117
360
351
90

3.92
31.1
392
392
1176
121.912
43
165^s fast

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1992phae.proj..3000

Oct 30, 9ʰ — Watch

Dᵉ watch $3^m 11^s$ ahead of Ang Clock
9ʰ 30ᵐ P.M. Ang Clock 06.5^s ahead of Mᵉ watch
$3^m 18^s$

Mᵉ Watch about $2^m 25^s$ slow
∴ Dᵉ watch $2^m 71^s - 2^m 25^s = 46^s$ fast

Alternative.

assuming the error of Ang. Clock on Oct 25, as entirely unknown we may project curve of Mᵉ watch to Oct 27 & thence carry in straight line of Dᵉ watch and from its position on Oct 30 correct for the 46^s and we get

Oct 25 10^h Dᵉ watch $1^m 28^s$ slow and gaining 20^s in 28 days.

This seems to me more probably correct.

Wrong day

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1892phae.proj..389D

Copy of Chilalaya Obs^ns

Wed. Oct. 26, 1893

8h 36m Limbs Grand N E 3.6 E 7.4 E 3.0 E 8.1

S E 5.5 E 5.6 W E 5.7 E 5.9

* λ Andromæ (3.8) ~~+45.9~~ ~~47.9~~ 3° 52′ 40″ 48″ } 44″

8 54 32

55 07

55 45

56 18

56 56

218

8 55 43.6

− .3

43.3

Compass 9° 44′

Subtract 5 0.3 or 5 0.4 to allow for personal Equation.

* ~~52~~ Andromæ. (4.9) +45.5 ~~+45.5~~

CW. 9 20 32 2° 22′ 50 ‖ 50 ‖ 50″

Comp 80° 13′

#9	25	00	4.887	28° 14′.5
"	27	10	.890	
"	28	40?	.885	
	29	55	.882	28 13.7

CW. 9 32 10 | 4° 41′ 50 ‖ 60 ‖ 55″

Comp 10° 38′

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1892phae.proj . 389D

Chilileya Obs^ns

β Hydrae (2.8) -77.9
Cw. 9 37 24.5 3° 51' 15//10// 13.4
9° 49'

9	41	22	5.274	28° 26'.0
	44	06	.272	(.277)
	45	30	.275	
	46	25	.272	
	47	30	.273	
	48	45	.265	28° 26'.2

Cw 9 50 37 Comp 9 01

Compass zero at

363	3°	52′	44″	- 9°	44′	= 354	09′
362	2	22	50	- 8	13	= 354	10
364	4	41	55	- 10	38	= 354	04
363	5	51	13	- 9	49	= 354	02

25 | 4 | 13 | 3.3

Compass zero — 354 06.3

3	OH	-77	52
4	+	32	34
		45	18
2			
4			

for Oct 26.4 mm 1893

☆	λ Andromedæ	23	32	19,3	+45	52	45	+ 2.5
	β Hydrae	0	20	13,6	-77	51	41	- 8.4
☆	22 Andromedæ	0	04	45.3	+45	28	39	+ 2.5

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1892phae.proj..0000

Computation

Reduce stars & Nut. of β Hydrae

β Hyd	24	20	13.6
λ Androm	23	32	19.3
	0	47	54.3 S.T.
			− 7.9
	0h	47m	46s.4 in M.T. Nuts.
	8	55	43.3 λ androm. came
	9	43	29.7
	9	43	30

λ Androm at 3° 52′ 44″

β Hyd	0	20	13.6
22 Androm	0	04	45.3
	0	15	28.3
			− 2.5
	0	15	25.8 in M.T. Nuts.
	9	20	32
	9	35	58 = 22 Androm at 2° 22′ 50″ (2.5 per 30″)

A.S.T. 23ʰ59ᵐ36

	0	15	26
	9	32	10
	9	47	36 = 22 Androm at 4° 41′ 55″

A.S.T. ~~0ʰ0ᵐ03~~ 00ʰ11ᵐ16

β Hydrae	9	37	25 at 5° 51′ 15″ (8.4 per 30″)

A.S.T. 00.01 03 − 6ˢ > 00 00 57

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$$\begin{array}{r} 767,4125 \\ 1461 \\ \hline 9060225 \\ 904 \\ \hline 3015 \\ 3015 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 1461 \\ 1460 \\ 1 \end{array}$$

$$\begin{array}{r} 119 \\ 120 \\ 239 \\ \hline 1460 \\ 1461 \\ \hline 239 \end{array}$$

$$\begin{array}{r} 27,50 \\ 4 \\ \hline 367 \\ 329 \\ \hline 3841 \\ 3829 \\ \hline 1225 \\ 1100 \\ \hline 125 \end{array}$$

$$\begin{array}{r} 44 \\ 544 \\ 5540 \end{array}$$

$$27' = 1^m\,48.0$$

$$42'' = 2.8$$

$$50.8$$

$$1^m = 4^m$$

$$15' = 1^m$$

$$\frac{12}{15} = 0,8$$

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9	35	58
4	45	20
14	21	18
14	21	17,0
9	35	58
	2	21
23	59	36
	1	27
00	01	03
	10	11
		2
00	11	16

37	25
35	58
1	27

E 8,1 / E 3,0 / W

W 5,4 / E 5,7

E. high $\frac{\frac{27}{2} + \frac{27}{2}}{2} = 1.35$

1.35
13"
405
135
17.55
E high 18"

				Zurl		
22 Anchor	23	59	36	W high 25"	E high 18"	W high 7" if no account
"	00	11	16	W high 25"	E high 18"	W high 7" " " "
B Hyd.	00	01	03	E high 25"	E high 18"	E high 43" = 6.4 Subtraction

Mole Chil. & Tul. Office in La Paz 180912 ft

$\frac{180912}{6000 \text{ ft}} = 30.15$ of arc

11.9 | 30.15

∴ 27.70 = 27' 42" = 1m 50.8 W of La Paz

Long La Paz = 4 31 50

+ 1 51

Long Chililaya 4 33 41

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Chilileya Stars

	Ang. Sid. Time (approx)				
22 Androm	23	59	36	at 2 22 50	$2^s.5$ per 30″
"	00	11	16	at 4 41 55	do
13 Hyd.	00	00	57	at 3 51 15	$8^s.4$ per 30″

30′ = 8^m 24^s
60′ = 16^m 48^s

by plotting these we get

Time of transit 00^h 05^m 38^s
Meridian 3° 34′ (4/5″)
354 06
Mag. Dec = 9° 28′

Stars due 0 20 14
Came 0 05 38
Clock error, slow 14^m 36^s including Long.

1092phae.proj.:389D

Computation

0 15 26, M.T. Reduc of 22 And. & B Hyd. transit

A.S.T.

9	25	00	+15	26	= 9	40	26	00	04	05	4.887
	27	10				42	36		06	15	890
	28	40				44	06		07	46	885
	29	55				45	21		09	01	882

9	35	58	=	23	59	36					
	40	26			4	28					
	42	36		00	04	05					
	2	10			2	10					
	44	06		00	06	15					
					1	30					
				00	07	46					
					1	15					
					09	01					

or

$-1^m 33^s$	4,887	
+ 37	.890	
+2 08	.885	
+3 23	.882	

22 Aurigae

489.0

0 05 38

0 01 03

4 35 S Mts

− 1

4 34 M Mts

9 37 25

9 41 59 Mer. Passage

$-0^m 37^s$	5.274	
+2 07	.272 (?)	
+3 39	.275	
+4 26	.272	
+5 31	.273	
+6 46	.265	

38.5
.11
385
385
4.235

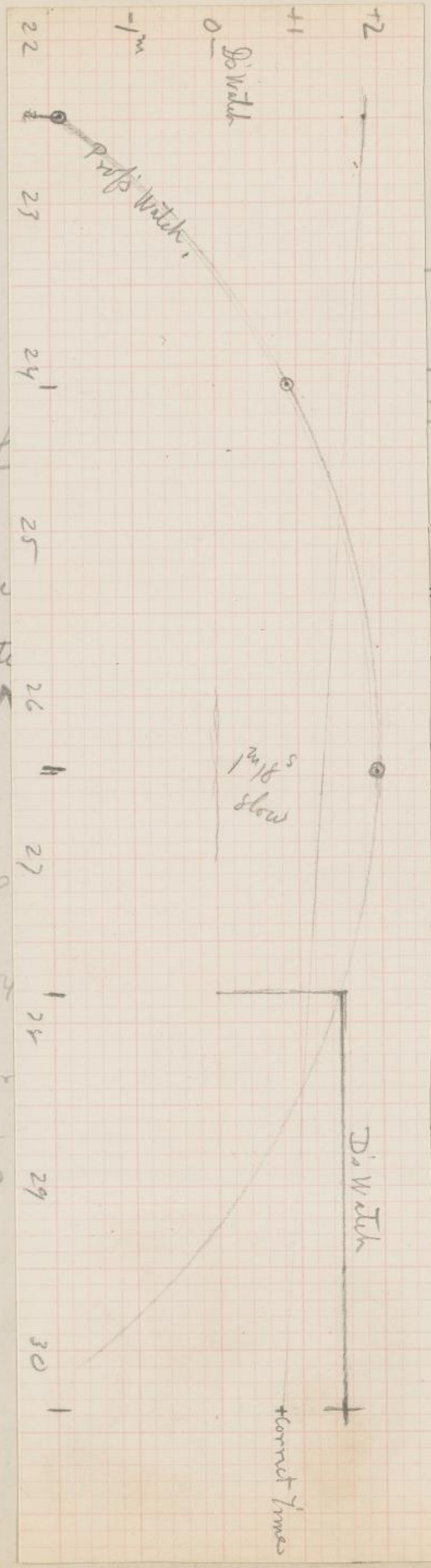
38.5
20.6 −0.11
2310
770
793.10 = 13' 13"
or better 13 09

β Hydrae

52.4.5
489.0
38.5

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1892phae.proj..389D



22 Austrom 45 28

51	41	41
13	13	09
04	54	50
28	39	39
36	15	11
18	08	06

mar 15 better

363 34.3
354 06.3
9 28.0

at 9h2 Oct 26.92

May 6 Op - at Δ aug. is 12m4
AED - 1909.

approp

appro

As the rear
m shall
tions as

3 slow

is 1m18s slow
long. obser-
s,

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1892phae.proj..389D

mar 15
better

22 Angstrom	45	28	39	β Hyd	77 51 41 41
				diff.	13 13 09
					78 04 54 50
					45 28 39 39
					32 36 15 11
				Lat of Chihlaya	16 18 08 06

363 34.3
354 06.3
9 28.0

May. Dec 9° 28' at 9h 2 Oct 26.92

Watch
~~Clock~~ error 14m 36s slow
including Long.

approx long 9m 20s

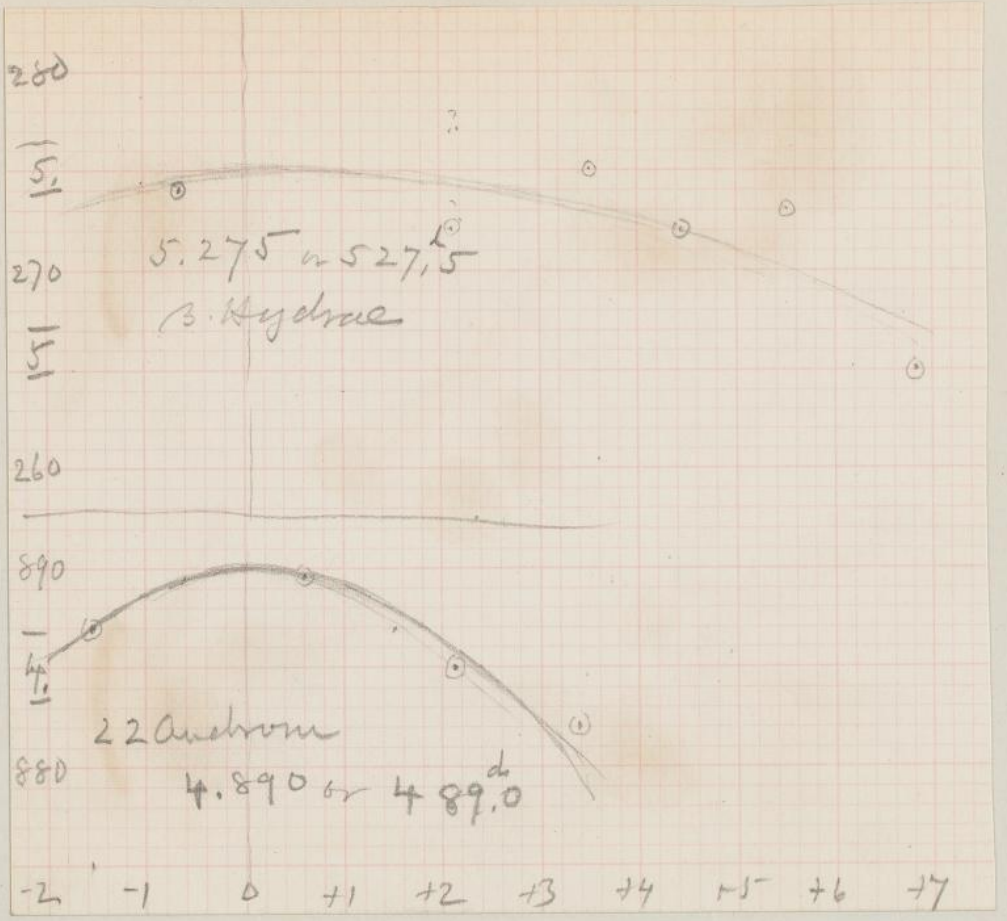
approx watch error 5m.3 slow

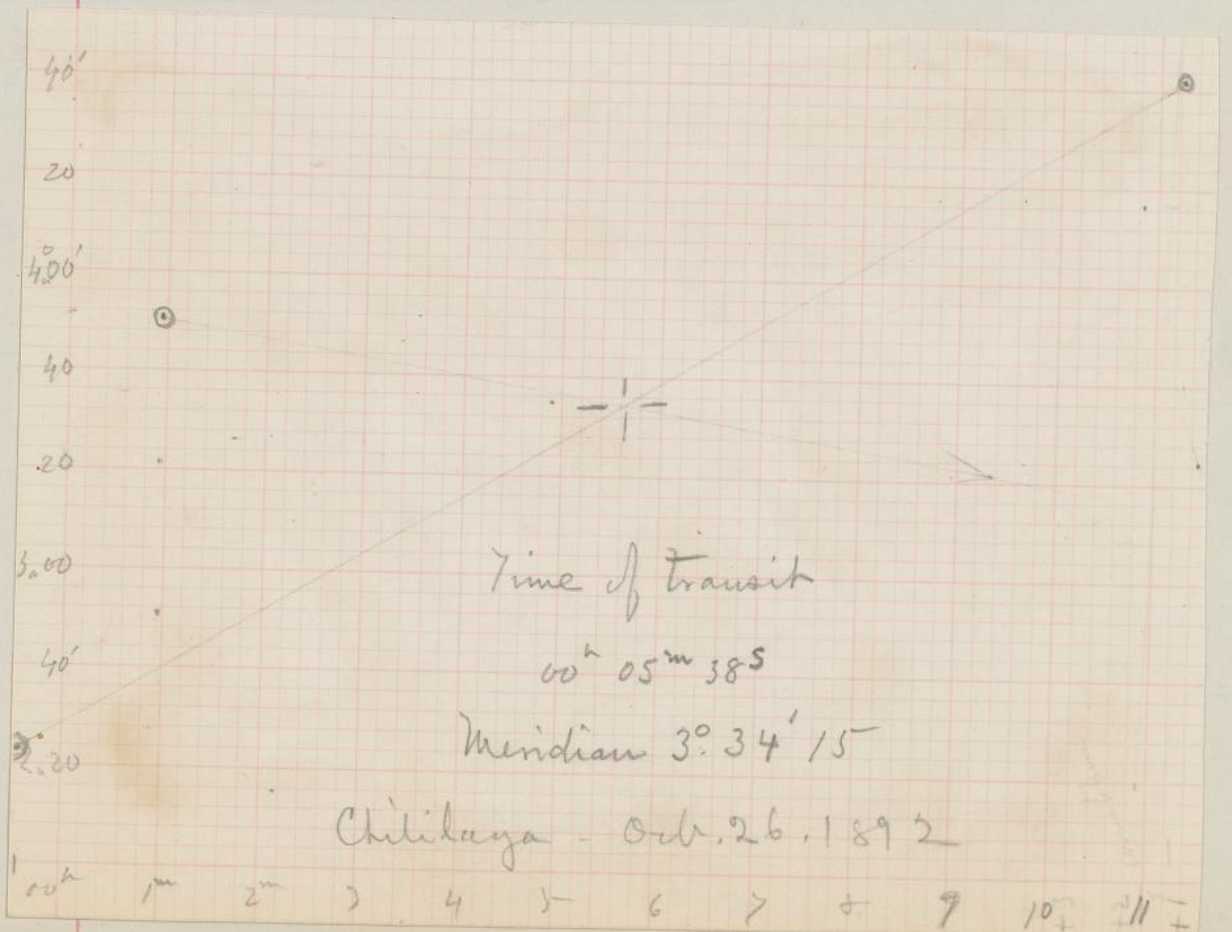
As the nearest approach to this is 1m 18s slow we shall have to consider the long observations as ~~of~~ doubtful, worthless,

May 6 OP - at Δ Aug. 4 12 M
AZD - 1909.

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La Paz Observations

Oct 30. 1892

Watch $3^m\ 11^s$ ahead of time sent by telegraph
Rate of Arng. Sta clock probably fairly large
Some idea of it may be obtained from
Watch Time. page 68

7.48

N	5,6 4.3	E	5.2 5,0	
S	4,5 5,5	W	4,9 5.2	

τ Pegasi

8	(26)	32,5	8	27	26.7
	(26)	59.2	14	41	36.4
	(27)	26.2	23	09	~~03.1~~ 03.1
	(27)	53.8			
	(28)	21.8			
		133.5			
		26.7			

(8h 31 30 ab.)

9° 52′ 51″
12 05

8.37

N-0	5.3 5.6	E	4.3 6.7	
S	0 5.3 5.6 0	W	5.9 5.1	

ω Piscium

8	(45)	20,0	8	46	10.6
	(45)	45.2	14	41	38.3
	(46)	10.4	23	27	48.9
	(46)	36.2			
	(47)	01.3			
		53.1			
		10.6			

23 50

(8h 50m 15s ab.)

359 22 26
01° 32′

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1892phae.proj..389D

Mean time of La Paz Obs^{no} $10.^{h}1$

δ Andromeda.

Watch

9	17	38	5.156	37°	17.′5
	18	19	.157		
	20	15	.160		
	21	00	.157		
	22	05	.157		
	23	14	.153		
	24	10	147		
	25	20	138		
	27	20	5.112	37°	17.′0 (error for 37° 16.′0)

Transit at 9 h 26.

δ Andromeda

(9) (27) 23.6

(27) 55.4

(28) 25.0 (?) Call it 26.0

(28) 57.3

(29) 28.4 (9^{h} 32^{m} ab 34)

130.7

26.12

9	28	26.1
14	41	42.3
00	10	08.4

10° 02′ 16″

12° 14′

μ Andromeda

CW$_1$

(9) (50) $08.^{s}4$ (9 53 ab 15)

14	41	44.4
00	31	52.8

05° 57′ 26″

00° 10′

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La Paz

μ Androm.

	Clock	Watch		Gr. Sc.
		9 55	55	2,100
53		57	–	.106
10		58	20	.108
12		59	20	.1095
07	10	00	18	.105
06		01	15	.1005
06		02	15	.094
04		03	10	.1090
07		04	16	2.076

Assumed an error in identifying this star will bring the Lat. Obs^ns closer together

Transit at 9h 58m 26s

μ Androm

(10)	(02)	23.8		10 03 27.5	
	(02)	55.8		14 41 45.6	
	(03)	27.1	06 32	00 45 13.1	
	(03)	59.3	06		
	(04)	31.4	(10 07 38)		
		137.4			
		27.5			

09° 11′ 31″
11° 23′

* κ Incanae

		C.W.	
(10)	(10)	18^s	(10 13 30)
14	41	46.2	
00	52	04.2	

187° 54′ 50″

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1892phae.proj..389D

Observations

κ Tucanae

Clock	Watch			Gr. Sc.
	10	15	27	4.6935
42		16	50	.700
		18	42	704
		19	50	.7025
		20	47	.704
		22	20	.7055 (!)
19		24	25	.696
		25	50	.689
		26	55	4.679 = 37° 01.8

Transits at
10 h 19 m 45 s

κ Tucanae

(10)	(26)	07.0		
	(27)	19.0	(10 30 30)	
	(28)	31.5	(10 31 45)	
	(29)	43.0		
	(30)	54.5		
		155.0		
		31.0		

10	28	31.0
14	41	47.8
1	10	18.8

185° 54′ 55″
080 08′

★ ζ Hydrae

		CW.	
(11)	(13)	25.5	(11 16 ab 30)
14	41	52.1	
01	55	17.6	

188° 25′ 35″

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La Paz Observations

δ Hydrae

Clock	Watch		2r Se.
	11 18	19	5.201 −
22	19	25	.206 −
19	20	20	.210 +
	21	44	.219
59	23	05	.227
23	24	25	.233
56	26	00	.233
0	27	03	.232
	28.	23	.230 +
40	29	40	.229 +
	30	43	.228 = 37° 19′.7 (map at 37 19.8
	32	40	.217
	33	47	.212 −
24	35 −	25	5.201

Transit N 11 27 20

37 19.8

Clk 01ˢ at 0ˢ.3 by watch

δ Hydrae

Cl.

(11) (34) 26.3 (− 37ᵐ 23ˢ ±)

14 41 54.1

02 16 20.4

186° 04′ 18″

11ʰ.40ᵐ Lurlo N 0 3.4 / 8.2 E 2.0 / 9.6

S 0 5.4 / 5.2 W 8.3 / 3.2

4 | 13.1 / 3.3 / 16.4

Slight d 1.25 = 16″

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Approximate work on Mag. Dec in La Paz

Oct. 30 1892

✱	μ Andromeda	9	50	08.4	365°	57′	26″	8° 10′	357°	47′.4
✱		10	03	27.1	369	11	31	11 23	357	48.5

δ Hydrae

11	13	25.5	188	25	3.5
11	34	26.3	186	04	18

✱	μ Andromeda due	0	50	48.5
✱	δ Hydrae "	2	19	55.1
	Sid T. dif	1	29	06.6
				− 14.6
	W. T. Int.	1	28	52.0
		9	50	08.4
	μ Andromeda	11	19	00.4
		10	03	27.1
	μ Andromeda	11	32	19.1

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zero at 357° 48.0'

μ Aquarii

11	19	00.4	5	57	26
11	32	19.1	9	11	31

δ Hydrae

11	13	25.5	188	25	35
11	34	26.3	186	04	18

From Chart we get

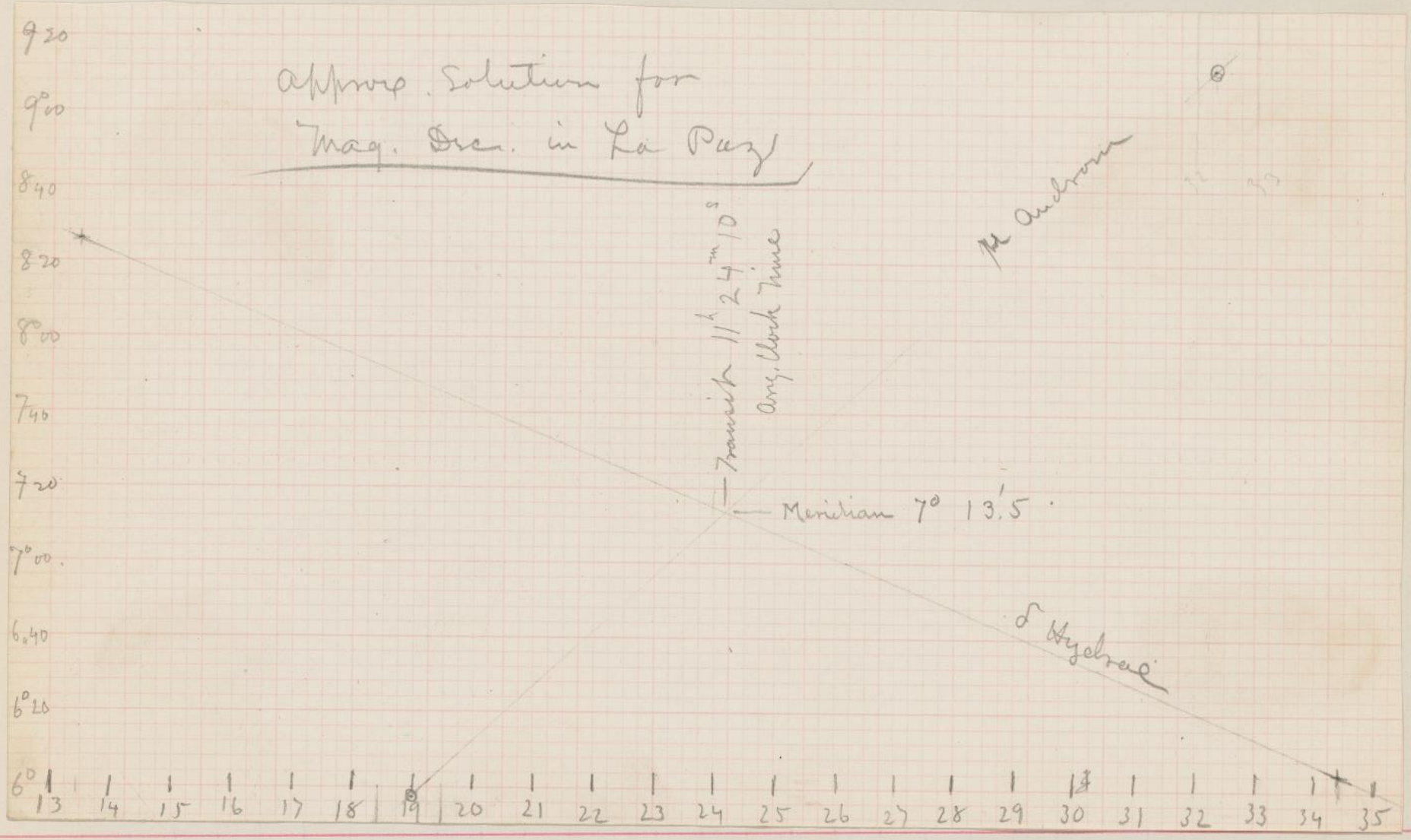
Transit at 11 24 10 | Instant of δ Hydrae

Meridian 367° 13'.5

357 48.0

9 25.5

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1892phae.proj.389D

Approx. Lat. of La Paz

		Check
☆ δ Androm.	5, 160	
☆ d Hydrae	5, 233	☆ μ Androm 2,110
	07.3	☆ K Tucanae 4,705
	20.6	2 ☆ 59.5
	238	20,6
69 09 03	146	15570
2 30	~~148.3~~	5190
69 11 33	150.4	60 | 5345.70
36 11 11	2' 30".4	60 | 89' 06"
33 00 22		1° 29' 06"
16 30 11		

~~Tucanae~~ for Jan 0.

K Tucanae	69	26	59
	1	29	06.
	70	56.	05
	37	54	49
2	33	01	16
	16	30	38

Cor.

These four stars are. 1892 Jan 0.

☆ δ Androm.	0h 12.7	+36	11	10.9
☆ μ "	0 50.8	+37	54	48.7
-17.5 ☆ K Tucanae	1 12.1	-69	26	58,8
-14.0 ☆ δ Hydri	2 19,8	-69	09	03.1

We must reduce these Dec's to Oct 30. 92

for comparison stars in Lacaille

				Jan 0	Oct 30	cor
2 Androm.	0	02.8	+28	29 38,8	62.4	+23".6

G = 328°.14'
H = 49°.15'

Star	α		δ			μ'	I μ'	G+α	H+α
δ Androm	003°	10.3	+36	11	10.9	+19.98	16".6	331.24	52.28
μ "	012	41.4	+37	54	48.7	19.614	16.3	340.55	61.59
K Tucanae	018	02.6	-69	26	58,8	19.178	15.9	346.16	67.20
δ Hydrae	034	57.4	-69	09	03.1	16.458	13.7	003.+	84.15
2 Androm	000	42.0	+28	29	38.8	19.884	16.5	328.56	50.00

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1892

Comparison Stars,				Jan 0	Oct 30	Cor
β Hydriæ	0	20.1	−77 57	45.2	42.0	−03.2
2 Eridani	1	33.7	−57 46	68.1	55.6	−12.5

κ Draconis	12	28.9	+70 22	60.7	39.7	−21.0
2 Draconis	14	01.5	+64 −53	31.1	16.7	−14.4
5 Hrs. Mins.	14	27.8	+76 10	33.8	20.2	−13.6
	14	14.7	70 30			−14.0

Cor for δ Hyd. −14.″0 Cor for κ Tuc. −17.5

These must be worked out by Ind. Star Nos

Ind. Star Nos for Oct 30. 12ʰ.

$\tau = .8332$ | $G = 328°14'$ | $\log g. +1.1578$ | $H = 49°18'$ | $\log h = +1.2883$ | $\log i$ +0.8055

$\iota = 6.''4$

$$\delta = \delta_0 + \tau\mu' + g\cos(G+2_0) + h\cos(H+2_0)\sin\delta_0 + i\cos\delta_0\,(\text{in ax})$$

σ Au.	δ Hydri.	κ Tucanae	μ Androm	2 Androm.	σ Androme
	1,1518	1,1518	1.1518	1,1518	1.1518 log g
	$\bar{1}$.9993	$\bar{1}$.9874	$\bar{1}$.9755	$\bar{1}$.9328	$\bar{1}$.9435 log cos(G+2₀)
	1,1511	1,1392	1.1273	1.0846	1.0953
	+14,2	+13.8	+13.4	+12.2	+12.5
	1.2883	1,2883	1.2883	1,2883	1.2883 log h
	$\bar{1}$.0008	$\bar{1}$.5859	$\bar{1}$.6718	$\bar{1}$.8081	$\bar{1}$.7848 log cos(H+2₀)
	n$\bar{1}$.9706	n$\bar{1}$.9714	$\bar{1}$.7885	$\bar{1}$.6786	$\bar{1}$.7712 log sin δ₀
	n0.2597	n0.8456	0.7486	0.7750	0.8443
	−1.8	−7.0	+5.″6	+6.0	+7.″00

(cos δ₀)	(g)	(h)	Tot cor.	δ Oct. 30,		
+5.″2	+12.″5	+07.″0	+24.7	+36	11	35.6
+5.0	+13.4	+05.6	+24.0	+37	55	12.7
+2.2	+13.8	−07.0	+09.0	−69	26	49.8
+2.3	+14.2	−01.8	+14.7	−69	08	48.4
+5.6	12.2	06.0	+23.8			

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True (i.e. apparent) Decs of Lat Stars
Obsd in La Paz - Oct 30. 1892

Mags.			R.A.		Oct 30.92			
4.4	✡	♂ Androm	0h 12m.7		+36 11 35.6		1° 43 37.1	
4.0	✡	μ Androm	0 50.8		+37 55 12.7			
4.9	✡	κ Tucanae	1 12.1		−69 26 49.8		0 18 01.4	
4.2	✡	δ Hydri.	2 19.8		−69 08 48.4			

Rough Lat.

mag

(4.4) ♂ Androm − δ Hyd.
(4.0) δ Hyd. 69 08 48.4
+ 2 30.4
69 11 18.8
36 11 35.6
2 | 32 59 43.2
16 29 51.6

μ Androm
κ Tucanae
69 26 49.8
1 29 05.7
70 55 55.5
37 55 12.7
33 00 42.8
~~16~~ 30 21.8
29 53.9

♂ Androm & κ Tucanae
♂ And. 5.160
κ Tuc. 4.705
45.5
20.6
2730
910
937.3
15′ 37″.3
36 11 35.6
36 27 12.9
69 26 49.8
32 59 36.9
16 29 48.5

μ Androm & δ Hydrae
μ And. 2.110
δ Hyd 5.233
3.123
20.6
18738
6246
6433.38
107 13″.4 = 1° 47′ 13″.4
69 08 48.4
70 56 01.8
37 55 12.7
33 00 49.1
16 30 24.6

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1892phae.proj..389D

σ And. 5,160⁻
μ " 2,110
305.0
20.6
1830
610
60 | 6283.0
104 43
Obs d 1° 44 43

516,0
210,9
470,5⁻
523,4

ξ Hyd. 5,233
κ Tuc. 4,705.
52.8
20.6
3168
1056
10887.68
18' 07".8
60
1080

There is an error of 1' somewhere — Identify stars!

52.8 | 1087.8 | 20.6
1056
3180
3168
1200

52.8 | 1081.4 | 20.48
1056
2540
2112
4280

468. = 37 01,8
523. = 37 19.8
55 18'

516 = 37 17.5
48 = 15 7.
60
48 | 942 | 20'

5572
128
424

35° 58.8'

1 43 37,1 = 103' 37,"1
60
305 | 6217,"1 | 20,38
610
1171
915
2560

259,6
20,38
20768
7788
5192
6 | 5290.648
88' 10,"16
1° 28' 10,"16
69 26 49,8
70 55 00.4
37 55 12,7
2 | 32 39 47.7
16 29 53,9

M Andromedae
K Tucanae

312,5
20,38
25000
9375
6250
6 | 6368.850
106' 08,"8
1 46 08,8
69 08 48.4
70 54 57,2
37 55 12,7
2 | 32 59 44.5
16 29 52.3

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1892phae.proj..389D

From a rough plotting of the curves for Lat I get approx

							Time	Cuts
α Androm.	516.0	at	9	19	50	$38^m\ 35^s$	38	04
μ Androm	210.9	"	9	58	25	21 45	21	20
κ Tucanae	470.5	"	10	20	10	66 25	67	43
ζ Hydrae	523.4	"	10	26	35			

Stars are identified,

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We have given in the Obs^ns

						Gr Sc	Scale
A	σ Androm.	5,11,2 +	= 37	17.0	d	04.4 = 91"	90"
		5,15,6	= 37	17,5		47.7 = 16,4	15.7
C	K Tucanae	4,67,9	= 37	01,8		54.9 = 18.85	17.9
D	δ Hydrae	5.22,8	= 37	19.7			

5 11.2	37	17.0	d	
5 22,8	37	19.7	11.6 = 4.0)	2.7
11.6				

· Assuming that in the case of σ Androm 37 17.0 should read 37 16.0 we have all three above agreeing sufficiently well.

	Gr Sc	Scale			Gr	Scale
A	d 47.7 = 16.4	15,7	also	A α 15.6	d 7.2 = 2.5	2,2
C	54.9 = 18,85	17.9		D 22,8		
D						

Error in ratio = $\frac{15.7}{16.4} = \frac{17.9}{18,85} = \frac{2.2}{2,5}$

$= \frac{7}{164} = \frac{9,5}{188} = \frac{3}{25}$

$= \frac{8}{175} = \frac{8}{175} = \frac{21}{175}$

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Rough Lat. of La Paz

This trouble about Lat Brs pro P. arises from a variation in the value of a Sr. Sc. div at different parts of the screw owing to tangential action.

New mr Lam o Androm is 1° 43' 37".1 south of μ Androm.

Hence μ And. & δ Hyd. = 2' 30".4 + 1° 43' 37".1

which = 1 46 07.5

δ Hyd	69	08	48.4	1	44	43.0
	70	54	55.9	1	43	37.1
	− 37	55	12.7		2	65.9
	32	59	43.2			33.0
	16	29	51.6			

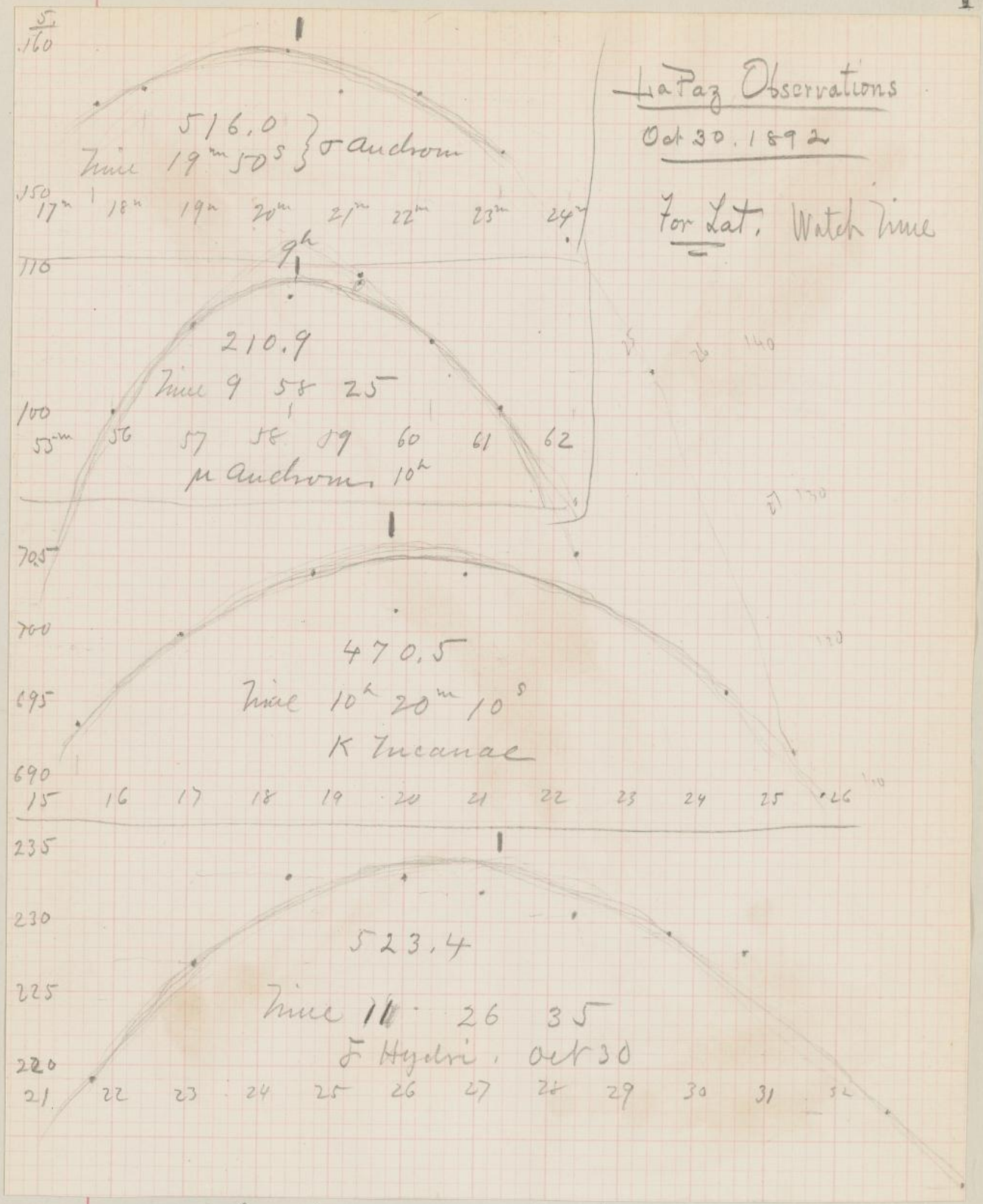
We Lam Thereon – deriving the value of a Sr Sc div. from the diff. between the two northern stars & applying it & get new values for μ Androm

o And. & δ Hyd.	16	29	51.6
o And. & K Tucan.			48.5
μ And & δ Hyd			52.3
μ And & K Tucan			52.9
			6.3
Average.	16	29	51.6

N.B. It must be remembered that this is the approx. Lat. The final value cannot be gotten till the full investigation of the Sr. Sc. divs. is made

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La Paz Observations

Oct 30. 1892

For Lat. Watch Time

Level errors during Obs^ns

σ Androm -	S high	2.4 2	Cor to Gn. Sc. Rdg	−
μ Androm	" "	6.5	"	−
K Incanae	" "	10.5	Cor to Gn, Sc, Rdg	+
δ Hydri	" "	14.5	"	+

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Here follow computations on Clocks

La Paz Observations

from page 68

Sun; Oct 30

	Sta clock			Mis Watch			Clock
7	59	00	7	59	00		0 s
9	30	00	9	29	53.5		+ 6.5 in 91m
	41	00		40	53.0		+ 7.0 in 102m = 142m

Tues. Nov 1. 2 39 00 3 05. 46 - Clk had probably stopped

Mis Watch slow

7	59	00	2m	24.s6
9	30	00	2	24.7
	41	00	2	24.7

$\frac{6.5}{91} = 0.071$

$\frac{7.0}{102} = 0.069$

av = +0.s070 per min.

Clocks true rate was +0.069 per min. starting at 2m 24.s6 slow at 7h 59m 00

Rate of Clock in terms of watch

Watch rate - 0.001 per min

N.B.

Study of same from rate of Ds watch

See page 71. At P and Ds Watch was losing 9.s0 per hour on Sta. Clock.

81. Ang. clock was gaining 4.s8 per hour. therefore Ds Watch's rate was -4.s2 per hour. or

Ds true rate -0.07 per min.

Oct 30 8.45. Watch 3m 11s ahead

11.30 " 2 59.3

2h.75 = 165m 11.7

or 0.071 per min.

165) 11.70 (0.071
1155
150

8.31.5	8.s2		13 | 249.7 | 19.2
8.50.3	13.7		
9.32.6	5.6	8/13 20	13 | 160 | 12.3
53.3	6.6	8	13/70
10.07.6	6.6		Dif. 1st 123 + 123
13.5	12.0		
30.5	11.0		
51.8	13.5	4.5	-3.3

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To face page 147 Sept 18, 1893

At foot of page 147 it says
Dis W. Oct 30 —— fast 49.6
" " Nov 12 —— " 21m 09.7 — this seems to be in error

On page 66 it says

Sat. Nov 12.	Mis Watch	Dis watch	difference
	8h 37m 00s	8h 58m 09.7	Dis watch ahead 21m 09.7

Brief review of Dis watch error of Oct 30.

Mis watch 55.2 behind M.T.C.
M.T.C slow 1m 29.0 } from diag. page 62-3
Mis watch 2m 24.2 slow.

Very good

Aneroid ahead 3.3 page 68
Aneroid 2m 20.9 slow —
Dis watch 3m 11s ahead
Dis watch 50s fast

for Nov 12

Mis watch behind M.T.C.	2m 38.3	page 62-3
M.T.C. slow	1 30.0	
Mis watch slow.	4 08.3	

From page 61

Nov 12. 0h.8 Dis Mis Watch slow 4m 07.0 formerly 3m 07.0 ?
10h.9 (10.1) 08.8 (1.8) (Error just discovered)
20h.9 (10.0) 11.9 (3.1)
At 8h 38m 49s Mis Watch slow 4m 08.4

From page 66 we have Nov 12d 8h 37m Dis watch was 21m 09.7 ahead of Mis watch or 17m 01.3 fast.

Rate of Dis Watch from Oct 30 to Nov 12 = 3.7 per day
or −0.0026 per minute.

1.8 1.4 5 20.9 20.9

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Ds watch in comparison with Sta clock. from lat. 06 ms in La Paz.

α Androm. 9 57 to 10 04

10.0 8.0 11.0 9.0 9.0 6.0 9.0 | 62/7 | = 8.9

K Tucanae 10 17 to 27

8.0 6.0 | 14/2 | = 7.0

δ Hydri 11 19 to 11 35

3.9 6 2 4 3 0 1 | 19/7 | = 2.7

actual value is −0.7

Cor = −3.4

Hence

0.4	10.0	Err. 5.5	1.9	19/209
1.1	10.4	" 3.6	4.3	11/4 · 19 = 209/4 = 5.2
	11.5	" −0.7		

We have

0.4 = 24m + 1.9/24 = 0.079

(90 6.2/90 = 0.069 } av. = 0.074 per min

1.1 = 66m + 4.3/66 = 0.065 }

Clock was gaining on watch 0.072 per min.

It seems probable that Ds Watch's rate in La Paz was not the same as in Phus

DsW. Oct 30 2m 24.6s − 3.2s = 2m 21.4s (1 − 3m 11.5s/f) = fast 49.6s

" Nov 12

In 13 days gained 69.7 − 49.7 = 20.0s

in 24 hours 1.54

in favour 0.06 p/m

Thus its rate in La Paz if it upholds the clock rate on the

a letter rec'd from D'Wrecker stating that he was a clock slow on Oct 30 by 2m 24.6s + 0.011/day since Oct 30 and on Nov 12 by 2m 49.7s

Difference since 8th 17m = 1.1 − 0.4 = 0.7 m

Mean of these = 0.9 m

Mean of these = 0.9 m

Error of Ds watch on Oct 30 = 2m 21.4s − 3m 11.5s/f = fast 49.6s

Nov 12 2m 09.7s

− 20.0s

1 09.7

Thus its rate in La Paz

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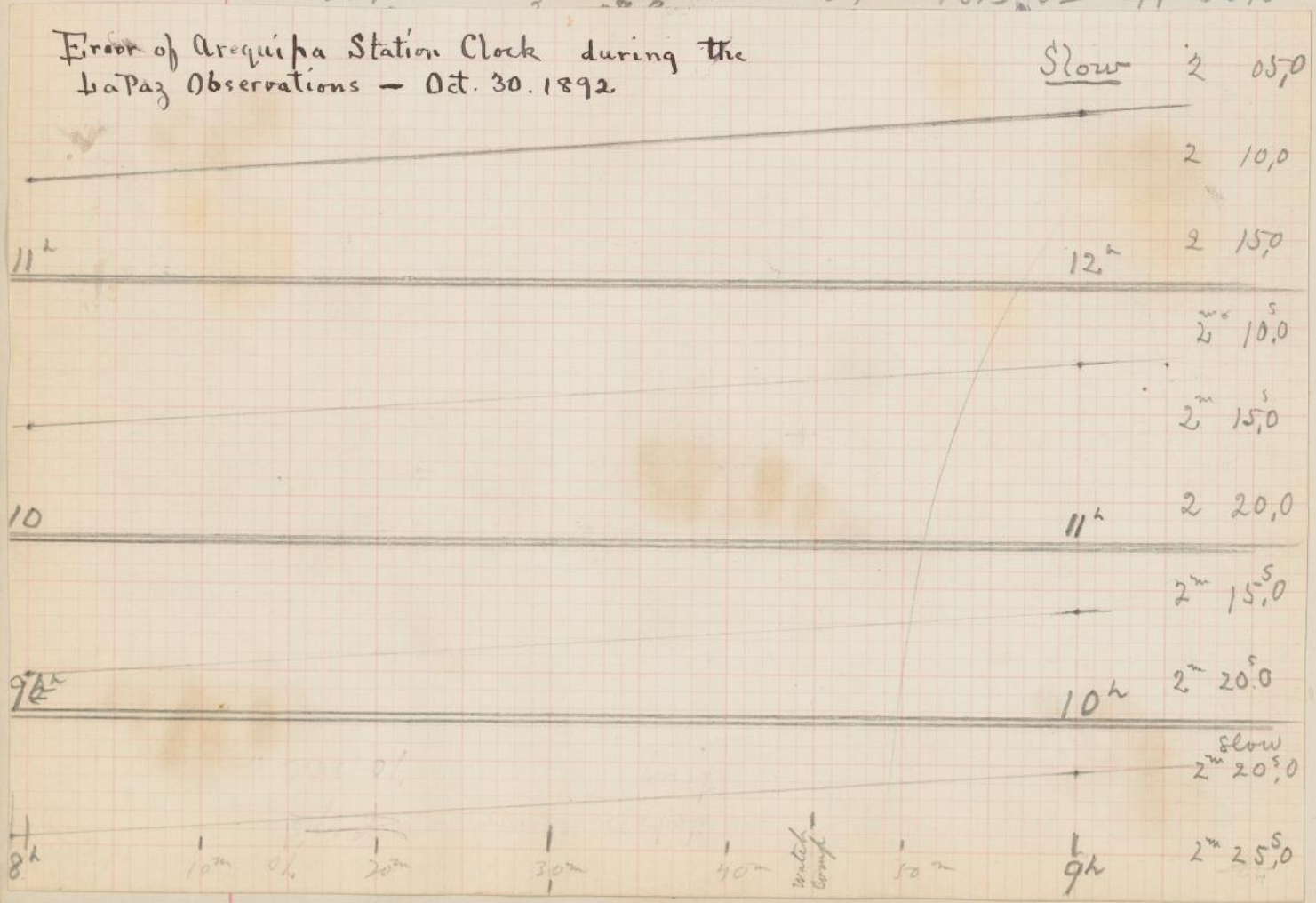
Rate of Arq. Sta. Clock during the La Paz Obsns

Rate was +0.069 per minute starting at 2m 24.5 slow at 7h 59m 00

Obsns lasted from 8h 25m to 11h 35m

+0.069 per min = 04.14 per hour

at Clock Time	Clock		Sid Time			S.T. + Clk Err.		
8h 00m.0	slow	2m 24.5	22	39	08.9	22	41	33.8
9 00.0	"	2 20.4	23	39	18.8	23	41	39.6
10 00.0	"	2 16.2	00	39	28.6	00	41	45.7
11 00.0	"	2 12.1	01	39	38.4	01	41	50.9
12 00.0	"	2 07.9	02	39	48.3	02	41	56.6



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Mean time into Sid. Time during La Paz Obs^ns

Oct. 30.

8^h 00 00	14	37	03.2
4 45 20	8	02	05.7
12 45 20	22	39	08.9 8^h
	1		09.9
	23	39	18.8 9^h
	1		09.8
	00	39	28.6 10^h
	1		09.8
	01	39	38.4 11^h
	1		09.9
	02	39	48.3 12^h

Check.

12 00 00	14	37	03.2
4 — —	12	02	45.1
16 45 20	02	39	48.3

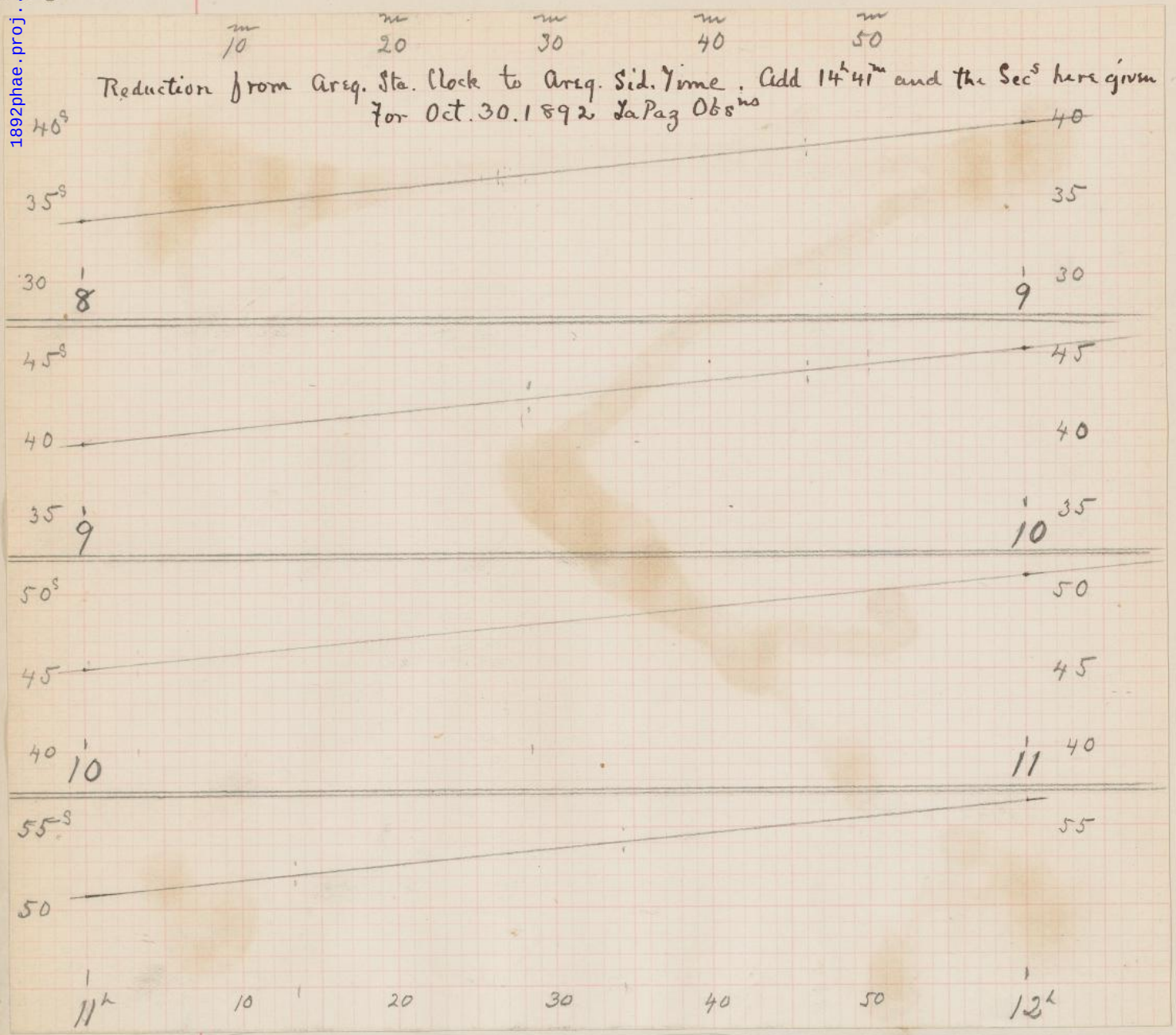
Comet.

39	08.9	39	18.8	39	28.6	39	38.4	39	48.3
2	24.5	2	20.4	2	16.2	2	12.1	2	07.9
	00.4		0.4		00.4		00.4		00.4
41	33.8	41	39.6	41	45.2	41	50.9	41	56.6

Gen Cor. to reduce from Orig. clock time to Sid Time add 14^h 41^m and the no of seconds in chart

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~~Zero~~ Print m Scale for zero of compass readings

369	53	− 12	05.9	= 357 48	0
359	22	− 01	32.9	50 + 2	2
370	02	− 12	14	48	0
365	57	− 08	10	47 − 1	1
369	12	− 11	23	49 + 1	1
365	55	− 08	08	47 − 1	1
				48 6)49	0.8

Scale Rdg for Mag. zero 357° 48′ 10″

367 12.0
357 48.2
10 23.8

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La Paz Obs no 1

Sid Watch Time reduced to ang. Sid. Time.

7.45

N 0^{d} 5.6, 4.3

E 0^{d} 5.2, 5.0

S 0^{d} 4.5, 5.5

W 0^{d} 4.9, 5.2

N high $0^{d}.58 = 7''.6$

E high $0^{d}.10 = 1''.3$

* T Pegasi (4.6) $23^{h}\ 15^{m}.3 \times +23\ 09$

Corrections S +4.1

23	08	08.8
	08	35.6
	09	02.6
	09	30.3
	09	58.3

23 09 03.1

9 52 51

+2 05

(4.6) W + 5.8 + 25 = W + 30"

CW. E. 33"

8.37

N 0^{d} 5.3, 5.6

E 0^{d} 4.3, 6.7

S 0^{d} 5.3, 5.6, 0

W 0^{d} 5.9, 5.1

W high $0^{d}.8 = 10''.5$

+4.5 ω Piscium (4.2) $23\ 53.8 \times +06\ 16$ | Lev. Int. $\frac{3}{94}$ | W + 11".5 = W + 37"

5 wires. $23^{h}\ 27\ 48.9$ at 359 22 26 Hor. Apis Cor. W + 25 CWE 33"

+4.9 * σ Androm. (4.4) $0^{h}\ 12.7 \times +36°\ 11'$ | Lev. Int. $\frac{23}{94}$ | W + 18".1 + 25" = 43"

5 wires 00 10 08.4 at 10 02 16 CWE 33"

+5.0 * μ Andromedae (4.0) $0^{h}\ 50^{m}.8 \times +37\ 55$ | Lev. Int $\frac{30}{94}$ | W + 20".4 + 25" = 45"

Cwire. 00 31 52.8 at 05 57 26 | CWE 33"

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La Paz Obs no 2

Corrections

+5.3	✱	μ Androm (4.0)	0h 50m 8.8s	+ 37° 55'	Lw. Inst	45/94 = N + 25".4 + 25" = 50" CW E 33"
		5 wires.	00h 45m 13.1s	at	9 11 31	
−6.0	✱	κ Tucanae (4.9)	1h 12.1s	− 69 27	Lwd Inst	52/94 = N + 27.h7 − 25" = 03" CW W 33"
		Cwire	00 52 04.2	at	187 54 50	
−5.4	✱	κ Tucanae	do	do	Lw. Inst	67/94 = N + 32".6 − 25 = 08" CW W 33"
		5 wires	01 10 18.8	at	185 54 35	
−5.1	✱	δ Hydri. (4.2)	2h 19m.8	− 69 09	Lw. Inst	74/94 = N + 34.9 − 25 = 10" CW W 33"
		Cwire.	01 55 17.6	at	188 25 35	
−4.8	✱	δ Hydri	do	do	Lw. Inst	92/94 = N + 40.9 − 25" = = 16" CW W 33"
		Cwire	02 16 20.4	at	186 04 18	

11.40

N − 0 − 3.4 / 8.2

E − 0 − 2.0 / 9.6

S − 0 − 5.4 / 5.2

W − 0 − 8.3 / 3.2

S. high $\frac{d}{1.25} = 16".4$ Aroud N. high $\frac{6.35}{2} = \frac{d}{3.18} = 41".7$

At Beg. N. high 10.5

Change in 94 Obs^{ns} + 31".2

" " 1 Obs + 0".33

Formulas:—

For Collimr. $\frac{33"}{\sec^2}$

$Cor = \left(\frac{2.2}{\cos Dec}\right)$

$Cor = \left(\frac{N \cos(D-\phi)}{15 \cos D}\right) \sec$

N = number of (") from the horizontal.

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	Dec		CW 0 33"	Error		$\phi = -16.5$	D − φ	$\frac{W+x}{15}$ Coef =	Total Cor.
τ Pegasi	+23,2	E	+ 2,4	W+30"	+ 1.7		39.7	2.00 v	+ 4,1
w Piscium	+06.3	E	+ 2,2	+37	+ 2.3		22.8	2.50 v	+ 4.5
σ Androm	+36,2	E	+ 2,7	43	+ 2,2		52.7	2.89 v	+ 4.9
μ Androm	+38,0	E	+ 2,8	45	+ 2,2		54.5	3.00 v	+ 5,0
dup μ Androm	+38,0	E	+ 2,8	50	+ 2,5		54,5	3,33 v	+ 5, 3
κ Tucanae	−69,5	W	− 6,3	03	+ 0,3		-53,0	0.20 v	− 6,0
dup κ Tucanae	−69,5	W	− 6,3	08	+ 0,9		-53.0	0.53 v	− 5,4
δ Hydrae	−69,2	W	− 6,2	10	+ 1,1		-52.7	0.67 v	− 5,1
dup δ Hydrae	−69,2	W	− 6,2	16	+ 1,8		-52,7	1.07 v	− 4,8

	+23.2	+0,6,3	+36,2	+38,0	−69,5	−69,2
Log 2.2	0,3424	0,3424	0,3424	0,3424	0,3424	0,3424
" cos δ	T,9634	T,9974	T,9069	T,8968	T,5443	T,5504
	0,3790	0,3450	0,4355	0,4456	0,7981	0,7920
	2,4	2,2	2,7	2,8	6,3	6,2

	+23,2	+06,3	+36,2	+38,0	+38,0	−69,5	−69,5
Log Corr.	0,3010	0,3979	0,4609	0,4771	0,5224	T,3010	T,7243
" cos (D−φ)	T,8862	T,9647	T,7825	T,7640	T,7640	T,7795	T,7795
Colog cos D	0,0366	0,0026	0,0931	0,1032	0,1032	0,4557	0,4557
	0,2238	0,3652	0,3365	0,3443	0,3896	T,5362	T,9595
	1,7	2,3	2,2	2,2	2,5	0,3	0,9

	−69,2	−69,2
Log Corr.	T,8261	0,0294
" cos (D−φ)	T,7825	T,7825
Colog cos D	0,4496	0,4496
	0,0582	0,2615
	1,1	1,8

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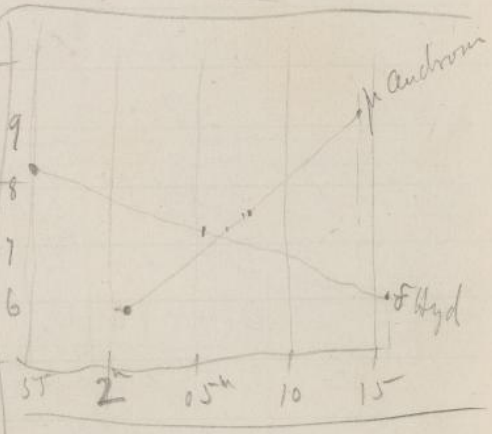
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La Paz Time Obs. '92

		Cor^{ns} transits			Scale Rd's			Dec^{n}		
	τ Pegasi +23,2	23	09	07.2	369	52	51	23	15	19.9
	w Piscium +06,3	23	27	53.4	359	22	26	23	53	48,7
	σ Androm +36.2	00	10	13,3	370	02	16	00	12	44.0
CW	μ Androm +38,0	00	31	57.8	365	57	26	00	50	46.5
	μ Androm +38,0	00	45	18,4	369	11	31			
CW	κ Tucanae -69,5	00	51	58,2	187	54	50	01	12	12.4
	κ Tucanae -69,5	01	10	13,4	185	54	35			
CW	δ Hydri -69,2	01	55	12,5	188	25	35	02	19	55,1
CW	δ Hydri -69,2	02	16	15,6	186	04	18			

	26	19	55.1	26	19	55.1	02	19	55,1
	23	15	19,9	23	53	48,7	00	12	44,0
Cor	+ 3	04	35.2	+ 2	26	06,4	2	07	11.1
	23	09	07.2	23	27	53.4	00	10	13,3
	02	13	42.4	01	53	59,8	02	17	24,4

	02	19	55,1	2	19	55.1
	00	50	46,5	1	12	12,4
	1	29	06.6	1	07	42,7
	00	31	57,8	00	57	58,2
	2	01	04.4	01	59	40,9
	1	29	06,6	1	07	42,7
	00	45	18,4	01	10	13,4
	2	14	25,0	2	17	56,1



Approx. Mer. Transit 11 24 10 Ang. Clock Time
+ 14 41 53
Approx. Mer. Passage 02 06 03 Ang. Sid. Time.

2 19 55
2 06 12
Approx Long 13 43

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La Paz Time Obs^ns reduced to transit of δ Hydri

	AZP			SP			ZP			
02	13	42.4	2°	40	51	66	50	40	106	30	00	15.5
01	53	59.8	7	49	34	83	43	46	106	30	00	15.3
02	17	24.4	2	50	16	53	48	24	106	30	00	12.5
02	01	04.4	1	14	34	52	04	47	106	30	00	12.0
02	14	25.0	1	59	31	52	04	47	106	30	00	11.9
01	59	40.9	0	42	50	20	33	10	73	30	00	10.5
02	17	56.1	1	17	25	20	33	10	73	30	00	11.6
01	55	12.5	1	13	35	20	51	12	73	30	00	10.2
02	16	15.6	1	07	42	20	51	12	73	30	00	10.5

on basis of 367.12

δ Hydræ μ Andromedæ.

6°	04.'3	2	16	16	9°	11.'5	2	14	25
8°	25.'6	1	55	12	5	57.4	2	01	04
2	21.3		21	04	3	14.1		13	21 = 801

Call the meridian at 367° 13'.00"

For formulas See Page 99.

180
106 30
73 30
23 08 57
66 57 03
6 15 55
83 44 05
36 11 36
53 48 24
37 55 13
52 04 47

69 26 50.
20 33 10
69 08 48
20 51 12

1260
687
8820
10080
2560
8656.20 | 612
8478
1782
1413
3690

68.7 • 1264^s = 612
141.3 = 10^m 12^s

02 16 16.9 | 1 55 12.5
10 12
02 06 04 | 2 05 25

from δ Hydri $\frac{1}{9} = 0.11$

$\frac{75.'6}{194.1}$ 801 = 312^s = 5^m 12^s + 2^h 01 04 = 2^h 06 16 from μ And. $\frac{1}{9} = 0.24$

The mean is at 2^h 06^m 08

$\frac{11}{35}$. 12 = 3.7^s or 4^s

367° 12' 00" is better at 2^h 06^m 12^s

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Formulas:

1. $\text{Ctn } APZ = \frac{\text{Cos } ZP}{\text{Ctn } AZP}$

2. $\text{Sin } AP = \text{Sin } ZP \text{ Sin } AZP$

3. $\text{Cos } APS = \text{Tan } AP \text{ Ctn } SP$

4. $SPZ = APZ - APS$: Reduce to time intervals.

The following computations are for an assumed meridian at 367° 12' 01" with an approximate time of transit 2h 06m 12s

This makes La Paz 240 miles East of Angusha and Pond is 107.6 " " " "

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Tpegasi Friday March 3d 9h

$$\operatorname{tg} A\,P\,Z = \frac{\cos ZP}{\operatorname{tg} A\,Z\,P} = \frac{\cos 106\ 30\ 00}{\operatorname{tg} 2^\circ\ 40'\ 50''}$$

log cos 106° 30' 00 = $\bar{1}$, 4533747 m
− log tg 2° 40' 50" = 1, 3.2 9 5 8 1
log tg A P Z = $\bar{2}$, 1 2 3 7 6 1 m A P Z = 90° 45' 43"

$$\sin AP = \sin ZI \cdot \sin AZP = \sin 106^\circ\ 30'\ 00 \sin 2^\circ\ 40'\ 50''$$

sin 106° 30' 00 = $\bar{1}$, 9 8 1 7 3 7
+ sin 2° 40' 50" = $\bar{2}$, 6 6 9 9 4 4
log sin A P = $\bar{2}$, 6 5 1 6 8 1
A P = 2° 34' 12"

$$\cos A\,P\,S = \text{tang } AP \cdot \operatorname{tg} SP = \operatorname{tg} 2^\circ 34'12'' \operatorname{tg} 66^\circ 50'40''$$

log tg 2° 34' 12" = $\bar{2}$, 6 5 2 1 0 5
+ log tg 66° 50' 40" = 1, 6 3 1 1 7 7
log cos A P S = $\bar{2}$, 2 8 3 2 2 7
A P S = 188° 54' 00

A P Z = 90° 45' 43"
A P S = 88° 54 00

S P Z = 1° 51 43

02 13 42,4
7 26.9
02 − 6 − 15,5

1° = 4 m
51' = 3 m 24 s
43' = 2,9
6 m 26,9

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Hydr. $\operatorname{cotg} \frac{1}{2} A\hat{P}Z = \frac{\cos \frac{1}{2}(P)}{\operatorname{cotg} \frac{1}{2} A\hat{Z}P} = \frac{\cos 73° 30' 00}{\operatorname{cotg} 1° 07' 42}$

$\log \cos 73° 30' 00 = \bar{1},453342$
$- \log \operatorname{cotg} 1° 07' 42 = \bar{1},705629$

$\log \operatorname{cotg} \frac{1}{2} A\hat{P}Z = \bar{3},747713$
$\frac{1}{2} A\hat{P}Z = 89° 40' 46''$

$\sin A\hat{P} = \sin Z\hat{P} \cdot \sin A\hat{Z}P = \sin 73° 30' 00 \cdot \sin 1° 07' 42$

$\log \sin 73° 30' 00 = \bar{1},981737$
$+ \log \sin 1° 07' 42 = \bar{2},294287$

$\log \sin A\hat{P} = \bar{2},276024$
$A\hat{P} = 1° 04' 55''$

$\cos A\hat{P}S = \tan A\hat{P} \cdot \operatorname{cotg} S\hat{P} = \tan 1° 04' 55' \operatorname{cotg} 20° 57' 12'$

$\log \operatorname{tg} 1° 04' 55' = \bar{2},276137$
$+ \log \operatorname{cotg} 20° 57' 12' = 0,419155$

$\log \cos A\hat{P}S = \bar{2},695292$
$A\hat{P}S = 87° 09' 30''$

$A\hat{P}Z = 89° 40' 46''$
$A\hat{P}S = 87° 09\ 30$
$S\hat{P}Z = 2° 31' 16''$

$2° = 8^m$
$31' = 2'' 4^s$
$16'' = 1^s,1$
$10^m 5^s,1$

02 16 15,6
10 5,1
02 06 10,5

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ω Piscium

$$\operatorname{ctg} A\,\underline{P}\,Z = \frac{\cos Z\underline{P}}{\operatorname{ctg} A\,Z\,\underline{P}} = \frac{\cos 106^\circ 30' 00''}{\operatorname{ctg} 7^\circ 49' 34''}$$

$\log \cos 106^\circ 30' 00'' = \bar{1},453372\,n$
$-\log \operatorname{ctg} 7^\circ 49' 34'' = 0,861871$
$\log \operatorname{ctg} A\,\underline{P}\,Z = \bar{2},591471$
$A\,\underline{P}\,Z = 92^\circ 14' 08''$ (87° 45' 53")

$\sin A\,\underline{P} = \sin Z\underline{P} \cdot \sin A\,Z\,\underline{P} = \sin 106^\circ 30' 00'' \sin 7^\circ 49' 34''$

$\log \sin 106^\circ 30' 00'' = \bar{1},981737$
$\log \sin 7^\circ 49' 34'' = \bar{1},134075$
$\log \sin A\,\underline{P} = \bar{1},115812$
$A\,\underline{P} = 7^\circ 30' 07''$

$\cos A\,\underline{P}\,S = \operatorname{tg} A\,\underline{P} \cdot \operatorname{ctg} S\,\underline{P} = \operatorname{tg} 7^\circ 30' 07'' \operatorname{ctg} 83^\circ 43' 46''$

$\log \operatorname{tg} 7^\circ 30' 07'' = \bar{1},119543$
$\log \operatorname{ctg} 83^\circ 43' 46'' = 1,040927$
$\log \cos A\,\underline{P}\,S = \bar{2},160470$
$A\,\underline{P}\,S = 89^\circ 10' 15''$

$A\,\underline{P}\,Z = 92^\circ 14' 08''$
$A\,\underline{P}\,S = 89^\circ 10' 15''$
$S\,\underline{P}\,Z = 3^\circ 03' 53''$

$3^\circ = 12^m$
$03' = 12^s$
$53'' = 3,5$
$12^m 15.5^s$

1 53 59.8
12 15.5
2 06 15.3

March 3 d 1893

δ Andromedæ $\frac{\cos ZP}{\operatorname{tg} AZP} = \frac{\cos 106°30'00}{\operatorname{tg} 2°50'16}$

$\log \cos 106°30'00 = \bar{1},453342$ n
$- \log \operatorname{tg} 2°50'16 = 1,304754$
$\log \operatorname{tg} APZ = \bar{2},148588$
$APZ = 90°48'24''$ $(89°11'36'')$

$\sin AP = \sin ZP \cdot \sin AZP = \sin 106°30'00 \sin 2°50'16$

$\log \sin 106°30'00 = \bar{1},981737$
$+ \log \sin 2°50'16'' = \bar{2},694712$
$\log \sin AP = \bar{2},676449$
$AP = 2°43'15''$

$\cos APS = \operatorname{tang} AP \cdot \operatorname{tg} SP = \operatorname{tg} 2°43'15 \operatorname{tg} 53°48'24''$

$\log \operatorname{tg} 2°43'15'' = \bar{2},676926$
$+ \log \operatorname{tg} 53°48'24'' = \bar{1},864339$
$\log \cos APS = \bar{2},541265$

$APS = 88°0'26''$

$APZ = 90°48'24''$
$APS = 88°0'26''$

$SPZ = 2°47'58''$

$2^h\ 17^m\ 24,4^s$
$11\ \ 11,9$
$06^m\ 12,5^s$

$2° = 8^m$
$47' = 3^m\ 08^s$
$58'' = \frac{3,9}{11^m\ 11,9}$

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μ Andron, $\operatorname{ctg} A\,\underline{P}\,Z = \dfrac{\cos Z\,\underline{P}}{\operatorname{ctg} A\,Z\,\underline{P}} = \dfrac{\cos 106^\circ\,30'\,00}{\operatorname{ctg} 1^\circ\,14'\,34''}$

$\log \cos 106^\circ\,30'\,00 = \bar{1},453342\,n$
$-\log \operatorname{ctg} 1^\circ\,14'\,34'' = 1,663661$

$\log \operatorname{ctg} A\,\underline{P}\,Z = \bar{3},789681\,n$
$A\,\underline{P}\,Z = 90^\circ\,21'\,11''$

$\sin A\,\underline{P} = \sin Z\,\underline{P} \cdot \sin A\,Z\,\underline{P} = \sin 106^\circ\,30'\,00 \cdot \sin 1^\circ\,14'\,34''$

$\log \sin 106^\circ\,30'\,00 = \bar{1},981737$
$+\log \sin 1^\circ\,14'\,34'' = 2,336236$

$\log \sin A\,\underline{P} = \bar{2},317973$
$A\,\underline{P} = 1^\circ\,11'\,30''$

$\cos A\,\underline{P}\,S = \operatorname{tang} A\,\underline{P} \cdot \operatorname{ctg} S\,\underline{P} = \operatorname{tg} 1^\circ\,11'\,30'' \operatorname{ctg} 52^\circ\,04'\,47''$

$\log \operatorname{tg} 1^\circ\,11'\,30'' = \bar{2},318095$
$\log \operatorname{ctg} 52^\circ\,04'\,47'' = \bar{1},891563$

$\log \cos A\,\underline{P}\,S = \bar{2},209658$
$A\,\underline{P}\,S = 89^\circ\,04'\,17''$

02	07 04,4	$A\,\underline{P}\,Z = 90^\circ\,21'\,11''$
	5 07,6	$A\,\underline{P}\,S = 89\;04\;17''$
02	$6^h\,12^s.0$	$S\,\underline{P}\,Z = 1^\circ\;16\;54''$

$1^\circ = 4^m$
$16' = 1^m\,4^s$
$54^s = 3,6$

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α Andromedæ

$$\operatorname{ctg} A\,P\,Z = \frac{\cos Z\,P}{\operatorname{ctg} A\,Z\,P} = \frac{\cos 106^\circ\,30'\,00}{\operatorname{ctg} 1^\circ\,59'\,31''}$$

$\log \cos 106^\circ\,30'\,00 = \bar{1},\,475\,342$ n
$- \log \operatorname{ctg} 1^\circ\,59'\,31'' = 1,\,475\,870$
$\log \operatorname{ctg} A\,P\,Z = \bar{3},\,999\,472$
$A\,P\,Z = 90^\circ\,33'\,58''$ $(89^\circ\,26'\,02'')$

$\sin A\,P = \sin Z\,P \cdot \sin A\,Z\,P = \sin 106^\circ\,30'\,00 \cdot \sin 1^\circ\,59'\,31'$

$+ \log \sin 106^\circ\,30'\,00 = \bar{1},\,981\,737$
$\log \sin 1^\circ\,59'\,31' = \bar{2},\,541\,068$
$\log \sin A\,P = \bar{2},\,522\,805$
$A\,P = 1^\circ\,54'\,36''$

$\cos A\,P\,S = \operatorname{tg} A\,P \cdot \operatorname{ctg} S\,P = \operatorname{tang} 1^\circ\,54'\,36'' \operatorname{ctg} 52^\circ\,04'\,47$

$\log \operatorname{tg} 1^\circ\,54'\,36'' = \bar{2},\,523\,072$
$\log \operatorname{ctg} 52^\circ\,04'\,47 = \bar{1},\,891\,563$
$\log \cos A\,Z\,S = \bar{2},\,414\,635$
$A\,P\,S = 88^\circ\,30'\,41''$

$A\,P\,Z = 90^\circ\,33'\,58''$
$A\,P\,S = 88^\circ\,30'\,41$
$S\,P\,Z = 2^\circ\,03'\,17''$

$0^h\,14^m\,25^s$
$8^m\,13,1$
$2^h\,6^m\,11.9$

$2^\circ = 8^m$
$03' = 12^s$
$17'' = 1^s,1$
$8^m\,13^s,1$

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K Imenae.

$\text{cg } A\,P\,Z = \frac{\cos Z\,P}{\text{cg } A\,Z\,P} = \frac{\cos 73^\circ 30' 00}{\text{cg } 0^\circ 42' 50'}$

lg cos 73° 30' 00 = $\bar{1}$,453342
lg cg 0° 42' 50" = 1,901470
lg cg A P Z = $\bar{3}$,548872
A P Z = 89° 47' 50"

sin A P = sin Z P . sin A Z P = sin 73° 30' 00 . sin 0° 42' 50'

lg sin 73° 30' 00 = $\bar{1}$,981737
lg sin 0° 42' 50' = $\bar{2}$,095497
lg sin A P = $\bar{2}$,077234
A P = 0° 41' 04"

Cos A P S = tg A P . cg S P = tg 0° 41' 04" cg 20° 33' 10'

lg tg 0° 41' 04' = $\bar{2}$,077231
lg cg 20° 33' 10' = 0,172604
lg cos A P S $\bar{2}$,503275
A P S = 88° 10' 27"

A P Z = 89° 47' 50"
A P S = 88° 10' 27'
S P Z = 1° 37' 23"

07 59 40,9
6 49,6
02 06 10.5

1° = 4m
37' = 2m 28s
23" = 1,6
6m 29,6

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Z Tucanae

$\text{cotg } A\,P\,Z = \dfrac{\cos Z\,P}{\text{cotg } A\,Z\,P} = \dfrac{\cos 73^\circ\,30'\,00}{\text{cotg } 1^\circ\,17'\,25''}$

$\log \cos 73^\circ\,30'\,00 = \bar{1},453342$
$\log \text{cotg } 1^\circ\,17'\,25'' = 1,647367$
$\log \text{cotg } A\,P\,Z = \bar{3},805978$
$A\,P\,Z = 89^\circ\,38'\,00$

$\sin A\,P = \sin Z\,P \cdot \sin A\,Z\,P = \sin 73^\circ\,30'\,00 \cdot \sin 1^\circ\,17'\,25''$

$\log \sin 73^\circ\,30'\,00 = \bar{1},981737$
$\log \sin 1^\circ\,17'\,25'' = \bar{2},352523$
$\log \sin A\,P = \bar{2},334260$
$A\,P = 1^\circ\,14'\,14''$

$\cos A\,P\,S = \text{tg } A\,P \cdot \text{cotg } S\,P = \text{tg } 1^\circ\,14'\,14'' \cdot \text{cotg } 20^\circ\,33'\,10'$

$\log \text{tg } 1^\circ\,14'\,14'' = \bar{2},334392$ 360
$\log \text{cotg } 20^\circ\,33'\,10' = 0,426044$ 044
$\log \cos A\,P\,S = \bar{2},760436$ 404
$A\,P\,S = 86^\circ\,41'\,52''$

$A\,P\,Z = 89^\circ\,38'\,00$
$A\,P\,S = 86^\circ\,41\,52$
$S\,P\,Z = 2^\circ\,56'\,08''$

$0^h\,2$ $17^m\,56,1$ $2^\circ = 8^m$
$11\;\;44,5$ $56' = 3\;\;44^s$
$0^h\,2$ $6^m\,11.6$ $08'' = \underline{\quad 0,5}$
$11\;\;44,5$

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δ Hydrae

$$\text{cfg } A\,P\,Z = \frac{\cos Z\,P}{\cos A\,Z\,P} = \frac{\cos 73^\circ 30' 00}{\text{cfg } 1^\circ 13' 35''}$$

$\log \cos 73^\circ 30' 00 = \bar{1},753372$
$\log \text{cfg } 1^\circ 13' 35'' = 1,669448$
$\log \text{cfg } A\,P\,Z = \bar{3},783894$
$A\,P\,Z = 89^\circ 39' 06''$

$\sin A\,P = \sin Z\,P \cdot \sin A\,Z\,P = \sin 73^\circ 30' 00 \sin 1^\circ 13' 35$

$\log \sin 73^\circ 30' 00 = 1,981737$
$\log \sin 1^\circ 13' 35 = \bar{2},330472$
$\log \sin A\,P = \bar{2},312209$
$A\,P = 1^\circ 10' 33''$

$\cos A\,P\,S = \log A\,P \cdot \text{cfg } S\,P = \log 1^\circ 10' 33'' \cdot \text{cfg } 20^\circ 57' 12''$

$\log \log 1^\circ 10' 33'' = \bar{2},312282$
$\log \text{cfg } 20^\circ 57' 12'' = 0,419155$
$\log \cos A\,P\,S = \bar{2},731437$
$A\,P\,S = 86^\circ 54' 41''$

$A\,P\,Z = 89^\circ 39' 06''$
$A\,P\,S = 86^\circ 54' 41''$
$S\,P\,Z = 2^\circ 44' 25''$

01	55	12,5
	10	57,7
02	06	10.2

$2^\circ = 8^m$
$44' = 2^m\,56^s$
$25 = \quad 1,7$

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On the meridian of 367°12′00″ in hour

wt						wt	
10	CW.	μ Auchrom	+38.0	02h 06m	12.0	1	2.0
11		μ "	"		11.9	5	9.5
		σ "	+36.2		12.5	5	12.5
		τ Pegasi	+23.2		15.5	11	24.0
5							12.18
5		w Piscium	+06.3		15.3		
	CW	δ Hydri	-69.2		10.2	1 =	~~10.2~~
	CW	δ "	"		10.5	1 =	~~10.5~~
	CW	K Incanar	-69.5		10.5	1 =	~~10.5~~
		K "			11.6	5 =	8.0
						8	9.2
							11.15

Weather Law

Reg.	Wt.	Dec	Transit	Rel. Mers Corr	Rate Cent Corr
A	11	+37.1	12.5 2	+2.0	+0.4
B	5	+23.2	15.5	+1.4	+0.5
C	5	+06.3	15.3	+0.7	+0.5
D	8	-69.3	11.2 5	-4.6	+1.0

B = A − ½

A						
12.2	11	24.2	8.8	1.2	13.2	20.9
15.5	5	27.5	12.5	4.8	24 0	8.5
15.3	5	26.5	11 5	4.9	24.5	9.0
11.2	8	29.6	8.0	3.5	28.0	32
~~17.2~~	29	8 | 7.8	13.03 40.8	29	89.7	41.6
		8 | 0 80	1.4		13.1	

C = A + ½

3.2
6.2
5.7

Came 1 06 13.0 +0.5 (see note-page 147)
due 2 19 55.1
13 42.1 -0.5 = 13m 41.5
4 45 32.5
4 31 50.4 +0.5 = 4h 31m 50.9

See page 147

N.B (see page 190) Henry not had error in transit here - page 153
Gives this sometimes - for N stars -1.3, for S stars +2.9

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Discussion of a mistake in level or collimation corrections

Pivot Stars

A	+58,0	10	08,5	0,3	22 − 1	− 4,2	4,3	+ 3,5	8,5	
B	+35,6	10	10.7	0,4	14 − 1	− 2,7	8,0	+ 1,9	10,7	
C	+23,0	2	12.1	0,5	1 = 16.0	− 2,4	9,7	+ 1,5	12.1	
D	−68,8	6	9,9	1,0	5 = 9.0					
					(4 21.1)	11.2	16.1	− 4,4	22.5	

La Paz Stars

A	+37,1	11	12.2	0,4	3,3 = 1	− 2,8 =	9,6	12,2
B	+23.2	5	15,5	0,5		− 2,4 ·	13.1	15,5
C	+06.3	5	15.3	0,5		− 2,2	13.1	15.3
D	−69,3	8	11.2	1,0		+ 6.3	17.5	23.8

We may assume that there is no error

Time of transit 2 06 13
Due 2 19 55
Clock slow 13 42

	σ Androm			μ Androm			κ Tucanae			δ Hydri		
due	00	12	44	00	50	49	01	12	12			
clk corr −		13	42		13	42		13	42			
	23	59	02	24	37	07	24	58	30	26	06	13
− 14h 41m	14	41		14	41		14	41		14	41	
	09	18	02	09	56	07	10	17	30	11	25	13
−			−41			−45			−47			53
Star due	09	17	21	09	55	22	10	16	43	11	24	20
Corr watch	+	3	05	+	03	04	+	03	03	+	03	00
Watch Time of transit	09	20	26	09	58	26	10	19	46	11	27	20

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La Paz. Lat. Obsns.

reduced to their instant of transit.

σ Andromedæ

−2ᵐ	48ˢ	5.156
−2	07	157
−0	11	160−
+0	34	157
+1	39	157
+2	48	153
+3	44	147
+4	54	138−
+6	54	.112+

Map. Reading 516.00

μ Andromedæ

−2	31	2.100
−1	26	.106
−0	06	.108
+0	54	.1095
+1	52	.105
+2	49	.1005
+3	49	.094
+4	44	.090
+5	50	.076

May Reading 210.85

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La Paz Lat. Obsus

K Tucanae

−4	19	4.6935
−2	56	.700
−1	04	.704
+0	04	.7025
+1	01	.704
+2	34	.7055
+4	39	.696
+6	04	.689
+7	09	4 .679

δ Hydri

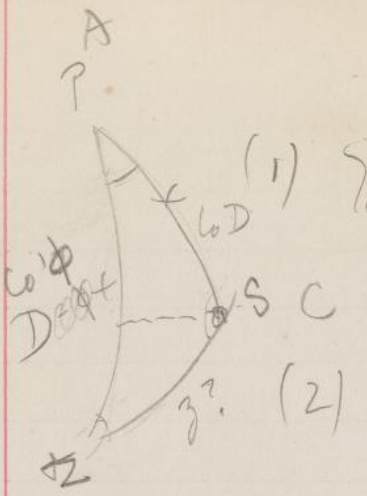
−9	01	5.201
−7	55	.206
−7	00	.210
−5	36	.219
−4	15	.227
−2	55	.233
−1	20	.233
−0	17	.232
+1	03	.230
+2	20	.229
+3	23	.228
+5	20	.217
+6	27	.212
+8	05	.201

+17m
−9°06 +8.1

I 40.0
II 00.0

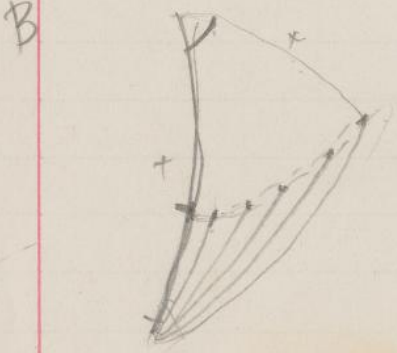
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(1) $\tan AD = \frac{\cos A}{\operatorname{ctn} AC}$

(2) $BD = AB - AD$



As the curve of differential ~~altitude~~ BD is evidently not a parabola, it would be well to get some idea of its theoretical shape.

In above $\triangle$ we have A (= P = S pole)
B (= Z = zenith) & C (= S = star)

Increase in angle A is the change in time
It is required to know the increase in length of side BC to correspond to a known increase in time.

Now we know the increase in $\angle$ ~~B~~ Z when $\angle P$ increases

From page 166 we have $\triangle \begin{matrix} Z = 30'' \\ P = 4^s.5 \end{matrix}$ approx for δ Hydri

now we have $\frac{\sin S Z}{\sin SP} = \frac{\sin P}{\sin Z}$ or $\sin SZ = \frac{\sin P \sin SP}{\sin Z} =$

$\sin SZ = \sin SP \frac{\sin 67.''5\,M}{\sin 30.''0\,M}$

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put $SZ = z$,
" $SP = CoD$
" $ZP = \phi D - \phi$
& fin formula

we have within small limits

$$\frac{dz}{dZ}\frac{dP}{dZ} = \frac{\sin(D-\phi)}{\cos D}\,dZ$$

$$\frac{\sin z}{\cos D} \doteq \frac{\sin P}{\sin Z} = \frac{dP}{dZ} = \frac{\sin D-\phi}{\cos D}$$

The curve seems to be flat topped.
from this new curve (N.C.) we get the following

	gr. sc			
σ Androm	515,85	0 − 2,"2	= −0.^{d}11	= 515.^{d}74
μ Androm	210.85	− 6,"5	= −0.32	= 210.53
κ Tucanae	470.38	+10."5	= +.51	= 470.89
δ Hydri	523.20	+14,"5	+.71	= 523.91

[last cor]

σ to μ Andr. $1^d.0$ = 20,"38 ~~2,200~~ ~~010~~
~~2038~~
1620

20.3

20.48) 2.200 (0,107
2048
15200

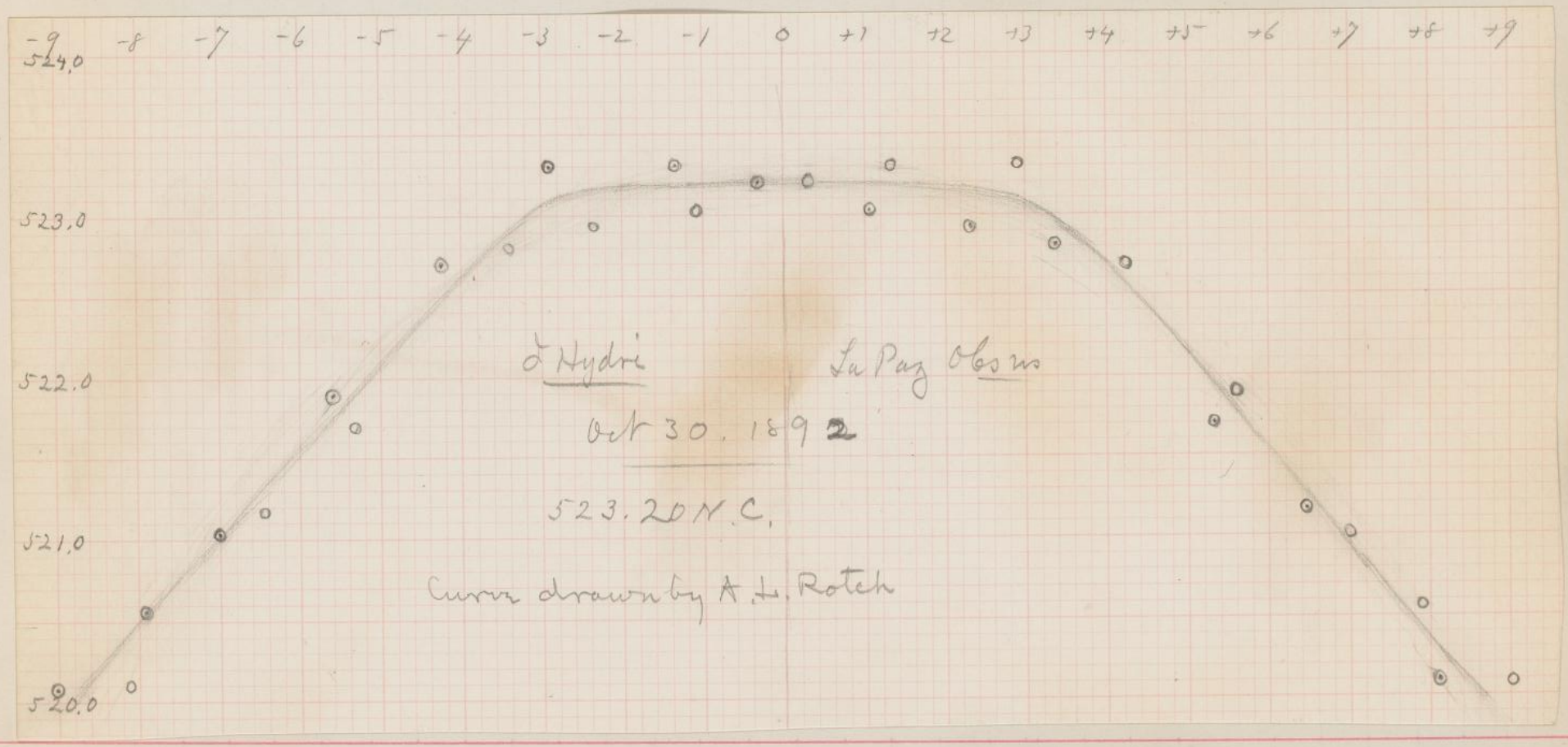
but κ to δ. $1^d.0$ = 20.48. i.e at 500.
" σ to μ $1^d.0$ = 20.38 i.e at 362
Then $1^d.0$ = 20.28 at 224

20.28) 6.500 (0,32
6084
4160

20.48) 10,500 (0.51
10240
2308
2600

20.48) 14.500 (0.71
14336
1640

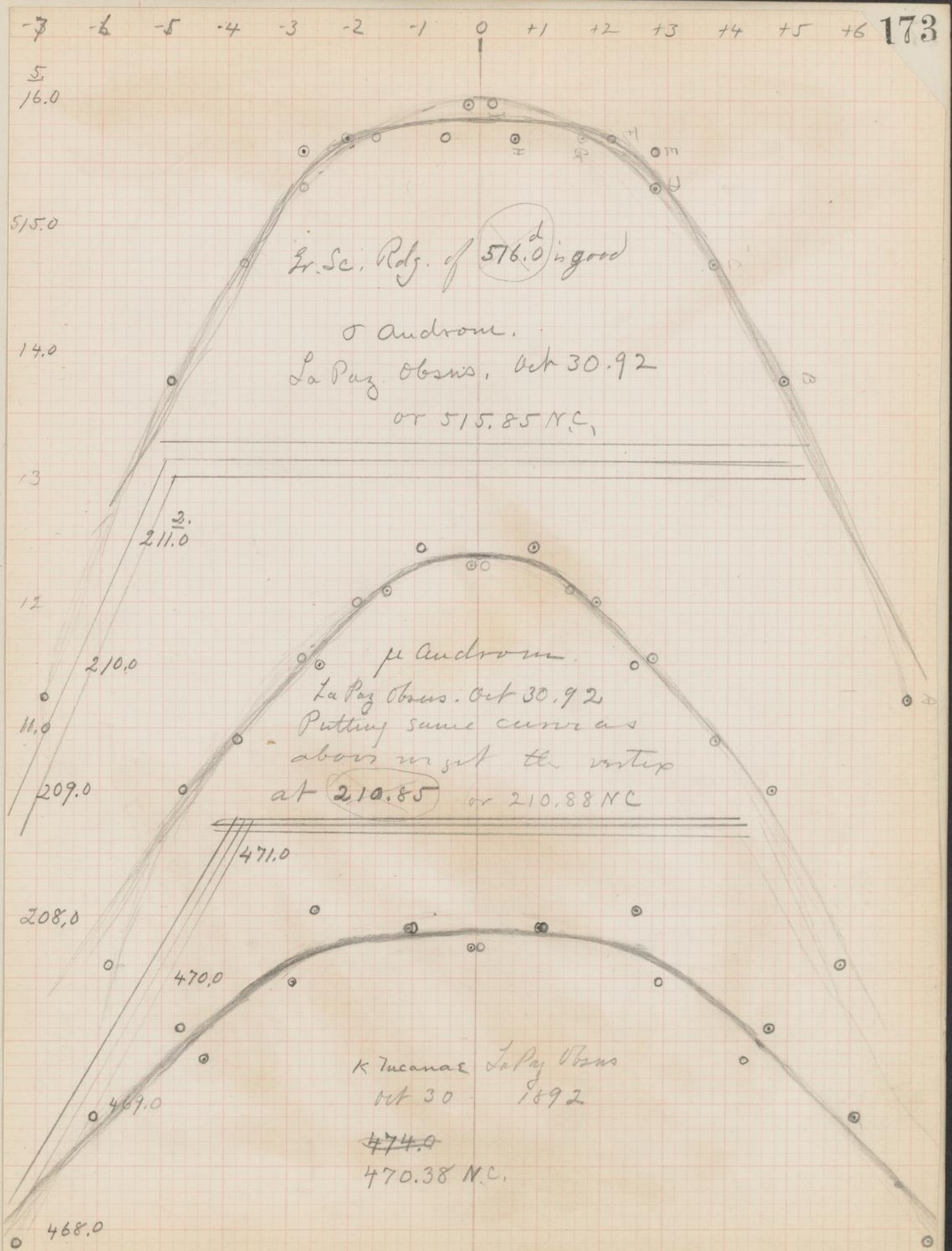
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March 15, 93

Mean from my Lats! —

star	Sr. Sc.	Oct 30.92		
σ	515.74	+36°	11′	35.″6
μ	210.53	+37	55	12.7
K	470.89	−69	26	49.8
δ	523.91	−69	08	48.4

Mean Flam

σ & K	.492	1.0 d	= 20.″48
σ & δ	520	1.0	20.50
μ & K	340	1.0	20.36
μ & δ	366	1.0	20.38

σ & K

σ 515.74
K 470.89
44.85
20.48
918.″5

0° 15′ 18.″5
36 11 35.6
36 26 54.1
69 26 49.8
2 | 32 59 55.7
16 29 57.8

σ & δ

σ 515.74
δ 523.91
8.17
20.50
167.″5

0° 02′ 47.5
69 08 48.4
69 11 35.9
36 11 35.6
2 | 33 00 00.3
16 30 00.2

μ & K

μ 210.53
K 470.89
260.36
20.36
5300.9

01 28 20.9
69 26 49.8
70 55 10.7
37 55 12.7
| 32 59 58.0
16 29 59.0

μ & δ

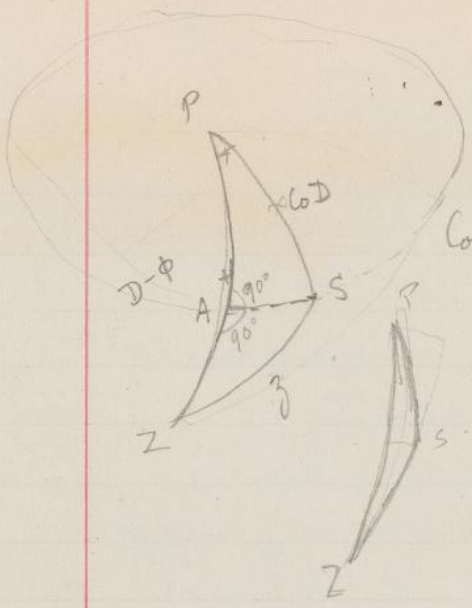
μ 210.53
δ 523.91
313.38
20.38
6386.7

01 46 26.7
69 08 48.4
70 55 15.1
37 55 12.7
| 33 00 02.4
16 30 01.2

					Δ²	
σ & K	16	29	57.8	1.″8	3.24	$r_1 = .6745\sqrt{\frac{[\Delta^2]}{n(n-1)}}$
σ & δ	16	29	60.2	0.6	.36	$r_0 = 0.6745\sqrt{\frac{[\Delta^2]}{n-1}}$
μ & K	16	29	59.0	0.6	.36	
μ & δ	16	29	61.2	1.6	2.56	$r_1 = \frac{2}{3}\sqrt{\frac{6.52}{3.}} = 0.96$
			38.2	4 6	[Δ] 6.52	
	16	29	59.6	1.2		Probable error of mean = 0.″96
						" " " single Obs = 1.″92

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$\cos D \sin P = \sin z \sin Z$

formulas for computing corr^{n} of dz

Diff between La Paz and Chil in long appro
is $1^{m}\,5\,4.^{s}6$ Computed from distance trian-
gulation between La Paz and Chilcayo. This
figure is probably correct only to within a
second or two.

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We shall have to return to the lat. & possibly the long. Obsns. However we may now begin

Yungas Observations.

1892

Mes. Nov. 8. Levels the N &c

N 73 5 4.8 4.9 2 4 — E 0 - 3.0 6.7 — 1.0 1.1 — 1.05

S 48 - 2.2 = 26 7.3 — 2.5 — 4.0 5.6 — .53

N high 1.25 = 16.″4 — W high 6.″9

8.30± ☉ Androne

Alt 45° 04.′5 at 8h 52m 30s Dis Watch

Compass 10° 31.′0 at 8h 53m 27.s5

10.10 Levels N 5.6 4.4 — 4.8 4.6 — 2 4.7 — 2.35 — E 5.8 4.1 — 5.0 4.9 — 4.95 — 2.48

S 0.8 9.0 — W 0.8 9.0

N high 30.″6 — W high 32.″2

Wed. Nov. 9. Observations on Sun

Upper limb 40° 52′ at 7h 57m 48.s6 (E+4″)

Compass 90 28 True east about 80

App. R limb 8 00 38 (S+24″)

Vernier 248° 08′ 50″ Compass 89° 55′

pretty well levelled.

8.06 AM Levels. N 2.5 6.2 — 3.1 3.2 — 3.15 — 1.58 — E 4.6 4.0 — 0.9 0.9 — 0.9 — 0.45

S 5.6 3.0 — W 3.7 4.9

S high 20.″7 — E high 5.″9

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Yungas Obs-ns.

Wd. Nov. 9.

☉ app. upper limb = 39° 02'.2 at 8h 10m 11.s8 (E+7")

☉ app. L limb. 8h 15m 00s (S+15")
Vern. 248 02 14 Compass 90 03

☉ app. upper limb 41° 08'.5 at 8h 19 01.4 C.H.W. (E+9")
(central horiz wire)

☉ app. L limb 8h 23m 50s (S+9")
Vern. 248 22 25 Compass 89°.41

Index Error. 0 and E. angle of depress. 1'.9. | Error in level circles 45" Index Error bub: zero pt to level 75"
0 " W " " Elev. 0'.4
Comp. about 90°. Level bubble extending equally.
(do not use)

app. upper limb 45 37.5 at 8 37 55.2 Comp 88°.47 (E+12")

Levels in depression of 1'.0 on vert. circle

N 3.7 / 3.7 Sun's Mer. E 5.0 / 2.5 (Comp 89°.9)
1.8

S 3.7 / 3.9 " " W 3.2 / 4.3 " 0.9
N high 0".6 E high 11".8

(Forward) S 4.3 / 3.0 True "

8°.53 AM

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Yerkes Compass Readings

Sig readings

1 Reduced Nov 8 – Dec computed
1 " " 9 " " "
1 " " " " " "

	Vernier ~~also~~		Compass		Compass Zero
also	248°	08.8 +	89	55.9 =	338° 03.8
		02.2	90	03 =	05.2
		22.4	89	41 =	03.4

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Approx. Lat. of Chulumani
Obs's of Nov 8.

Rdg on 2 Andromeæ at 8 52 30

Rdg of alt.	45°	04'.5
Corr. of hor. circles for high		+00.4
Refraction		−00.8
Altitude	45°	04'.1
Obs'd Zenith Dist	44	55.9
Corr. to true Z.D.		−02.0
True Z.D.	44°	53'.9
" Dec	28	30.0
	−16	23.9

2 Andromeæ +28°.5 Dec 0h 02m 51s.0
In Chulu. M. T. Dec 8h 48m 08s.2
Assuming a long. of 4h 27m W

La Paz

37	19.8	on δ Hydri at 30
	+00.2	S high
	−00.8	Refraction
37	19.2	altitude
52	40.8	Obs'd Zenith dist.

Dec δ Hydri −69 08.8
Lat La Paz −16 30.0
True Z.D. 52 38.8
2'.0
This diff. is due to index error in vert. circle when the mid. Hor. wire is used

N.B. From the method used in this survey
(1) the horiz. circles are limited independently by the suspended level
(2.) this fixes the zero point of the vertical circles
(3) From the above we know that when the vert. circle reads zero (the horiz. circles being level) the central horiz. wire points 02'.0 above the true horizon (level bubble tube)

as watch was 1m 30s behind local M time (see page 184) we have reading at 8h 52m 30s + 1m 30s = 8h 54m 00s,
Star found Merid at 8 48 08. or the Obs'n was made 5m 52s after merid. Passage

Error less than 1' from this.

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Chulumani Time Obsns.

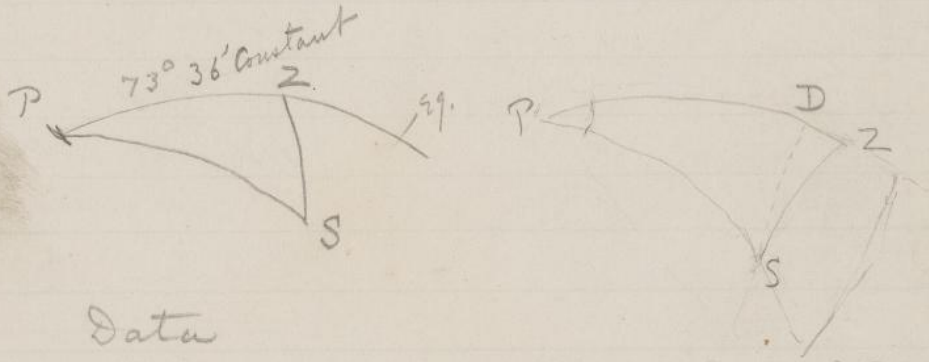
Nov. 9. 92.

							Level Cor
up. limb	40	52.- at	7	57	48.6.	(ε + 0.'1)	+ 0.'1
aff. do	39	02.2	8	10	11,8	ε + 0.'1	+ 0.'1
" "	41	05,5	8	19	01,4	ε + 0.'2	+ 0.'2
" "	45	37.5	8	37	55.2	ε + 0.'2	+ 0.'2

4 Time triangles

Lat. = -16.24

PZ = 73 36



Data

PZ			ZS			PS (=co-dec/hm)			Required ∠SPZ
73	36	00	53	23	12	72	54	35	
73	36	00	50	40	30	72	54	27	53° 07
73	36	00	48	34	00	72	54	18	
73	36	00	44	04	54	72	54	06	

Work out these four triangles

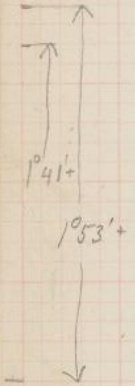
72	54	27	72	54	18	72	54	06
50	40	30	48	34	00	44	04	54
123	34	57	121	28	18	116	59	00
61	47	29	60	44	09	58	29	30
72	54	27	72	54	18	72	54	06
50	40	36	48	34	00	44	04	54
22	13	57	24	20	18	28	49	12
11	06	59	12	10	09	14	24	36

$\frac{PS+ZS}{2}$

$\frac{PS-ZS}{2}$

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1st 2D at $7^h\ 57.^m8$ = 53° 37'
" " 8 00.6 = 53° 25'
" " 8 15.0 = 49° 32'
" " 8 23.9 = 47 26

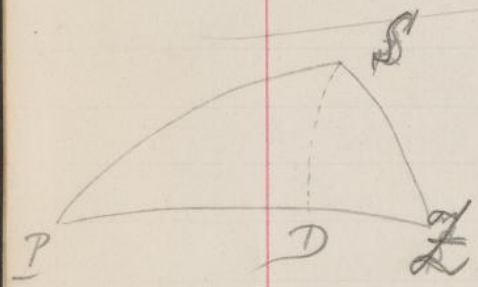
Cincinnati Obsn's An attempt to find the source of error in the first of these four observations.
The first ~~The fourth~~ Obsn had to be discarded.

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List of triangles to be solved for Lat & azimuth.

D. Watch	∠ Dist
8h 00m 38s	53° 25′
8 15 00	49 32
8 23 30	47 26



required angle at P

1/ $\text{tang}\frac{PZ}{2} : \text{tang}\frac{PS+SZ}{2} = \text{tang}\frac{PS-SZ}{2} : \text{tg}\frac{PD-DZ}{2}$

2/ $\frac{PZ}{2} + \frac{PD-DZ}{2} = PD$

3/ angle cos $SPZ = \text{tg}\, PD \cdot \cot PS$

$\text{tang}\, 36° 48' 00 : \text{tang}\, 63° 08' 54'' = \text{tang}\, 9° 45' 42'' : \text{tg}\frac{PD-DZ}{2}$

$\text{tg}\frac{PD-DZ}{2} = \frac{\text{tg}\, 63° 08' 54'' \cdot \text{tg}\, 9° 45' 42''}{\text{tg}\, 36° 48' 00}$

$\log \text{tg}\, 63° 08' 54'' = 0,295619$

$\log \text{tg}\, 9° 45' 42'' =$

$=$

$-\log \text{tg}\, 36° 48' 00 =$

$\log \text{tg}\frac{PD-DZ}{2} =$

$\frac{PD-DZ}{2} =$

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$$\operatorname{tg}\frac{PD-DZ}{2} = \frac{\operatorname{tg}\frac{PS+SZ}{2}\cdot\operatorname{tg}\frac{PS-SZ}{2}}{\operatorname{tg}\frac{PZ}{2}}$$

$\log\operatorname{tg} 61^\circ 47' 29'' = \bar{1},270525$
$\log\operatorname{tg} 11^\circ 06' 59'' = \bar{1},293336$
$\bar{1},563856$
$-\log\operatorname{tg} 36^\circ 48' 00'' = \bar{1},873957$
$\log\operatorname{tg}\frac{PD-DZ}{2} = \bar{1},689899$
$\frac{PD-DZ}{2} = 26^\circ 05' 24''$
$PD = 62^\circ 53' 22''$

$\operatorname{cos} SPZ = \operatorname{tg} PD \cdot \operatorname{cot} PS$

$\log\operatorname{tg} 62^\circ 53' 22'' = 0,290765$
$\log\operatorname{cot} 72\ 54\ 27 = \bar{1},487840$
$\log\operatorname{cos} SPZ = \bar{1},778605$
$SPZ = 53^\circ 05' 07''$

45° = 3h
8° = 32m
5° = 20s
7s = 0,5
3h 32m 20,5
8 10 11,8
11h 42 32,3

$\log\operatorname{tg} 60^\circ 44' 09'' = 0,251539$
$\log\operatorname{tg} 12^\circ 10' 09'' = \bar{1},333736$
$= \bar{1},585275$
$\log\operatorname{tg} 36^\circ 48' 00'' = \bar{1},873957$
$= \bar{1},711318$
$\frac{PD-DZ}{2} = 27^\circ 13' 20''$
$PD = 64^\circ 01' 20''$

$\log\operatorname{tg} 64^\circ 01' 20'' = 0,312246$
$\log\operatorname{ctg} 72^\circ 54' 18'' = \bar{1},487909$
$\log\operatorname{cos} SPZ = \bar{1},800155$
$SPZ = 50^\circ 51' 45''$

45° = 3h
5° = 20m
57' = 3m 24s
45s = 3s
3h 23m 27s
8 19 06,4
11h 42m 28,4

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log tg 58° 29' 30" = 0,212539
log tg 14° 24' 36" = $\bar{1}$,409835
= $\bar{1}$,622374
log tg 36° 48' 00 = $\bar{1}$,873957
log tg $\frac{PB - DZ}{2}$ = $\bar{1}$,748417
$\frac{PD - DZ}{2}$ = 29° 15' 42"
PD = 66° 03' 42"

46° = 3h 4m
08' = 32s
22" = 1,5s
3h 4m 33.5
8 37 55.2
11h 42m 28.7

log tg 66° 03' 42" = 0,352677
log cotg 72° 54' 06" = $\bar{1}$,487997
log cos SPZ = $\bar{1}$,840674
SPZ = 46° 08' 22"

Greenwich 15. 1893

11	42	29.8	Watch time of app. noon
+	16	00.7	Equation of time
11	58	30.5	Watch time of mean noon.

Estimated
Long LaPaz 13m 42s
LP to Chulu. 4 40
ang to Chulu. 18m 22s

Oct 30
Nov 12
13 days

Oct 30.
Nov 9
10 days

So mr Lun for watch correction - fast

(A) $20^m\ 49.^s6 + \frac{10}{13}\ 20.^s1 = 21^m\ 05.^s1$

or

(B) $17^m\ 49.^s6 + \frac{10}{13}\ 200.^s1 = 20\ 23.5$
1 29.5 Watch slow
Ang. 21 53.0 Chulu
13 41.6
LaPaz 8m 11.s4 Chulu,

this means 134 miles.

nat log 16° = $1 - \frac{1}{25}$

This puts Chulumani 81.8 miles east of LaPaz.

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To Face Page 184 (184a)

sept. 18. 1893

An error has been found in the determination of error of Dis watch for Nov 12. which will materially change the results of page 184

to replace part of page 184

~~So we have for watch correction~~ begin on page 185

From page 147

We may consider Dis Watch as follows.

Oct 30 d 8 h 45 m fast 49.6 ← 20m

Nov 12 d 8 h 38 m fast 01.3 ↑17m ↓ or slow 2m 58.7 according as the watch was turned ahead 17m or 20m 00s (uncertain)

So we have for watch correction

(A) $+ 20^m\ 49.6^s - \frac{10}{13}\ 228^s.3 = + 17^m\ 54^s.0$

(B) $+ 17^m\ 49.6 - \frac{10}{13}\ 48.3 = + 17\ 12.4$ (most prob)

	A		B		
	$+17^m$	$54^s.0$	$+17^m$	$12^s.4$	
Watch slow	1	29.5	1	29.5	
	19	23.5	18	41.9	Long. La Chulumani.
	13	41.6	13	41.6	Long. La Paz
	5^m	$41^s.9$	5^m	$00^s.3$	La Paz & Chulumani

Estimated distance $4^m\ 40^s$. Therefore adopt (B) as from recollection also it was more probably page 166.

Long La Paz 4 31 50.9

5 00.3 East

Long Chulumani 4 26 50.6 West from Greenwich.

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28.9
28.7 | 1.1
89.4 | 50
1.57

11 42 29.8 watch time of App. noon
−16 00.7 Equation of time
11 26 29.1 Watch time of Mean noon.

from page 147

We may consider the watch as follows
Oct 30 fast 49.6 — 17m
Nov 12 fast 1m 09.7 / 20m or fast 4m 09.7
in Augusta time

12 00 00
11 26 29.1
33 30.9 Slow ← that seems about 15m too much.

(Sign for Equation of time is (probably) wrong. See off-page)

A	B
fast 49.6	fast 49.6
to Slow 2 58.7	to fast 01.3
Loss 3m 48.3	Loss 48.3
= 228.3	

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Eclipse work.

Mon. April 10 1893
at Agua Amarga

		R.A.
☆ 41 Leo Min.	325.2 at 31^m 00	10h 37
☆ δ^2 Chamaelon.	564.3 at 40 —	10h 44

239.1
20.43 for 1.d0

7173
9564
4782
60 | 4884.813
8 ~~0~~ 24″

1° 21′ 24″ = dif in alt.

41 Leo Min	δ^2 Cham.
+23 44 54	-79 58 34″
− 02″	+13″
23 44 52	-79 58 47 higher
	+ 1 21 24
	81 20 11

δ Leonis 11 08	β Cham. 12.12
+21 06 35 Jan 0	-78 43 04 Jan 0
21 06 33 Apr 19	-78 43 17 Apr 19
Cor −02″	Cor +13″

81 20 11
23 44 52
5~~8~~ 35 19
28 47 40

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Eclipse work

Δ 41 Leo Min crossed the meridian at 9 31 00 watch time April 9

9	31	00	1	11	49
4	43	−	9	31	00
14	14			2	20
			10	45	09
		Star due	10	37	37
		Δ watch		7^m	32^s fast

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Collimation Error of Theodolite.

Check Obsns taken March 19, 1893

~~Mic~~

on star near south horizon ○Canopus

◎ Big Mg. Cloud

↑
•
↓

Horizon

Obs' on lower culmination

Time	Circle Readings		Reduced		
11 46 20.6	236° 24′ 41″		(1)	50 19	Diff equals 55″ or twice the coll. error corrected for alt of star observed.
" 50 16.5	" 36 10	Reversed	(2)	49′ 24″	
" 54 28.0	" 50 19		(3)	50 19	
" 58 15.0	" 61 20	Reversed	(4)	49′ 24″	
" 61 06.0	" 71 15		(5)	50 19	

	A		B		C	
54m 28.5	50′ 19″	61 06.0	71 15	58 15.0	61 20
46 20.6	24 41	54 28.0	50 19	50 16.5	36 10
8m 07.5	25′ 38″	6 38.0	20 56	7 58.5	25 10
= 487.5	1538″	= 398.0	1256″	478.5	1510″
per second.	3.″1555		3.″1557		3.″1557

Mean is 3.″1557

To reduce all to the instant of (3), (1) & (5) reduce to (3) as it stands (within less than 0.″5)

54m 28.5	58 15.0
50 16.5	54 28.0
4m 11.5	3 47.0
= 251.5 makes	= 227.0 makes
+13′ 14″	− 11 56
+36′ 10″	+ 61 20
= 49 24″	49′ 24″

On running the CW cam to the ~~left~~ r. h. collimation error makes southern stars on upper culminat. come too ~~late~~ early. Correction therefore subtractive for such stars. This agrees with former Obsns.

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Collimation error of theodolite.

Obs^ns of March 19. 1893

Put κ = collimation error

~~Obs^n giving alt α, $\kappa' = \kappa \cos \alpha$~~

by this method 2κ will be the arc measured. At a given alt. α, 2κ will produce a change in the horizontal angle of $\frac{2\kappa}{\cos \alpha}$ which is this 55" already found. Hence:-

$$\frac{2\kappa}{\cos \alpha} = 55''$$

$$\kappa = 27.''5 \cos \alpha$$

$$\alpha = 4^\circ\ 23'.5 \text{ or } 4.^\circ 4$$

Nat cos $4.^\circ 4 = 0,997$

Then Coll error is 27" - March 19. 1893
This error was 33" Jan 23 "
Mean 30"

Collimation Error

Av. Resid 3"

N.B. The times here given (i.e. for this coll. error, for the error in horiz. axis, & for calibration of Grad. screw) are approx. Arg. Mean times. The hour & min, were taken from watch & the sid. pendulum was used to give the signals. The sidereal clock time was not used as the Ladds had been Taken off for repairs.

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390 Constant hird error of horizontal axis.

Obs^ns March 19. on α Crucis.

Time (approx, A.M.T.)						
12	17	22,7	236	16	48	(1)
	21	15,0	235	38	29	Rumed (2)
	26	16.9	234	51	31	(3)
	29	14.3	234	21	43	Reversed (4)
	32	17.5	233	53	53	(5)

Position of α Crucis = 12^h 20,^m5 × −62° 30′ / 3D = 62 30 − 16 22 = 46.0′
On March 19, 12^h 26 M.T. would by about 12^h 18^m S.T. Alt = 43° 52′
Then for α Crucis passed the meridian not far from the middle of these Obs^ns

26	16.9	234	51	31	32	17.5	233	53	53	29	14.3	234	21	43
17	22.7	236	16	48	26	16.9	234	51	31	21	15,0	235	38	29
8	54.2	7	85	17	6	00,6		57	38	7	59.3	1	16	46
534.2		51 17″			360.6		3458″			479.3		4606		
4 27.1														
Per Second of time		9.″5788			3	00.3		9.″5895		3	59.6		9.″6098	
at 21^m 49.8					at 29^m 17.2					at 25^m 14.6				

approx Solution

Assume that (1)+(5) will reduce to (3) Then reduce (2)+(4) to (3) using the rate obtained on (2)+(4) 9.″6098

26	16.9	235	38	29	29	14.3	234	21	43	of course useless.
21	15,0	48	21		26	16,9		28	25	
5	01.9	234	50	08	2	57.4	234	50	08	
301.9					177.4					

51′ 31″
Rumed 50 08
1 23 = 83″ / i.e. on being rumed the star came later by an azimuth of 83″

This error is in the same direction as the Collim. error & must be lessened by that to produce the hird error in Az therefore

2. hird error at alt 43°52′ = 83″ − .54″ / Cos 43°52′

this leaves a very small hird error

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Level Error of Horiz. Axis.

The former determination of this error was made by a small standing level which seems to be very inaccurate. Of it $l_0 = 41.''2$.

The former readings were

		Rdg.	Hor Circles	Perp adj. of level	Hor. error of horiz. axis
Circle W —	A	2,0	W + 0,1	B + 0.4	Circle + 1,3
	B	1,0 E	" 0.1	" 0,3	" 1.4
" E —	A	1.9		" 0,3	
	B	1,1 W			
	A	0,9 W	W + 0,2	" 0,2	" 1.0
" E —	B	2,2		1.2	" 1,1
			" 0.2	2 0.3	8
	A	0,7 E	Mean W + 0.15	B + 0,15	1.2
" W —	B	2,4	.08		Circle + 0.6
	A	0,7 E	W + 0.1	B + 0,4	Circle + 1,3
" W —	B	2.4	" 0.1	" 0,5	
	A	0,8 W		" 0,4	" 1.2
" E —	B	2,3			
				" 0,4	
	A	1,9	W + 0.1	4 1.70	" 1.1
" E	B	1,2 W	" 0,0	2 0.43	" 1.1
	A	2,0		B + 0,21	4 .7
" W	B	1,2 E	Mean W + 0.08	.15	1.175
			above, 2 0.22	2 3.6	.588
			2 0.11	B + 0.18	60
			W + 0.06		1.188
					.594
					Circle + 0.6

	Proof		Corrns		result	
41,2	Circle W — A	2,00	− 0.08	+ 0,15	2.07	1.14
0.6	E B	1,00	+ 0.08	− 0,15	0.93	1.24
24,72	A	1,90	+ 0.08	+ 0.15	2.13	1.16
" E — W	B	1.10	− 0,08	− 0,15	0,87	1.26
25"	W A	0,9	− 0,08	+ 0,15	0.97	1.20
" E —	B	2,2	+ 0.08	− 0.15	2.13	.60 as above
	E A	0,7	+ 0,08	+ 0,15	0.93	
" W —	B	2,4	− 0,08	− 0.15	2.17	

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Level Error of Horiz. Axis

This error of W + 2.5" may be quite uncertain for :-

Error of horiz. circles comes out W + 0.d06
which is W + 2".5 At the same time
by the suspended level we had
W + 0.d044 (of susp. level) = W + 0".6

Now since

Inequality in pivots should make no diff. see below.

1st The hor. axis was not reversed in the V's to test for inequality of pivots which might explain a considerable error, and

2nd there may be an error in the result on the level of the horiz. circles, we may say that this method is known likely to be at fault than the former because such a poor level was used on Jan 23.

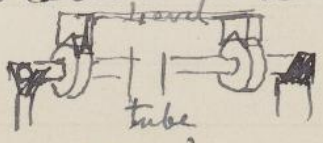
Coll. error ±7".

Double do 5-4" log = 1.732394
log cos 43° 52' = 1.857908
log double do at alt 43° 52' = 1.874486
do do = 75"

Double Coll. error at alt 43°52' = 75" Horiz. Angle.

The method of Jan 23, employed a poor level on bearings whose exact position with reference to the axis of rotation could not be certified.

Therefore it probably deserves less weight than the later method.



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Level Error of Horiz Axis

On page 190 we used (2), (3), & (4) Now try (1) (2) & (3). Rate of change per Sec = 9."5788

2/m 15.0

17 22.7 ⟷ 236 16 48

3 52.3 = 232.3 at 9."5788 = 37' 05"

235 39 43

235 38 29

1 14 = 74"

Try (3) (4) & (5)

29 14.3

26 16.9 ⟷ 234 51 31

2 57.4 = 177.4 at 9."5895 = 28' 21"

234 23 10

234 21 43

1 27 = 87"

So we get

74"	1
83"	2
87	6

$3\overline{)15}$ & $\frac{5}{81} = \frac{1}{16}$ Probable error

(or 3")

average 81" minus 75" leaves 6" due to error in level of horizontal axis at alt 43° 52'

Suppose we have a level error l_2 at zenith. At alt 43°.52 its effect is $l \sin 43°52'$. Now then this distance at this alt. when measured on horiz. circles ~~becomes~~ makes a larger angle or $l \frac{\sin 43°52}{\cos 43°52}$ or altogether $l \tan 45°52'$

Hence $3'' = l \tan 43°52'$ or $l = \frac{3''}{\tan 43'52''}$

$\log 3 = 0.477121$

$\log \tan 43°52' = \overline{1.982814}$

0.494307 or 3."1

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Level error of Horiz. axis,

Trials

Old method - circle and high 25"

New do do do do 03"

Average: Circle and high ~~14"~~ see below

This value greatly helps the Obs^ns at Puno & La Paz

Therefore:

Old { Collimation error is reduced from 33" to 30"

~~Level. horiz. axis~~ " " " " 25" to ~~14~~"

Sept 18.93

taking Level method in 1/2 conflicts we get

~~+3~~ 0.68 + .085

0.5~~2~~ - .075

0.63 + .035

0.55 - .045

4 | 38 4 | 240

.595 .060 or Av. Resid of 1/10

by other method it was 1/16

By allowing something for uncertainty of centering of level bearings (see foot of page 182) we may adopt the ratio of Wt 2 for the later method (by stars & Obns) & 1 for the former method. - Old method Circle and high 25"

New " " " " 3 } Wt 2

" " " " " 3 }

3 | 31

Average. " " " 10"

N.B. Level error of Horiz. axis

Av. Resid 10"

The effect then of putting in a level error of 10" with by its size be a direct indep of the accuracy of the meth,

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Fraclinter Screw

Observations March 19. 1893 Work May 23. 1893 +c

Levels.

N 8.1 3.4 N + 1.1 1.2 Σ 11.15 d 0.58

S 7.0 4.6 N + 0.58

E 6.6 5.0 W + 1.8 2.0 3.8 1.9 d 0.95

W + 0.95

On β Centauri Dec −59° 51′
2 Cent. " −60 23
2 Tri. Austr. −68 50

Mean Time to reduce to Sid. Time subtract 2m 9h 28

Time	Sec's by sid. clock	Rdgs/Sc.	
9h 44	49.8	0.00.0 − 0.2	
46	14.0	30.8	= 27°.58′.4
48	25.0	76.2	
49	20.7	95.2	
50	21.4	116.5	Star has moved to next vert. wire
		Intival — I do other work	
10 21	13.3	116.5	on Cent. Vert. Wire approx Id = 20.35
22	25.4	140.9	
24	22.9	180.3	
25	11	— Crossed outer vert. wire	
26	30	" Central " "	
27	14.1	236.3	
28	13.0	255.7	
29	08.0	274.1	
30	15	Crossed outer left wire	
30	30	" " right "	
31	15.0	315.9	
32	13.5	334.3	
33	08.5	352.6	
34	06.7	371.8	
35	07.2	391.3	
36	20.2	416.1	
37	07.0	430.3	
		491.5	
		509.1	

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1892phae.proj..389b

Gradienter Screw

2

Time	Sec's by Clock	Rdg's of Sc.
10h 37m	42	Crossed outer Left wire
39	02	" " Right "
40	12.9	491.5
41	06.0	509.1

10 45 Levels :-

N — 7.1 / 4.3 N + 1.5 / 1.7 / 1.6

S — 5.6 / 6.0 N + 0.80

E — 3.3 / W 8.1 W + 6.2 / 6.2 / 6.2

W — 9.5 / E 1.9 W + 3d.1

β Centauri

α Centauri

10 55 Levels :-

N — 6.9 / 4.6 N + 1.2 / 1.1 / 1.15

S — 5.7 / 5.7 N + 0d.58

E — 2.7 / 8.7 W + 7.0 / 7.0 / 7.0

W — 9.7 / 1.7 W + 3d.5

Star now used.

~~α Centauri~~ β Trianguli Australis

Time	Sec's	Rdg's.
11h 10m	22	Outer right wire
11	33.0	512.4
12	19.2	526.9
13	18.9	546.6
14	09.3	564.1
15	06.8	582.0
16	09.0	602.7
17	25.3	627.8
18	08.7	642.2
19	09.2	662.9
20	13.2	682.9
21	15.0	703.3

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Gradienter Screw

3

Time	Sec's by Sid. Clock	Rdg f Sc.	
11h 22	14.0	723.1	after 1d = 16.815
23	10.1	741.1+	
24	15.2	763.3	
25	12.1	780.6	
26	17 –	Crossed outer Left wire	
26	30	" " Right "	
27	29.2	825.3 (?) or (?)	?.
28	16.0	840.3	This is prob wrong, this + the next give after 1d = 15.52
29	32.2	866.2 –	
30	21.4	880.9	
31	02.1	894.0 –	after 1d = 15.64
32	13.9	918.1	
33	08.6	934.3 –	C.W. also
34	16.8	956.9 –	
35	09.9	973.9	
36	16	Crossed 4th Wire	

11 40 Levels:–

N – 5.9 N + 1.0 / 5.6 / 1.1 / 4.05

E – 1.4 W + 7.8 / 10.1 / 8.0 / 7.9

S – 4.9 N + 0.53 / 6.7

W – 9.2 W + 3.95 / 02.1

β Centauri 13h 56m 17.9s x – 59° 51′ 24.″8

β Tri. Austr. 15 45 44.1 x – 63 05 57.0

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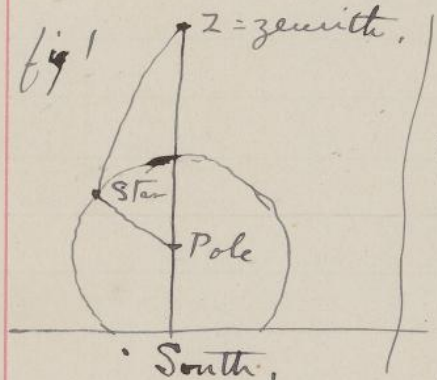
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Thurs. Sept. 28., 1893

Gr. Lc.
Formulas for reducing Obsns

In reducing the preceding observations we have the following problem:-

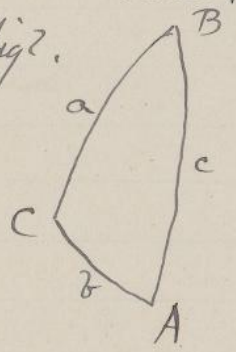
fig 1



$ZP = Co\ Lat$. given
$SP = Co\ Dec$ "
ZPS = hour angle " but varying
ZS is required, or rather the change in ZS.

Now

fig 2.



In fig 2. we have

(1) $\cos a = \cos b \cos c + \sin b \sin c \cos A$

$\cos b \cos c = K$

$\sin b \sin c = k$ then

$\cos a = K + k \cos A$ differentiating

$-\sin a\, da = -k \sin A\, dA$. or

$$(2)\quad da = \frac{k \sin A}{\sin a}\, dA.$$

Therefore

Using formula (1) solve for value of a at

9h	40m	} β Centauri
9	50	
10	20	
10	41	
11	10	} β Tri. Austr.
11	22	
11	35	

Plot these in a curve.
Plot on the same paper the value of A.

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Page 200a ~~III~~ page 200a



c (constant) = 73° 37′ 51″

b (constant) = 90° − Dec of star.

A variable = hour angle East.

Two stars observed

β Centauri	13^h	56^m	$17.^s9$	−59° 51′ 24.″8
β Triang. Austr.	15	45	44.1	−63 05 57.0

Observations made at

Sid. Time $9^h\ 38^m\ 00$
$9\ 48\ 00$
$10\ 18\ 00$
$10\ 39\ 00$
} On β Centauri.

" $11\ 08\ 00$
$11\ 20\ 00$
$11\ 33\ 00$
} On β Triang. Austr.

Required: value of a at each observations.

Formula:- $\cos a = \cos b \cos c + \sin b \sin c \cos A$.

In above triangle, B is the zenith

A " " South Pole

C " " Star.

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page 200 2

For each value of a, computed, and of A used compute the following:-

$$da = \frac{\text{Sin } b \text{ Sin } c \text{ Sin } A}{\text{Sin } a} dA.$$

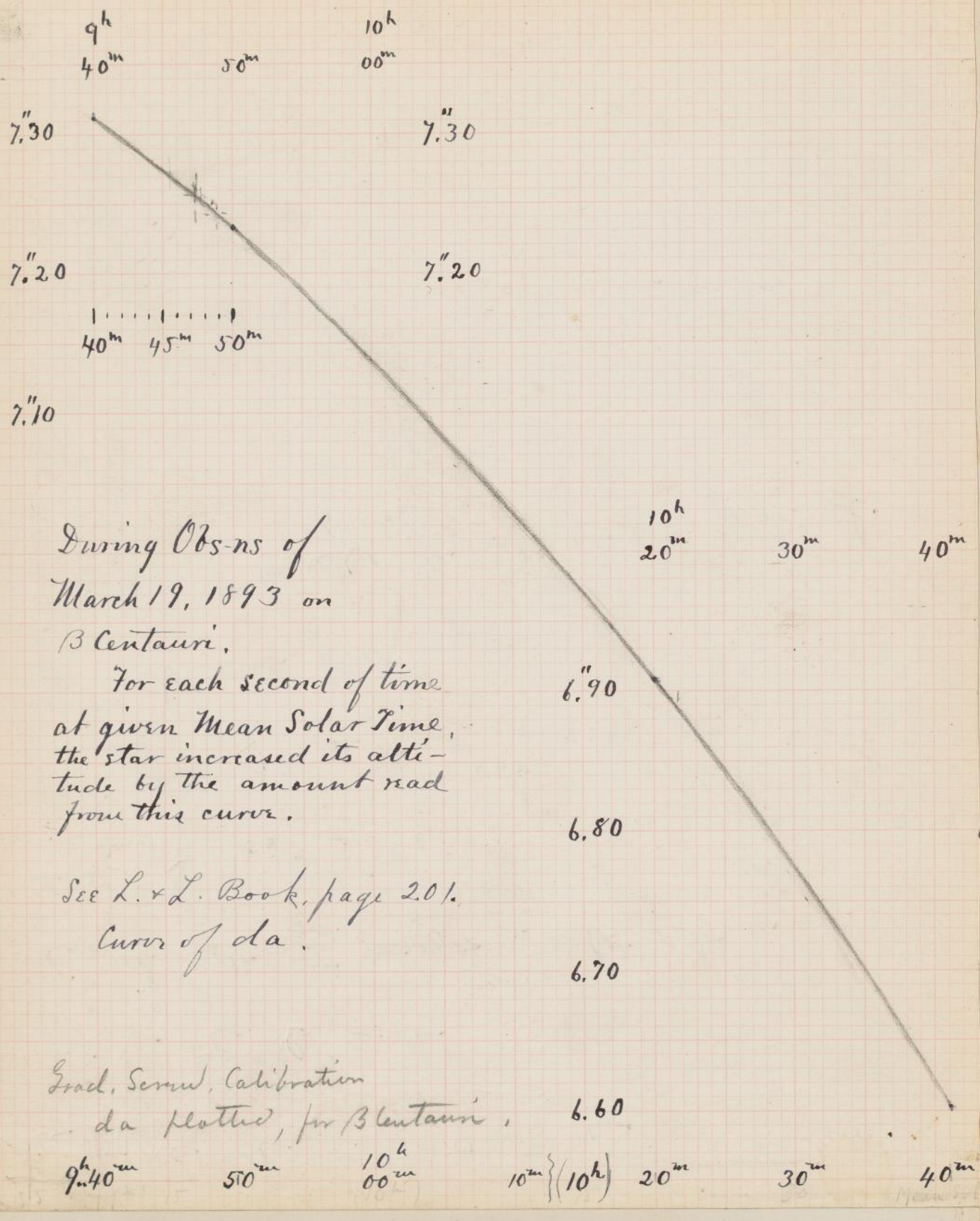
in which $dA = 15'' = 1.^{s}0$

Arrange the whole in the form of a table, thus:-
or fill in this table as it stands

Sid. Time.	Mean Sol Time	A	a	da
9 38 00	9 40 00	64 34 29	63 13 11	7.″3113
9 48 00	9 50 00	62 04 29	62 00 27	7.2316
10 18 00	10 20 00	54 34 29	58 25 01	6.9094
10 39 00	10 41 00	49 19 29	56 06 00	6.6037
11 08 00	11 10 00	69 26 02	66 10 56	6.6644
11 20 00	11 22 00	66 26 02	64 51 23	6.5923
11 33 00	11 35 00	63 11 02	63 26 16	6.4945

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During Obs-ns of March 19, 1893 on β Centauri.

For each second of time at given Mean Solar Time, the star increased its altitude by the amount read from this curve.

See L. & L. Book, page 201. Curve of da.

Grad. Screw. Calibration da plotted, for β Centauri.

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1892phae.proj..389D

Sat. Sept 30. 93

	B Cent	B Tri. Aust.
Dec B Centauri	−59 51 25	−63 05 57
b = Co Dec	30 08 35	26 54 03

c = 73° 37′ 51″

log Cos b = T. 936903	log Sin b = T. 700843
" Cos c = T. 449980	log Sin c = T. 982030
" Cos b Cos c = T. 386883	log Sin b Sin c = T. 682873
Cos b Cos c = 0.243716	

R.A.	13 56 17.9	13 56 17.9	13 56 17.9	13 56 17.9
	9 38 00.0	9 48 00.0	10 18 00.0	10 39 00.0
	4 18 17.9	4 08 17.9	3 38 17.9	3 17 17.9
Red to (°)s	60° 00′	60	45	45
	4 30′	2 00	9 30	4 15
	04 29″	4 29	4 29	04 29
A =	64 34 29	62 04 29	54 34 29	49 19 29
log Sin A	T. 955758	T. 946236	T. 911089	T. 879907
" Sin b Sin c	T. 682873	T. 682873	T. 682873	T. 682873
" Sin a	T. 638631	T. 629109	T. 593962	T. 562780
" 15	T. 950725	T. 945965	T. 930612	T. 919085
	T. 687906	T. 683144	T. 663350	T. 643695
	1. 176091	1. 176091	1. 176091	1. 176091
log Cos A	T. 632795	T. 670542	T. 763159	T. 814095
" Sin b Sin c	T. 682873	T. 682873	T. 682873	T. 682873
" 2nd term	T. 315668	T. 353415	T. 446032	T. 496968
2nd term	0. 206856	0. 225640	0. 279275	0. 314028
+ 1st term	0. 243716	0. 243716	0. 243716	0. 243716
Sum =	0. 450572	0. 469356	0. 522991	0. 557744
log Sum =	T. 653764	T. 671501	T. 718494	T. 746435
a =	63° 13 11	62 00 27	58 28 01	56 06 00
log d a	0. 863997	0. 859235	0. 839441	0. 819786
d a	7. 3113	7. 2316	6. 9094	6. 6037

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202

Calibrating
Cir. Sc.
Alt

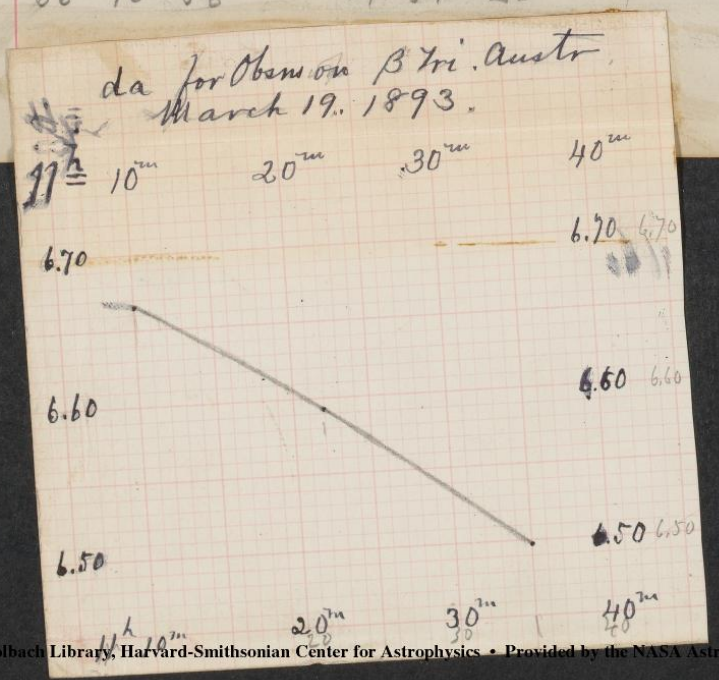
Sat. Sept 30. 93

Dec β Tri. Austr. −63 05 57
z = Co Dec 26 54 03
c = 73 37 51

log Cos b = T. 950263
" Cos c = T. 449980
" Cos b Cos c = T. 400243
Cos b Cos c = 0,251330

log Sin b = T. 655568
" Sin c = T. 982030
" Sin b Sin c = T. 637598

	15 45 44.1	15 45 44.1	15 45 44.1
	11 08 60.0	11 20 00.0	11 33 00.0
	4h 37 44.1	4 25 44.1	4 12 44.1
A =	69° 26 02	66° 26 02	63° 11′ 02″
log Sin A =	T. 971400	T. 962180	T. 950588
" Sin b Sin c =	T. 637598	T. 637598	T. 637598
" 15 =	1,176091	1,176091	1,176091
	0,785089	0,775869	0,764277
" Sin a =	T. 961342	T. 956766	T. 951556
" d a =	0.824747	0.819103	0.812721
d a =	6.66 5.577 6.6642	5,4030 6.593	5,1980 6.497
log Cos A =	T. 545663	T. 601850	T. 654301
" Sin b Sin c =	T. 637598	T. 637598	T. 637598
" 2nd part =	T. 183261	T. 239448	T. 291899
2nd part =	0,152497	0,173559	0,195839
1st part =	0,251330	0,251330	0,251330
Sin a Cos a =	0,403827	0,424889	0,447169
log Cos a =	T. 606196	T. 628276	T. 650472
a =	66 10 56	64 51 23	63 26 16



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Calibrating Sr Sc. Method.

Sunday, Oct. 1. 1893

I find that the error in altitude involved in allowing the star to move along the horizontal wire is of no importance.

Method In general we shall multiply each interval (between two obsns) by the reading from the plotted curve for mean time of center of intervals and divide the result by the difference in screw readings. This will give us the value of 1d.00 at the mean point of the two readings. This makes the results differential and avoids accumulation errors.

Level error During the series on β Centauri there was a distinct change in level ~~which was~~ N.B. The level readings should have been made in line with the star & at right angles to it. All ~~change~~ in level will have to be accounted for but perhaps this can be done with better judgement after the curve of the screw is plotted. ~~A break in the curve at 116d will show where the change in level is.~~ It is most likely that changes in level took place when the horiz. axis was being unclamped or clamped. That is, the chances are that these changes of level will not affect the computed values of a second division.

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1892phae.proj..3890

Forms for calib.g
R. Ac.,
Reductions

Sunday. Oct. 1, 93

Calibrating the Brachistus Screw
Reduction of Observations.

Series on β Centauri:

9h 28m Limbs N + 0d.56 W + 0d.95

	Mean Solar Time	Sec.	Gr. Scr.	d a	
9	44	49,8	−000,2 →	7.″270 √	Log 7.270 = 0.861534
	Int.	84.2	31.0	612″.0	" 84,2 = 1.925312
		42,1	15,5		Colog 31,0 = $\bar{2}$.508638
	45	32.9	at 015.3	1d.0 = 19.746 √	Log 1d.0 = 1.295484
	46	14,0	+ 030,8	7.256 √	Log 7.256 = 0.860697
		131.0	45.4	950.4	" 131,0 = 2, 117271
		65,5	22.7		C$_0$ " 45.4 = $\bar{2}$, 342944
	47	19.5	at 053,5	1d.0 = 20,937 √	" 1d.0 = 1.320912
	48	25.0	076.2	7,243 √	Log 7,243 = 0,859918
		55.7	19.0	403.5	" 55,7 = 1,745855
		27.9	9,5		C$_0$ " 19.0 = $\bar{2}$, 721246
	48	52.9	at 85.7	1d.0 = 21.233 √	" 1d.0 = 1.327019
	49	20,7	095,2	7.234	Log 7.234 = 0,859379
		60.7	21.3		" 60.7 = 1,783189
		30.4	10.7	439.0	C$_0$ " 21.3 = $\bar{2}$, 671620
	49	51.1	at 105,9	1d.0 = 20.615	" 1d.0 = 1.314188
	50	21,4	116,5		

9.50 to 10.21
Interval

Interval, next on star.

10	21	13.3	116,5	6,885	Log 6,885 = 0,837904
		72.1	24.4	496.3	" 72,1 = 1,857935
		36.1	12,2		C$_0$ " 24,4 = $\bar{2}$,612610
	21	49 4	at 128.7	1d.0 = 20.345	" 1d.0 = 1,308449
	22	25,4	140,9		

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1892phae.proj..389D

Sun. Oct. 1. 93

Series of Obns on β Cent. for Calibrating Sr. Sc.

		Seconds	Sr. Sc				
M. S. T.		~~25.4~~					
10	22	~~54.5~~	140.9	6.864	log 6.864	= 0.836577.	
	2	117.5	39.4		" 117.5	= 2.070038	806.5
		58.8	019.7		Co " 39.4	= $\bar{2}$.404504	
	23	24.2	160.6	1.0^d = 20.47	" 1.0^d	1.311119	
	24	22.9	180.3	6.831		log 6.831 = 0.834484	
10.26+ Changed hor. Tan screws	2	171.2	056.0		1169.5	" 171.2 = 2.233504	
		85.6	028.0			Co " 56.0 = $\bar{2}$.251812	
	25	48.5	208.3	1.0^d = 20.88		" 1.0^d = 1.319800	
	27	14.1	236.3	6.806		log 6.806 = 0.832892	
		58.9	019.4		400.9	" 58.9 = 1.770115	
		29.5	009.7			Co " 019.4 = $\bar{2}$.712198	
	27	43.6	246.0	1.0^d = 20.66		" 1.0^d = 1.315205	
	28	13.0	255.7	6.793		log 6.793 = 0.832062	
		55.0	018.4		373.6	" 55.0 = 1.740363	
		27.5	009.2			Co " 018.4 = $\bar{2}$.735182	
	28	40.5	264.9	1.0^d = 20.31		" 1.0^d = 1.307607	
10.30.4 Changed hor. Tan screw	29	08.0	274.1	6.772		log 6.772 = 0.830717	
		127.0	041.8		860.0	" 127.0 = 2.103804	
		63.5	20.9			Co " 41.8 = $\bar{2}$.378824	
	30	11.5	295.0	1.0^d = 20.58		" 1.0^d = 1.313345	
	31	15.0	315.9	6.749		log 6.749 = 0.829239	
		58.5	018.4		394.8	" 58.5 = 1.767156	
		29.3	009.2			Co " 18.4 = $\bar{2}$.735182	
	31	44.3	325.1	1.0^d = 21.46		" 1.0^d = 1.331577	
	32	13.5	334.3	6.734		log 6.734 = 0.828273	
		55.0	018.3		370.2	" 55.0 = 1.740363	
		27.5	1009.2			Co " 18.3 = $\bar{2}$.737549	
	32	41.0	343.5	1.0^d = 20.23		" 1.0^d = 1.306185	
	33	08.5	352.6				

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1892phae.proj..3890

206

Sr. Sc.

End of Obsns

Sunday, Oct 1. 93

Series of Obsns on β Cauh for calibrating Sr. Sc.

10	33	08,5	352,6	6,721		Log 6,721 = 0,8274
		58.2	019.2		391.1	" 58,2 = 1,7649
		29.1	009.6			G " 19,2 = $\bar{2}$,7167
	33	37.6	362.2	$1,0^d$ = 20,37		" $1,0^d$ = 1,3090
	34	06,7	371.8	6,704		Log 6,704 = 0,8263
		60,5	019.5		405.6	" 60,5 = 1,7818
		30,3	009.8			G " 19,5 = $\bar{2}$,7100
	34	37,0	381,6	$1,0^d$ = 20,80		" $1,0^d$ 1,3181
	35	07,2	391.3	6,688		Log 6,688 = 0,8253
		73,0	024.8		488,2	" 73,0 = 1,8633
		36,5	012.4			G " 24,8 = $\bar{2}$,6055
	35	43,7	403.7	$1,0^d$ = 19,68		" $1,0^d$ 1,2941
	36	20,2	416,1	6,673		Log 6,673 = 0,8243
		46,8	014,2	In place of these two we could adopt $1,0^d$ = 20,84 at 413.5	312,2	" 46,8 = 1,6702
		23,4	007,1			G " 14,2 = $\bar{2}$,8477
	36	43,6	423,2	$1,0^d$ = 21,99		" $1,0^d$ = 1,3422
10.38.5 Changed to Sidy. Tau Serum	37	07,0	430,3	6,641		Log 6,641 = 0,8222
		185,9	061,2		1234,5	" 185,9 = 2,2693
		92,9	030,6			" 61,2 = $\bar{2}$,2132
	38	39,9	460,9	$1,0^d$ = 20,17		" $1,0^d$ = 1,3047
	40	12,9	491,5	6,609		Log 6,609 = 0,8201
		53,1	017,6		350,9	" 53,1 = 1,7251
		26,6	008,8			G " 17,6 = $\bar{2}$,7545
	40	39,5	500,3	$1,0^d$ = 19,94		" $1,0^d$ = 1,2997
	41	06,0	509,1			

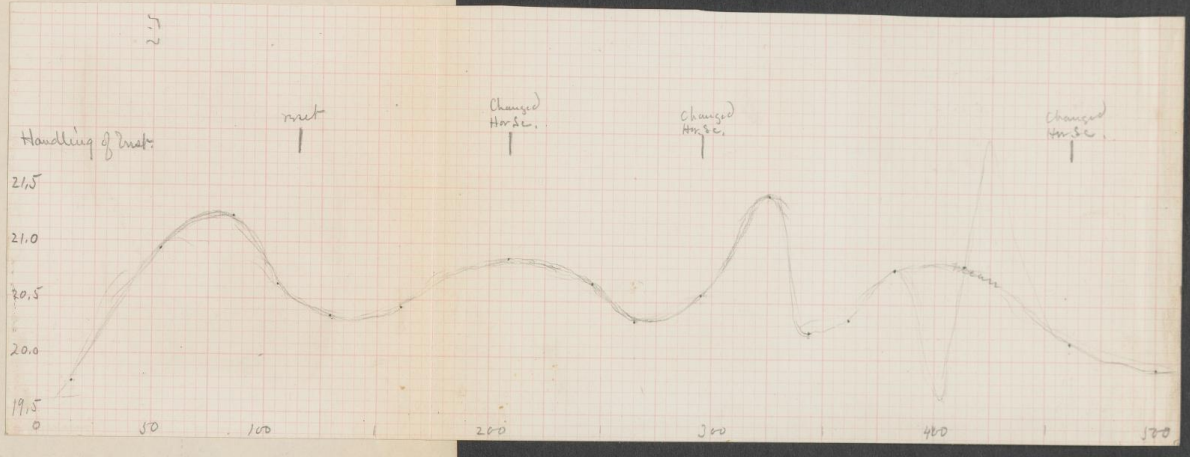
10.45 Levels: r + $0,^d80$ W + $3,^d10$

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Div. values 0 to 500.0

Tuesday. Oct. 3, 93

Ch	1/1.0 =
015.3	19.75
053.5	20.94
085.7	21.23
105.9	20.62
128.7	20.35
160.6	20.47
208.3	20.88
246.0	20.66
264.9	20.31
295.0	20.58
325.1	21.46
343.5	20.23
362.2	20.37
381.6	20.80
413.5	20.84
460.9	20.17
500.3	19.94



9.50 to 10.21 Interval.
10.26+ Changed hor. Tan. screw.
10.30.4 changed hor. Tan. screw.
10.38.5 changed hor. Tan. screw.
9h 28m levels N+7.598 W+12.445
10h 45m levels N+10.48 W+40.61

1 div. on level = 13.1

13.1		13.1	
.58		.95	
1048		655	
655		1179	
7.598		12.445	
13.1		13.1	
.80		3.1	
10.480		13.1	
		393	
		40.61	

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1892phae.proj..389D

Wed. Oct. 4. 1893

Last half of series.

Series on β Trianguli Australis.

10 55 Runs. N + 0ᵈ,37 W + 3ᵈ,50

11.	11	33.0	512,4	6,655		0,8232	2,4878
		46.2	014.5			1.6646	1.1614
		23,1	007.3			2,4878	1.3264
	11	56.1	519.7		27.20	307.″5	
	12	19,2	526.9	6.650		0.8228	2,5988
		59.7	19.7			1.7760	1,2945
		29.9	09.9			2,5988	1.3043
	12	49.1	536,8		20,15	397.″0	
	13	18,9	546.6	6.643		0,8225	2,5249
		50.4	17.5			1,7024	1,2430
		25,2	8.8			2,5249	1.2819
	13	44.1	555.4		19,14	335.″0	
	14	09.3	564,1	6.638		0,8221	2,5818
		57.5	17.9			1,7597	1,2529
		28,8	9.0			2,5818	1.3289
	14	38.1	573.1		21,35	381.″7	
	15	06.8	582.0	6.632		0,8216	2,6154
		62.2	20.7			1,7938	1,3160
		31.1	10.4			2,6154	1,2994
	15	37.9	592.4		19,92	412.″5	
	16	09,0	602,7	6.626		0,8213	2,7038
		76.3	25.1			1.8825	1,3997
		38,2	12,6			2,7038	1,3041
	16	47,2	615,3		20,15	505.″5	
	17	25,3	627.8				

Mean 20,25

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Gr Se
Red. 4 Obns

Wed. Oct. 4. 93

17	25.3	627.8	6.620	0.8209	2.4584
	43.4	14.4		1.6375	1.1584
	21.7	07.2		2.4584	1.3000
17	470	6350	19.95	287.3	
18	08.7	642.2	6.614	0.8205	2.6023
	60.5	20.7		1.7818	1.3160
	30.3	10.4		2.6023	1.2863
18	390	652.6	19.33	400.2	
19	09.2	662.9	6.608	0.8201	2.6263
	64.0	20.0		1.8062	1.3010
	32.0	10.0		2.6263	1.3253
19	412	672.9	21.15	423.0	
20	13.2	682.9	6.600	0.8195	2.6105
	61.8	20.4		1.7910	1.3096
	30.9	10.2		2.6105	1.3009
20	44.1	693.1	19.99	407.8	
21	15.0	703.3	6.594	0.8191	2.5900
	59.0	19.8		1.7709	1.2967
	29.5	9.9		2.5906	1.2933
21	44.5	713.2	19.65	389.1	
22	14.0	723.1	6.587	0.8187	2.5677
	56.1	18.0		1.7490	1.2553
	28.1	9.0		2.5677	1.3124
22	42.1	732.1	20.53	369.6	
23	10.1	741.1	6.580	0.8182	2.6318
	65.1	22.2		1.8136	1.3464
	32.6	11.1		2.6318	1.2854
23.	427	752.2	19.29	428.4	
24	15.2	763.3			

Mean 20.24

Mean 20.46

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For Se. Geolue. Sons

Friday. Oct. 6, 93

Last half of Series

24	15.2	763.3	6,573	0.8178	2,5729	
	56.9	17.3		1,7551	1,2380	
	28.5	8.7		2,5729	1.3349	
24	43.7	772.0	21,62	374.0		
25	12,1	780,6	6,562	0,8171	2,9541	
	137.1	44.7		2,1370	1,6503	
	68.6	22.4		2,9541	1,30,38	
26	20.7	803.0	20,13	899.8		
27	29.2	825.3	6,551	0,8163	2,4865	
	46.8	15,0		1,6702	1,1761	
	23.4	7,5		2,4865	1,31,04	
27	52.6	832.8	20.44	306.6		
28	16.0	840.3	6,544	0,8158	2,6978	
	76.2	25.9		1,8820	1,4133	
	38,1	13,0		2,6978	1,28,45	
28	54.1	853.3	19,25	498.7		
29	32,2	866.2	6,536	0,8153	2,5073	
	49.2	14,7		1,6920	1,1673	
	24.6	7,4		2,5073	1,3400	
29	56,8	873.6	21,88	321,7		
30	21,4	880,9	6,528	0,8148	2,4244	
	40.7	13,1		1,6096	1,1173	
	20.4	6.6		2,4244	1,30,71	
30	41,8	887.5	20,28	265.7		
31	02,1	894.0	6,522	0,8144	2,6705	
	71.8	24.1		1,8561	1,3820	
	35.9	12,1		2,6705	1,28,85	
31	38,0	906,1	19,43	468.3		
32	13.9	918,1				

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1892phae.proj..3896

Friday, Oct. 6, 93

11.	32	13.9	918.1 ‖ 6,574	0,8138	2,5518
		54.7	16.2	1,7380	1,2095
		27.4	8.1	2,5518	1,3423
	32	41.3	926 2 21.99	356.3	
	33	08.6	934.3 ‖ 6,506	0,8133	2,6471
		68.2	22.6	1,8338	1,3541
		34.1	11.3	2,6471	1,2930
	33	42.7	945.6 19.63	443.7	
	34	16.8	956.9 ‖ 6,499	0,8128	2,5379
		53.1	17.0	1,7251	1,2304
		26.6	8.5	2,53,79	1,30,75.
	34	43.4	965.4 20,30	345.1	
	35	09.9	973.9		

11 40 Curls $N + 0.^{d}53$ $W + 3.^{d}95$

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1892phae.proj..389D

r Sc

Friday Oct 6th 1893

Summary of all computed values of Screw divisions.

Sc. Readings Values of 1 d. Corr for

1st Cursor of

Gradienter Screw.

N. C.

This establishes a periodic error, depending on the revolution of the screw. This latter is plotted first.

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1892phae.proj..389D

Monday Oct. 9. 1893 — 3r 8c

Large intervals on the 3r 8c. which may be used,

30.8 - 180.3 - 430.3 - 780.6 - 880.9

~~76.2 - 274.1~~

116.5 - 315.9 - 416.1 - 564.1 - 866.2 -

140.9 - 391.3 - 49.1.5 - 642.2 - 741.1 - 840.3 (done)

274.1 - 723.1 - 825.3 - 973.9 - 371.8

352.6 - 703.3 NG

526.9 (done) - 627.8 - 825.3 - 9~~73.9~~

512.4 - 662.9 - 763.3

If a_1 is the 1st Rdg & t_1 its time
a_2 " " 2nd " t_2 " "

50d = some k | hence any da for a given time interval

~~C50 = ck~~

$da = c\cancel{50}k + dx = ck + dx$

da = change in alt

C50 some known multiple of 50

k = change in alt for 1 Rw. 8c

d = the no of divs from C50

x = the value of a Div. at that point

Value of	2 Rws
Place	Value
692	14v 2013.1
791	15v 2025.8
577	16v 2012.0
726	17v 2017.2

As there may be a long period change in the screw try first the Rdgs for ~~430.3, 780.6, 880.9~~

A 642.2; B 741.1; 840.3

100 - 1.1 d; 100 - 0.8 d

$da_1 = 2k - 1.1x = 1989.7 + 23.4 = 2013.1$

$da_2 = 2k - 0.8x = 2008.8 + 17.0 = 2025.8$

$da_2 - da_1 = 0 + 0.3x = 19.1$ | 38.9 av 2019.5

400.2	428.4
423.0	374.0
407.8	899.8
389.1	306.6
369.6	2008.8
1989.7	

quite useless for getting x, i.e. Assume that x = 21".3 then 1.1x = 23".4 and 0.8x = 17".0 k = 1009".7 or the mean value of 1d.0 = 20".19 at 740

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Gr Sc

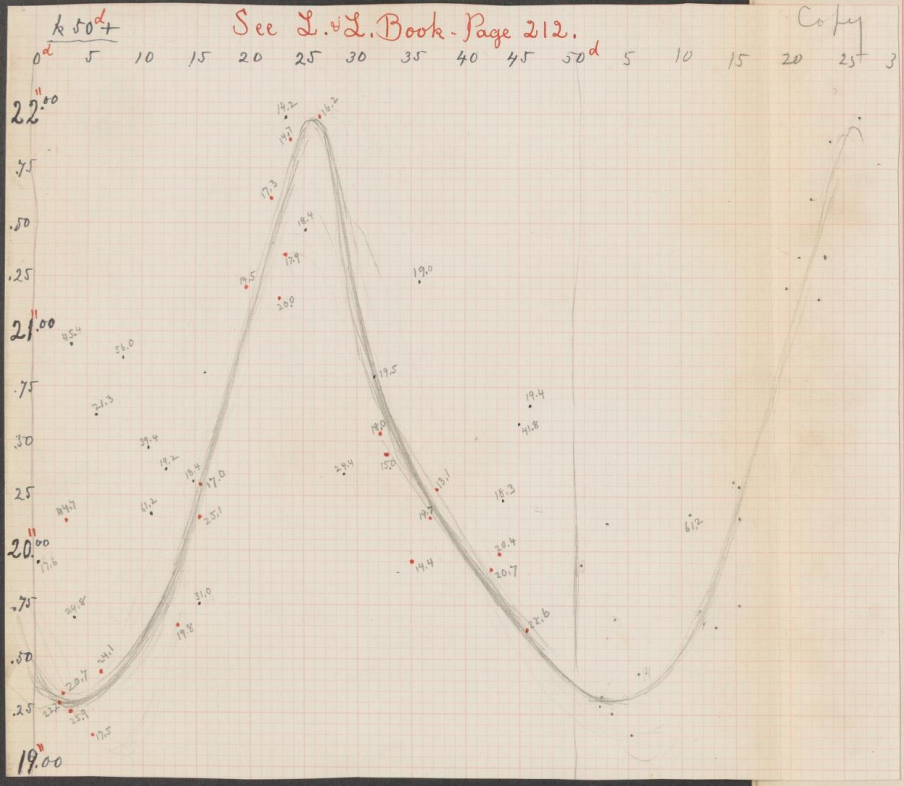
6

Friday Oct 6th 1893

Summary of all computed values of Screw divisions.

Sc. Reading	Value of 1.0	Corr for ∫ 215	Sc Reading	Value of 1.0	Corr for ∫ 205
015.3	19.75	-.41 -.33	519.7	21.20	+.02
053.5	20.94	-.37 .39	536.8	20.15	.03
085.7	21.23	.36 .28	555.4	19.14	.05
105.9	20.62	.34	573.1	21.35	.06
128.7	20.35	.32	592.4	19.92	.08
160.6	20.47	.30	615.3	20.15	.10
208.3	20.88	.26	635.0	19.95	.12
246.0	20.66	.22	652.6	19.33	.13
264.9	20.31	.21	672.9	21.15	.15
295.0	20.58	.18	693.1	19.49	.17
325.1	21.46	.16	713.2	19.65	.19
343.5	20.23	.14	732.1	20.53	.21
362.2	20.37	.12	752.2	19.29	.22
381.6	20.80	.10	772.0	21.62	.24
403.7	19.68	.08	803.0	20.13	.27
423.2	21.99	.07	832.8	20.44	.30
460.9	20.17	-.04	853.3	19.25	.31
500.3	19.94	.00	873.6	21.88	.33
			887.5	20.28	.35
			906.1	19.43	.36
			926.2	21.99	.38
			945.6	19.63	.40
			965.4	20.30	+.42

This establishes a periodic error, depending on the revolution of the screw. This latter is plotted first.



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1892phae.proj..389

Sc.

Monday, Oct. 9, 1893

Continuing process on last page, try

526.9 ; 627.8 ; 825.3

100 + 0.9 200 − 2.5

397,0	287.3
335,0	1984.7
381,7	428.4
412,5	374,0
505,5	899.8
2031.7	3979.2
− 19.8	+ 55.0
2 | 2011.9	4 | 4034.2
1006.0	1008.6
	6,0
	4.6
mean	1007."3
1.d.o Mean value	20."15

$da_1 = 2k + 0.9x = 2031.7$

$da_1 = 4k - 2.5x = 3979.2$

assume that $x = 22."0$ then

$0.9x = 19.8$ and

$2.5x = 55.0$.

June 4, 1894

For continuing the above, a table can be made as follows,

Sc. Rdg.	Elev.	Sc Rdg	Elevat	Sc Rdg	Elevation
- 000.2	0000."0	352,6	7276.7	582,0	1421,2
30.8	612.0	371.8	7667.8	602.7	1833.7
76.2	1562,4	391,3	8073,4	627,8	2339,2
95,2	1965.9	416,1	8561.6	642.2	2626.5
116.5	2404.9	430,3	8843.8	662,9	3026.7
140.9	2901.2	491.5	10108,3	682.9	3449.7
160.3	3707.7	509.1	10459.2	703.3	3857.5
236.3	4877.2			723.1	4246,6
255,7	5278,1	512.4	0,	741.1	4643.2
274,1	5651.7	526,9	307,5	763.3	5071.6
315.9	6511,7	546,6	704.5	780,6	5445,6
334.3	6906.5	564.1	1039.5	825,3	6345,4

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1892phae.proj..389D

28 ar

Nº 6 -	39.4	806,5	20.5	11
			.6	
17	61.2	1284.5	20.30	11

23	20.6	
780,6	5445.6	
682.9	3449.7	
97.7	1995.9	
+ 2.3	47,4	
ar 632	2043.3	

26.	20.4	
894.0	7738.1	
840.3	6652.0	
053.7	1086.1	
ar 3.7	75.5	
867	2010.6	

27.		
430.		
334.		
096		
+ 4		
ar 38		

30 - 180 - 430

116 - 315 - 416

140 - 391 - 491

274 - 371

512 - 662 - 763

526 - 627 - 723 - 825 - 973

564 - 866

642 - 741 - 840

780 - 880

19.	258	352
20	546	642
21	416	509
22	582	682

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1892phae.proj..389D

28 at

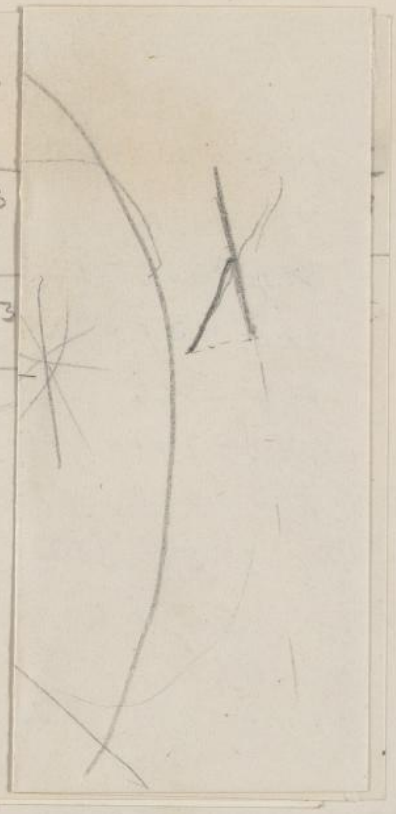
16 -	39.4	806,5	20.5	11
			.6	
17	61.2	1334.5	12.30	11

23	20,6
780,6	5445.6
682.9	3449.7
97.7	1995.9
+ 2.3	47.4
at 632	2043.3

24	20,5
334,3	6906.5
236.3	4877.2
98.0	2029.3
+ 2.0	41
at 285.	2070.3

26.	20.4
894.0	7738.1
840.3	6652.0
053.7	1086.1
at 3.7	75.5
867	2010.6

27,	21.0
430.3	8873.8
334.3	6906,5
096.0	1967.3
+ 4,0	84.0
at 382	2051.3



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1892phae.proj..389D

28 at

N°6 -	39.4	806,5	20.5	11
			.6	
17	61.2	1254.5	20.30	11

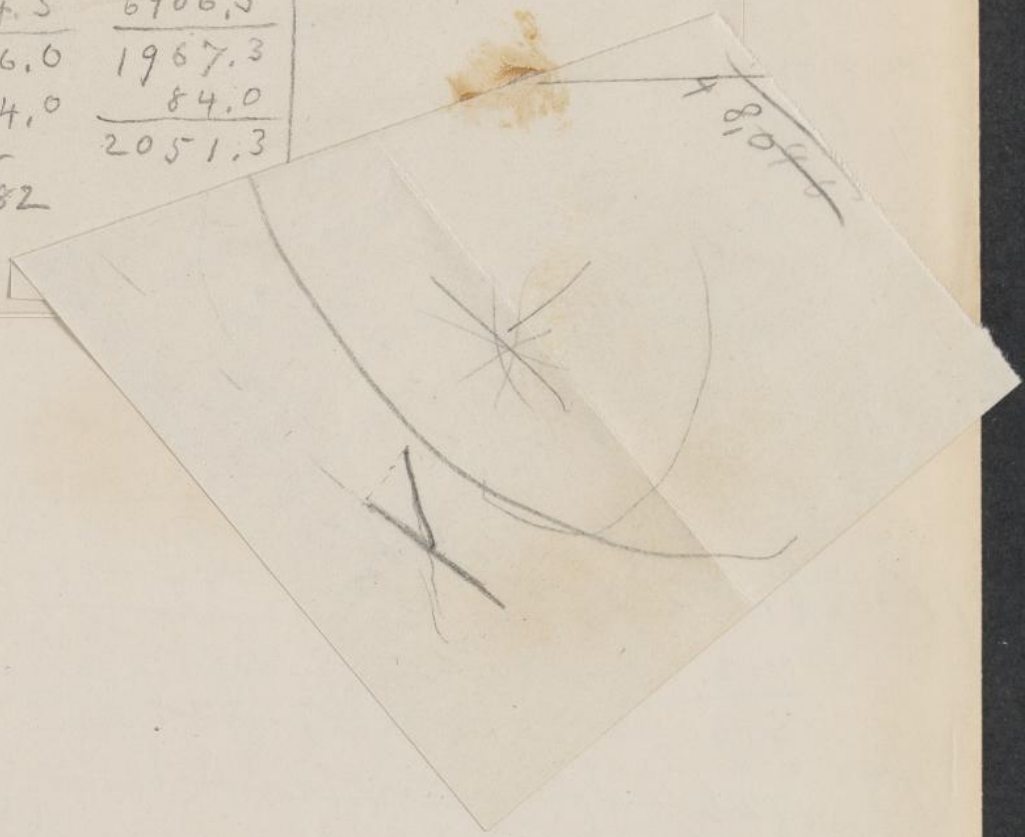
23	20,6
780,6	5445.6
682,9	3449.7
97,7	1995.9
+2,3	47,4
at 632	2043.3

24	20,5
334,3	6906.5
236,3	4877.2
98.0	2029,3
+ 2.0	41
at 285.	2070.3

25	21,8
274.1	5651,7
076.2	1562.4
197.9	4089.3
+2.1	45.8
at 175	4135.1
	2067.6

26.	20.4
894.0	7738.1
840.3	6652.0
053,7	1086.1
at 3.7	75.5
867	2010.6

27,	21.0
430.3	8873.8
334.3	6906,5
096.0	1967.3
+ 4,0	84.0
at 382	2051.3



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Sr Sc.

Monday, Oct. 9, 1893

Continuing process on last

526.9 ; 627.8 ; 825.3 da, =

100 + 0.9 200 − 2.5 da,

397.0 287.3 cos

335.0 1984.7 0.9 x

381.7 428.4 2.5 r

412.5 374.0

505.5 899.8

2031.7 3979.2

− 19.8 + 55.0

2 | 2011.9 4 | 4034.2

1006.0 1008.6

6.0

14.6

mean 1007."3

1.d.o Mean value 20."15

June 4, 1894

For continuing the above, a table can be made as follows,

Sc. Rdg.	Elev.	Sc Rdg	Elevat	Sc Rdg	Elevation
- 000.2	0000."0	352.6	7276.7	582.0	1421.2
30.8	612.0	371.8	7667.8	602.7	1833.7
76.2	1562.4	391.3	8073.4	627.8	2339.2
95.2	1965.9	416.1	8561.6	642.2	2626.5
116.5	2404.9	430.3	8843.8	662.9	3026.7
140.9	2901.2	491.5	10108.3	682.9	3449.7
180.3	3707.7	509.1	10459.2	703.3	3857.5
236.3	4877.2			723.1	4246.6
255.7	5278.1	512.4	0,	741.1	4643.2
274.1	5651.7	526.9	307.5	763.3	5071.6
315.9	6511.7	546.6	704.5	780.6	5445.6
334.3	6906.5	564.1	1039.5	825.3	6345.4

28 ar

11

N°6 - 39.4 806.5 20.5 .6

17 61.2 1334.5 1230 11

627-723 + 723 & 825

18 21.9

345.4 4246.6

246.6 627.8 2329.2

988.8 953 1907.4

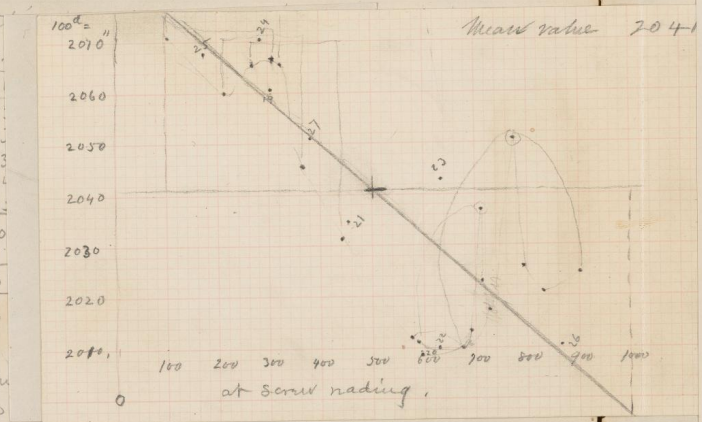
48.0 + 47 102.9

ar 675 2010.3

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Sr Sc.

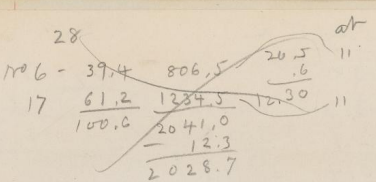
Monday, Oct. 9, 1893



June 4, 1894

For continuing the above, a table can be made as follows.

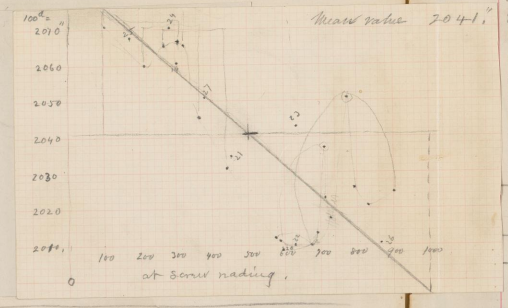
Sc. Rdg.	Elev.	Sc Rdg	Elevat	Sc Rdg	Elevation
000.2	0000.0	352.6	7276.7	582.0	1421.2
30.8	612.0	371.8	7667.8	602.7	1833.7
76.2	1562.4	391.3	8073.4	627.8	2339.2
95.2	1965.9	416.1	8561.6	642.2	2626.5
116.5	2404.9	430.3	8843.8	662.9	3026.7
140.9	2901.2	491.5	10108.3	682.9	3449.7
180.3	3707.7	509.1	10459.2	703.3	3857.5
236.3	4877.2			723.1	4246.6
255.7	5278.1	512.4	0.	741.1	4643.2
274.1	5651.7	526.9	307.5	763.3	5071.6
315.9	6511.7	546.6	704.5	780.6	5445.6
334.3	6906.5	564.1	1039.5	825.3	6345.4



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Sr Sc.

Monday, Oct. 9, 1893



June 4, 1894

For continuing the above, a table can be made as follows.

Sc. Rdg.	Elev.	Sc. Rdg.	Elev.	Sc. Rdg.	Elevation
000.2	0000.0	352.6	7276.7	582.0	1421.2
36.8	612.0	371.8	7667.8	602.7	1833.7
76.2	1562.4	391.3	8073.4	627.8	2339.2
95.2	1965.9	416.1	8561.6	642.2	2626.5
116.5	2404.9	430.3	8873.8	662.9	3026.7
140.9	2901.2	491.5	10108.3	682.9	3449.7
180.3	3707.7	509.1	10459.2	703.3	3857.5
236.3	4877.2			723.1	4246.6
255.7	5278.1	512.4	0.	741.1	4643.2
274.1	5651.7	526.9	307.5	763.3	5071.6
315.9	6511.7	546.6	704.5	780.6	5445.6
334.3	6906.5	564.1	1039.5	825.3	6345.4

Jan. 4, 1894

Sc. Rdg.	Elevation.
840.3	6652.0
862.2	7150.7
880.9	7472.4
894.0	7738.1
918.1	8206.4
934.3	8562.7
956.9	9006.4
973.9	9351.5

1v

187.3 − 3707.7
30.8 − 612.0
3k − 0.5 = 3095.7
+0.5 = + 10.6
3k = 3106.3
at 105 1035.4
100d = 2070.8

2v 2k = 100d

430.3 8873.8
180.8 − 3707.7
250d = 5k 5166.1
125
180
305 1033.2
at 305: 100d = 2066.4

3v

880.9 = 7472.4
780.6 5745.6
100.3 2026.8
− 3821 6.3
100d = 2020.5
at 830

4v 20.36

315.9 = 6511.7
116.5 2404.9
198.4 4106.8
+ .16 12.2
at 2 4119.0
216 2059.5

5v

416.1 8561.6
315.9 6511.7
100.2 2049.9
− .2 − 4.1
at 2045.8
366

6v

866.2 71507
564.1 1039.5
302.1 6111.2
− 2.1 42.8
3 6068.4
at 716 2022.8

7v 19.9

391.3 8073.4
140.9 2901.2
250.4 5172.2
− 0.4 8.0
125 5 1164.2
141
266 at 1032.8
2065.4

8v

491.5 10108.3
391.3 8073.4
100.2 2034.9
− .2 4.0
at 2030.9
441

9v 21.4

371.8 7667.8
274.1 5651.7
97.7 2016.1
+ 2.3 49.2
100d 2065.3
at 322

10v 21.8

825.3 8345.4
723.1 4246.6
102.2 2098.8
− 2.2 48.0
at 774 2050.8

11v

973.9 7351.5
825.3 6345.4
148.6 3006.1
+ 1.4 30.5
3 3036.6
at 900 1012.2
2024.4

N B

Page 215a

12v 19.8

662.9 3026.7
512.4 0
150.5 3026.7
− 0.5 9.9
75.5 3016.8
512.5 1005.6
588.0 2011.2
at

13v

763.3 5071.6
662.9 3026.7
100.4 2044.9
− 0.4 − 8.0
2036.9
at 713

Surface 213 for next 4 numbers

List of the above

1	105	2070,8	3	−0.5	352.6 7276.7
4	216	2059.5	4	0.6	255.7 5278.1
7	266	2065.6	5	0.4	96.9 1998.6
2	305	2066.4	5	0	+ 3.1 62
9	322	2065.3	2	2.3	100d = 2060.6
					at 304
5	366	2045.8	2	0.2	20 19.7
8	441	2030.9	2	0.2	642.2 2626.5
16	577	2012.0	2	0.9	546.6 704.5
12	588	2011.2	3	0.5	95.6 19220
18	675	2010.3	2	4.7	+ 4.4 86.7
14	692	2013.1	2	1.1	at 2008.7
					594
13	713	2036.9	2	0.4	21. 19.6
6	716	2022.8	6	2.1	509.1 10459.2
17	726	2017.2	4	2.5	416.1 8561.6
					− 7.0 1897.6
10	774	2050.8	2	2.2	+7.0 137.2 ± ?
15	791	2025.8	2	0.8	2034.8
3	830	2020.5	2	−0.3	at 452 22 20.6
11	900	2024.4	3	1.4	582.0 3449.7
					100.9 1421.2
					−0.9 18.5
					at 632 2010.0

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1892phae.proj.:3890

Division Values - corrected per page 215.

Nr.	Scale Rdg.		Value of 1d	Int.
1.	015.3	158	19.34	31 div. –
2	53.5	4.	20.55	45 –
3	85.7	36	20.87	19
4	105.9	6	20.28	21
5	128.7	29	20.03	24
6	160.6	11	20.17	39 –
7	208.3	8	20.62	56 –
8	246.0	46	20.44	19
9	264.9	15	20.10	18
10	295.0	45	20.40	42 –
11	325.1	25	21.30	18
12	343.5	44	20.09	18
13	362.2	12	20.25	19
14	381.6	32	20.70	20
15	403.7	04	19.60	25
16	423.2	23	21.92	14
17	460.9	11	20.13	61 –
18	500.3	0	19.94	18
19	519.7	20	21.22	15
20	536.8	37	20.18	20
21	555.4	05	19.19	18
22	573.1	23	21.41	18
23	592.4	42	20.00	21
24	615.3	15	20.25	25
25	635.0	35	20.07	14
26	652.6	3	19.46	21
27	672.9	23	21.30	20
28	693.1	43	20.16	20
29	713.2	13	19.84	20
30	732.1	32	20.74	18
31	752.2	2	19.51	22 div.
32	772.0	22	21.86	17
33	803.0	3	20.40	45 –
34	832.8	33	20.74	15
35	853.3	3	19.56	26 –
36	873.6	24	22.21	15
37	887.5	38	20.63	13
38	906.1	6	19.79	24
39	926.2	26	22.37	16
40	945.6	46	~~19.~~ 20.03	23
41	965.4	15	20.72	17
~~Units~~	19.19		22.37	
	3.18			

mean of above.

20.00 +

+.55	–.66	+ 13.18
.87	.40	1.86
.28	.06	.40
.03	.81	.74
.17	.54	2.21
62	.16	.63
.44	– 2.63	2.37
.10	– .49	.03
.40	.44	.72
1.30	.21	22.14
.09	3.77	– 3.77
.25		+ 18.37
.70		
1.92		
.13		
1.22		
.18		
1.41		
– .25		
.07		
1.30		
.16		
.74		
13.18		

41) 18.37 (45 –
164
197

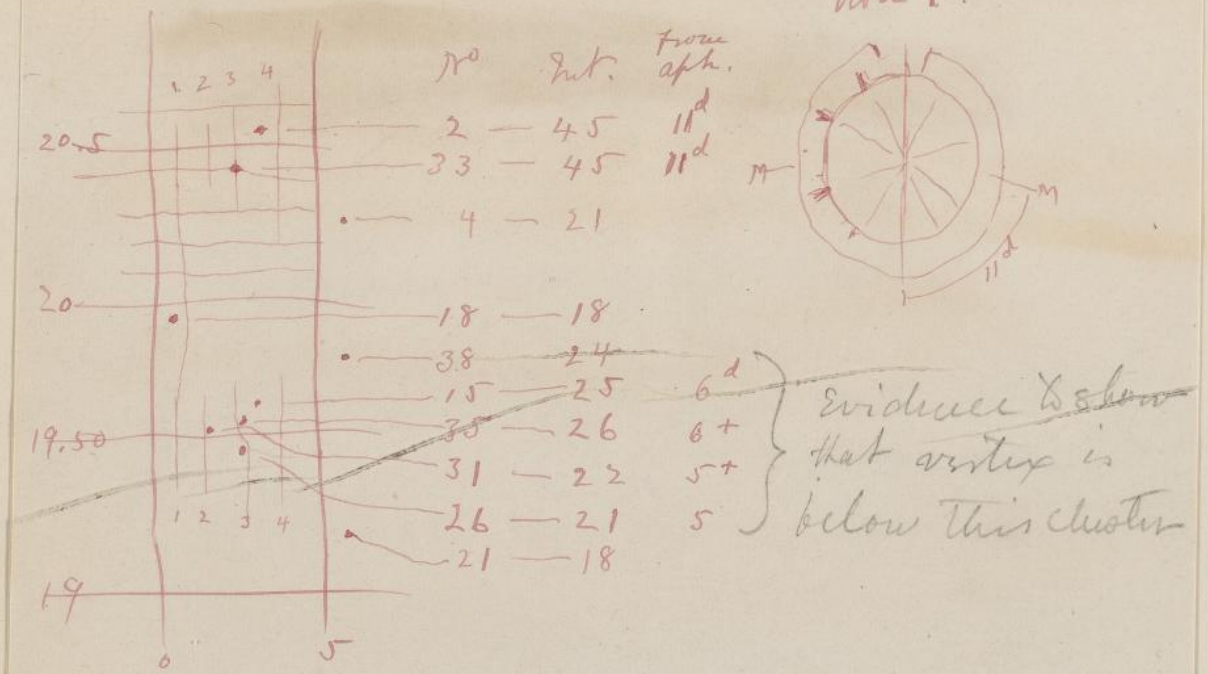
Mean = 20.45 –

Latter to be called 20.41
to match diagram
page 214

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1892phae.proj..389D

Note 1.



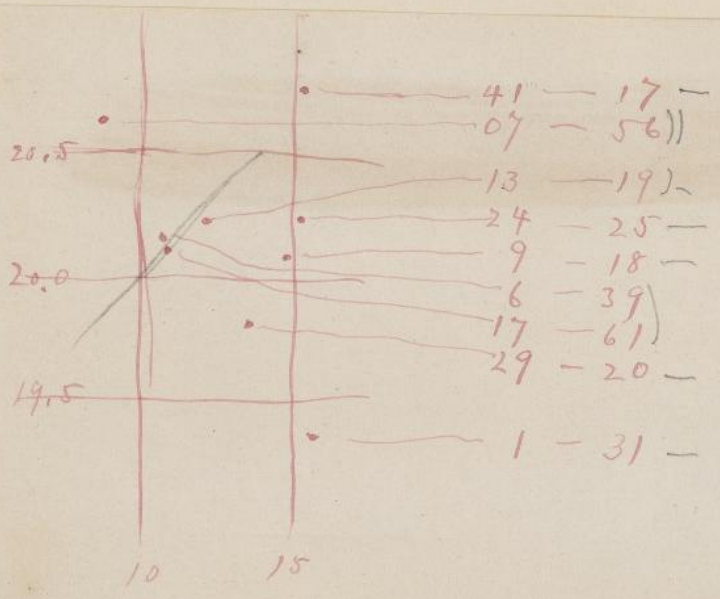
No	Int.	From aph.
2	45	11d
33	45	11d
4	21	
18	18	
38	24	
15	25	6d
35	26	6+
31	22	5+
26	21	5
21	18	

Evidence that vertex is below this cluster

Eccentricity.

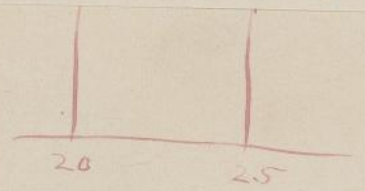
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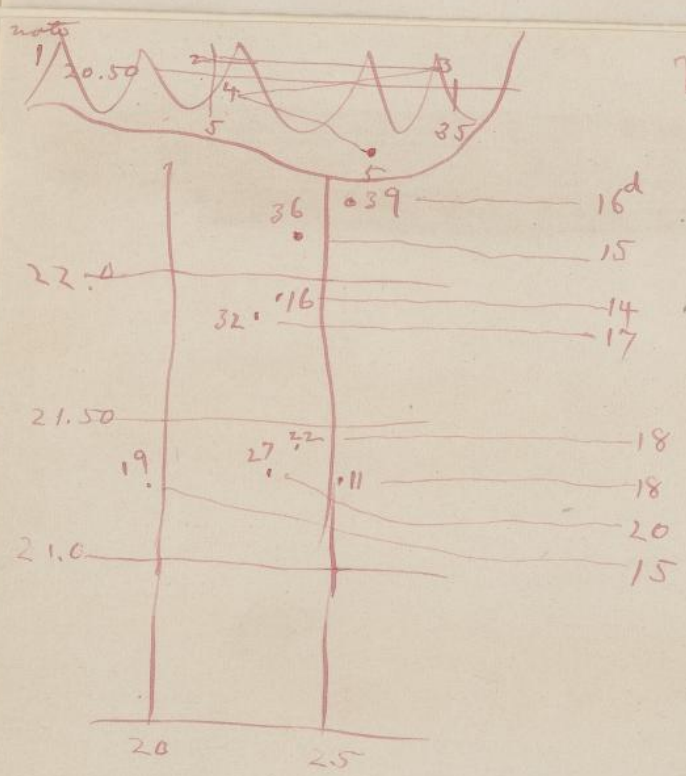
Note 2

line probably passes somewhat as drawn



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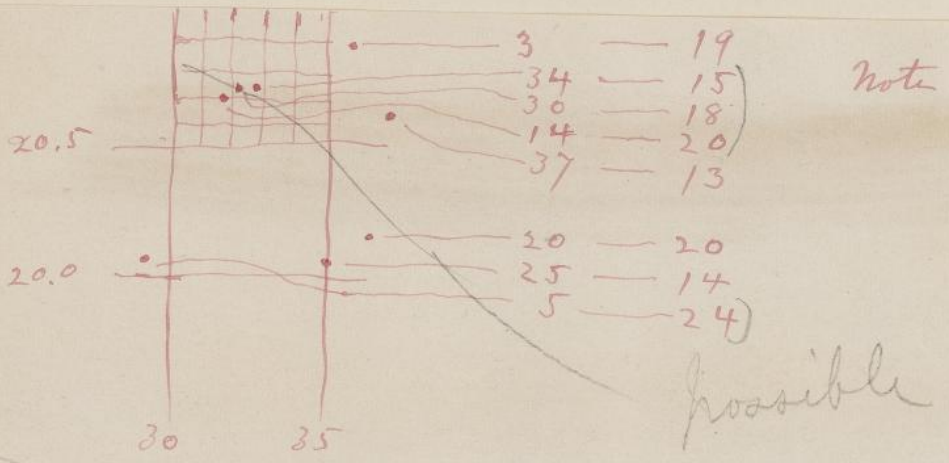


Note I

Sent enough progression in figures to do more than take means

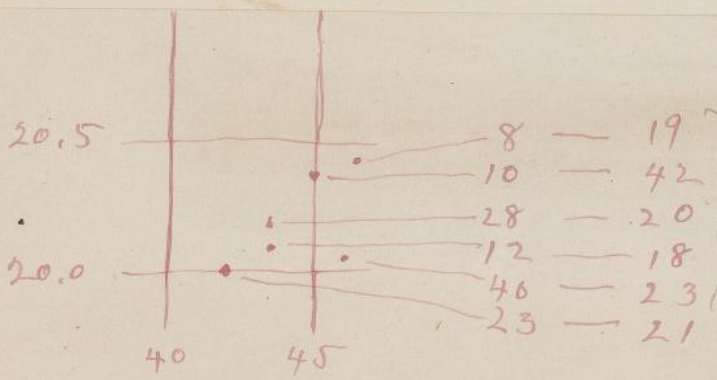
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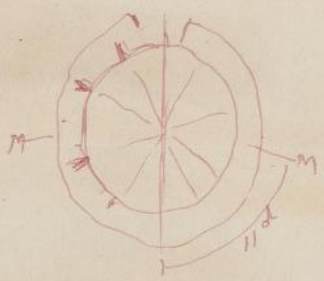
Note 5.

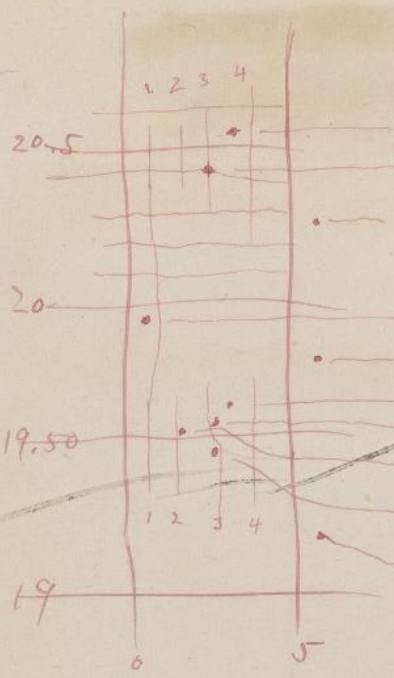
different values indicate that line ought to pass through cluster.

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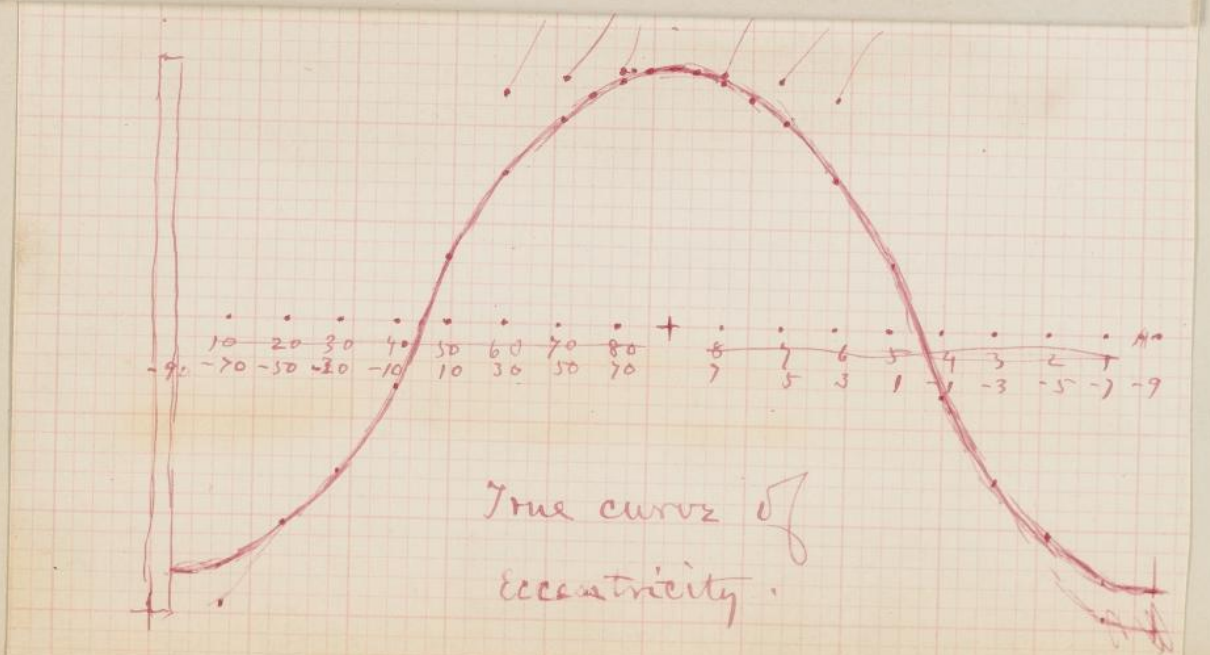
1892phae.proj..389D

Note 1





N°	Int.	From aph.	
2	45	11d	
33	45	11d	
4	21		
18	18		
38	24		
15	25	6d	Evidence is shown
35	26	6+	that variable is
31	22	5+	below this cluster
26	21	5	
21	18		



True curve of Eccentricity.

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1892pnae.proj..385c

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307,5	2
397.0	
704,5	3
335.0	
1039,5	4
381,7	
1421,2	5
412,5	
1833,7	6
505,5	
2339,2	7
287,3	
2626,5	
400,2	
3026,7	
423,0	
3449,7	
407,8	
3857,5	
389,1	
4246,6	
396,6	
4643,2	
428,4	
5071,6	
374,0	
5445,6	
899,8	
6345,4	
306,6	
6652,0	
498,7	
7150,7	8

612.0	2
950,4	
1562,4	3
403,5	
1965,9	4
439,0	
2404,9	5
496,3	
2901,2	6
806,5	
5278,1	9
373,6	
5651,7	10
860,0	
6511,7	11
394,8	
6906,5	12
370,2	
7276,7	13
391,1	
7667,8	14
405,6	
8073,4	15
488,2	
8561,6	16
312,2	
8873,8	17
1234,5	
10108,3	18
3509	
10459,2	19

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612.0 2
950.4
1562.4 3
403.5
1965.9 4
439.0
2404.9 5
496.3
2901.2 6
806.5

214

5278.1 9
373.6
5651.7 10
860.0
6511.7 11
394.8
6906.5 12
370.2
7276.7 13
391.1
7667.8 14
405.6
8073.4 15
488.2
8561.6 16
312.2
8873.8 17
1234.5
10108.3 18
350 9
10459.2 19

7150.7 866
321.7
7472.4
265.7
7738.1
468.3
8206.4 918
356.3
8562.7
443.7
9006.4
345.1
9351.5

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