

Received 12th April 1866

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(Film Front Cover For
First Page of Book)

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972266

Oakland Alameda Co Cal.
December 29th 1865

To the

Hon James M. Edmunds.
Commissioner of General Land Office

Sir;

I have the honor to transmit to your Office this book (Copy N^o: 2.) of Observations Reductions Discussion of Final Results and Field Notes: being an authentic Report of the proceedings attending the location, survey & demarkation of the Oregon & Washington Boundary, between the Columbia & Snake Rivers

Very Respectfully Submitted
Daniel G. Major.
Astronomer & Surveyor.

A list of the names of persons assisting in the location, survey, and marking of the Oregon and Washington Boundary, between the Columbia and Snake Rivers.

Daniel G. Major. Astronomer & Surveyor.
Frederick G. Hesse Observer at First-Station
P. C. Harnway Recorder " " "
John Major. Superintendent of Monuments
George Perin Chairman
Henry Boyer " "
W. Manning " "
William Henry Axman
William Hawk & W. Wood Flagmen.

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Affidavits

I, Frederick G. Hesse, Astronomer, do solemnly swear that I have made and reduced the principal series of ^{observations} taken on Cottonwood Creek, Oregon during the months of November and December 1863. and that every care and diligence was used in the field, for the correct determination of the 46th parallel of North latitude. I further certify to the best of my knowledge & belief that the requirements of the contract entered into between The Honorable Commissioner of the General Land Office and D. G. Major dated Washington D. C. April 25th 1863. have, with regard to the number & character of the astronomical observations, been more than complied with.

F. G. Hesse.

Subscribed by said Frederick G. Hesse Astronomer, and sworn to, before me a Justice of the Peace for the County of Alameda in the State of California this 29th day of December 1865.

Geo. H. Gogg
Justice of the Peace

I John Major do hereby certify that I have assisted D. G. Major, Astronomer & Surveyor to determine run & mark the 46th parallel of latitude between the Columbia & Snake Rivers; and to the best of my knowledge & belief, the boundary has been well deter-

mined & surveyed, and good substantial monuments have been built at the termination of each mile and half mile from the Columbia River to Mill Creek in the Blue Mountains. I do further certify that it was impracticable to chain and establish mile monuments through the Blue Mountains, but the Boundary Line has been faithfully marked through, by cutting through timber, blazing & marking trees and building durable stone monuments on the prominent ridges and important points through to Snake River.

John Major

Subscribed by said John Major, and sworn to before me a Justice of the Peace for the County of Alameda in the State of California this 29th day of December 1865.

Geo. F. Gogg }
Justice of the Peace }

I, Daniel G. Major, Astronomer & Surveyor do solemnly swear that I have truly, faithfully and impartially executed to the best of my skill & ability the observations, calculations & surveys mentioned in the Contract entered into on the 25th of April 1863. between James M. Edmunds Commissioner of the General Land Office & myself, so far as it was possible to carry out spirit and letter of Instructions forming portion of said contract. And I further swear that I have made and caused to be made more than double the number of observations agreed upon, in order to get the most reliable results for Latitude: That the measurements & chainings were carefully made and in all cases of doubt repeated.

Deeply marked, durable posts were erected in every instance where they were to be had, without regard to expense incurred or labor expended. The monuments were all of larger size than required by the terms of contract. After putting in the 42 mile monument it was not possible to ^{continue} make accurate measurements with chain or to erect monuments at the end of each mile but they were erected as the field notes show on all prominent ridges: &c. I hereby certify that this is a correct report of observations, calculations & Field notes.

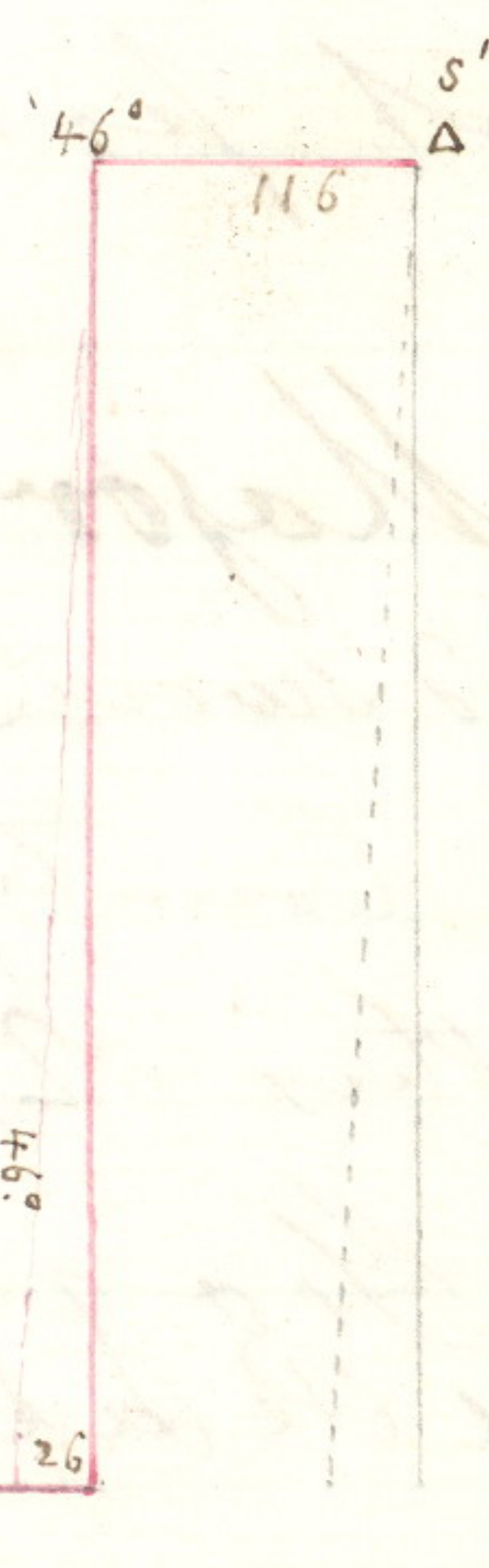
Daniel G. Major Astronomer & Surveyor

Subscribed and sworn to by said Daniel G. Major
 Astronomer and Surveyor, before me a Justice of the
 Peace for the County of Alameda State of California
 this 29th day of December 1865. Geo. F. Gogg, Justice of the Peace

Discussion of observations made at First Astro-
nomical Station Cottonwood Creek Oregon
and Second Astronomical Station Columbia
River Washington Territory; for the determination
of the eccentricity of the Sextant; —

the corrections to be applied to the results
deduced from the various altitudes of the
objects observed:—and

The most probable results for the position
of the Stations.



Measured North from ^{First astronomical station on} Cottonwood Creek
116 chains of 33 feet. Then ran West on tangent 35
miles to Columbia River; thence north 131 chains of
33 feet to Second Astronomical Station. Difference
of tangent from Parallel 46° in 35 miles = 26 chs of 33 feet

Difference of Latitude between S¹ and S² = 221 chs of 33 feet

$$221 \times 33 = 7293 \text{ feet} \quad \log \quad 3.8629060$$

$$3600 \quad 3.5563025$$

$$364635 \text{ ar. comp} \quad 4.4381416$$

$$\text{The measured distance betⁿ stations} = 1' 12".0 = 72".00 \quad 1.8573501$$

$$\text{Correction for Eccentricity} = e \sin A (1 - \cos B) + e \cos A \sin B.$$

Object	Weight	Latitude		1 - Cos B		sin B	
* Polaris	86	45° 59' 48".8	+	e sin A 322	+	e cos A 735	= l'
* Polaris	76	46 01 03.5	+	" 289	+	" 703	= l' = l + 2
Sun	90	45 59 17.9	-	" 084	-	" 401	= l
Sun	139	46 00 05.1	-	" 537	-	" 886	= l'
α Virginis	68	46 00 15.1	-	" 166	-	" 552	= l'
Saturn	35	46 00 05.6	-	" 253	-	" 665	= l'
α Bootis	34	45 59 46.0	-	" 560	-	" 898	= l'
α Tauri	16	45 58 58.6	-	" 503	-	" 867	= l'
α Pegasi	13	45 58 51.8	-	" 477	-	" 852	= l'
α Urse Majoris SP 12	12	45 59 25.5	+	" 052	+	" 318	= l'
β Ceti	11	45 59 23.8	-	" 096	-	" 427	= l'

* vide pages 73 and 108.

Equations of Condition.

$$l' = l_1 + 45^\circ 58'$$

Polaris	86	+ .322	e sin A	+ .735	e cos A	- l'	+ 108.8	= 0
Polaris	76	+ .289	"	+ .703	"	- l'	+ 111.5	= 0
Sun	90	- .084	"	- .401	"	- l'	+ 77.9	= 0
Sun	139	- .537	"	- .886	"	- l'	+ 53.1	= 0
α Virginis	68	- .166	"	- .552	"	- l'	+ 63.1	= 0
Saturn	35	- .253	"	- .665	"	- l'	+ 53.6	= 0
α Bootis	34	- .560	"	- .898	"	- l'	+ 34.0	= 0
α Tauri	16	- .503	"	- .867	"	- l'	+ 58.6	= 0
α Pegasi	13	- .477	"	- .852	"	- l'	+ 51.8	= 0
α Ursae Majoris S.P.	12	+ .052	"	+ .318	"	- l'	+ 85.5	= 0
β Ceti	11	- .096	"	- .427	"	- l'	+ 83.8	= 0

Equations of condition reduced to the same weight.

Polaris	+ 0.944	+ 2.155	- 2.93 l'	+ 319.07	= 0
Polaris	+ 0.797	+ 1.938	- 2.76 l'	+ 307.38	= 0
Sun	- 0.252	- 1.203	- 3.00 l'	+ 233.70	= 0
Sun	- 2.002	- 3.303	- 3.73 l'	+ 197.97	= 0
α Virginis	- 0.430	- 1.439	- 2.61 l'	+ 164.54	= 0
Saturn	- 0.473	- 1.244	- 1.87 l'	+ 100.28	= 0
α Bootis	- 1.033	- 1.656	- 1.84 l'	+ 62.69	= 0
α Tauri	- 0.636	- 1.097	- 1.26 l'	+ 74.12	= 0
α Pegasi	- 0.544	- 0.971	- 1.14 l'	+ 59.06	= 0
α Ursae Maj. S.P.	+ 0.057	+ 0.348	- 1.09 l'	+ 93.66	= 0
β Ceti	- 0.101	- 0.448	- 1.05 l'	+ 87.89	= 0

Normal Equation of e sin A.

Polaris	+ 0.8917	+ 2.0354	- 2.7693	+ 301.29	= 0
Polaris	+ 0.6347	+ 1.5440	- 2.1964	+ 244.89	= 0
Sun	+ 0.0635	+ 0.3031	+ 0.7560	- 58.89	= 0
Sun	+ 4.0081	+ 6.6130	+ 7.4640	- 396.34	= 0
α Virginis	+ 0.1874	+ 0.6231	+ 1.1289	- 71.23	= 0
Saturn	+ 0.2260	+ 0.5888	+ 0.8855	- 47.46	= 0
α Bootis	+ 1.0662	+ 1.7098	+ 1.9040	- 64.74	= 0
α Tauri	+ 0.4048	+ 0.6978	+ 0.8048	- 47.16	= 0
α Pegasi	+ 0.2958	+ 0.5283	+ 0.6201	- 32.12	= 0
α Ursae Maj. S.P.	+ 0.0032	+ 0.0198	- 0.0624	+ 5.33	= 0
β Ceti	+ 0.0101	+ 0.0451	+ 0.1056	- 8.85	= 0
	+ 7.7895	+ 14.7082	+ 8.6408	- 175.28	= 0

Normal Equation of $e \cos A$.

Polaris	+ 2.0354	+ 4.6460	- 6.3210	+ 687.75	= 0
Polaris	+ 1.5440	+ 3.7559	- 5.3427	+ 595.70	= 0
Sun	+ 0.3031	+ 1.4472	+ 3.6090	- 281.14	= 0
Sun	+ 6.6130	+ 10.9110	+ 12.3150	- 653.91	= 0
α Virginis	+ 0.6231	+ 2.0720	+ 3.7535	- 236.85	= 0
Saturn	+ 0.5888	+ 1.5478	+ 2.3274	- 124.75	= 0
α Bootis	+ 1.7098	+ 2.7418	+ 3.0532	- 103.81	= 0
α Tauri	+ 0.6978	+ 1.2027	+ 1.3872	- 81.29	= 0
α Pegasi	+ 0.5283	+ 0.9437	+ 1.1076	- 57.37	= 0
α Ursae Maj. S.P.	+ 0.0198	+ 0.1214	- 0.3816	+ 32.63	= 0
β Ceti	+ 0.0451	+ 0.2005	+ 0.4697	- 39.36	= 0
	+ 14.7082	+ 29.5900	+ 15.9773	- 262.40	= 0

Normal Equation of l'

Polaris	- 2.7693	- 6.3210	+ 8.600	- 935.68	= 0
Polaris	- 2.1964	- 5.3427	+ 7.600	- 847.36	= 0
Sun	+ 0.7560	+ 3.6090	+ 9.000	- 701.10	= 0
Sun	+ 7.4640	+ 12.3150	+ 13.900	- 738.05	= 0
α Virginis	+ 1.1289	+ 3.7535	+ 6.800	- 429.07	= 0
Saturn	+ 0.8855	+ 2.3274	+ 3.500	- 187.60	= 0
α Bootis	+ 1.9040	+ 3.0532	+ 3.400	- 115.60	= 0
α Tauri	+ 0.8048	+ 1.3872	+ 1.600	- 93.76	= 0
α Pegasi	+ 0.6201	+ 1.1076	+ 1.300	- 67.34	= 0
α Ursae Maj. S.P.	- 0.0624	- 0.3816	+ 1.200	- 102.60	= 0
β Ceti	+ 0.1056	+ 0.4697	+ 1.100	- 92.18	= 0
	+ 8.6408	+ 15.9773	+ 58.000	- 4310.34	= 0

$$7.7895 e \sin A + 14.7082 e \cos A + 8.6408 - 175.28 = 0$$

$$14.7082 \quad " \quad + 29.5900 \quad " \quad + 15.9773 - 262.40 = 0$$

$$8.6408 \quad " \quad + 15.9773 \quad " \quad + 58.000 - 4310.34 = 0$$

7.7895	log	0.891510	14.7082	log	1.167560	175.28	log	2.243732
8.6408	"	0.936554	8.6408	"	0.936554	8.6408	"	0.936554
0.90148	"	9.954956	1.7028	"	0.231006	20.285	"	1.307178

14.7082	log	1.167560	29.5900	log	1.471145	262.40	log	2.418964
15.9773	"	1.203493	15.9773	"	1.203493	15.9773	"	1.203493
0.92059	"	9.964067	1.85205	"	0.267652	16.4239	"	1.215471

8.6408	log	0.936554	15.9773	log	1.203493	4310.34		3.634511
58.000		1.763428	58.000	"	1.763428	58.000		1.763428
0.14898		9.173126	0.27544	"	9.440065	74.316		1.871083

$$l' = -0.90148 e \sin A - 1.7028 e \cos A + 20''285$$

$$l' = -0.92059 e \sin A - 1.85205 e \cos A + 16.4239$$

$$-l' = +0.14898 e \sin A + 0.27544 e \cos A - 74.316$$

$$0 = 0.75250 e \sin A + 1.42736 e \cos A + 54''031$$

$$0 = 0.77161 e \sin A + 1.57661 e \cos A + 57.892$$

1.42736	log	0.154533	54.031	log	1.732643
0.75250	"	9.876507	0.7525	"	9.876507
1.8968		0.278026	71.802		1.856136

1.57661	log	0.197724	57.892	log	1.762619
0.77161	"	9.887398	0.77161	"	9.887398
2.0433	"	0.310326	75.026	"	1.875221

$$0 = e \sin A + 1.8968 e \cos A + 71''802$$

$$0 = e \sin A + 2.0433 e \cos A + 75.026$$

$$0 = \quad \quad \quad + 0.1465 e \cos A + 3.224$$

3.224	log	0.508395	22''007 = e \cos A	log	1.342557
0.1465	"	9.165838	2.0433	"	0.310326
22.007	"	1.342557	e \cos A		44.966
					75.026

log e \sin A	1.477989	e \sin A = 30.060	log	1.477989
" e \cos A	1.342557	\sin A		9.906810
" tang A	0.135432	<u>A = 53° 47' 32.2</u>	log e	1.571179
		<u>e = 37.25</u>		

$$58.0000 l' = 4310.34 - 15.9773 e \cos A - 8.6408 e \sin A.$$

$l' = 74'' 316$	15.9773	1.203493	8.6408	9.936554
+ 6.062	$e \cos A$	1.342557	30.06	1.477989
+ 4.478	58.00 ar. comp.	8.236572		8.236572
84.856	6.062	0.782622	4.478	0.651115

$l = l' + 45^\circ 58' 00'' = \underline{45^\circ 59' 24'' 856}$ the most probable result for the latitude of Camp Cottonwood Creek

applying the measured distance = 1' 12" 0 and we get the most probable result for Camp on Columbia R. 46° 00' 36" 856

Correction for Eccentricity = $-30.06(1 - \cos B) - 22.007 \sin B.$

1st Astronomical Station Cottonwood Creek, Oregon

Object	Weight	Latitude	B = alt. ^o	Cor ⁿ e.	Corrected Results.
Polaris	86	45° 59' 48".8	47° 18'	-26".0	45° 59' 22".8
Sun	90	45 59 17.9	23 40	+11.4	45 59 29.3
α Tauri	16	45 58 58.6	60 10	+34.3	45 59 32.9
α Pegasi	13	45 58 51.8	58 29	+33.2	45 59 25.0
α Ursa Maj S.P.	12	45 59 25.5	18 31	- 8.6	45 59 16.9
β Cete	11	45 59 23.8	25. 17	+12.3	45 59 36.1

2nd Astronomical Station Columbia River Washington Territory.

Polaris	76	46° 01' 03".5	44° 38'	-24".2	46° 00' 39".3
Sun	139	46 00 05.2	62 24	+35.7	46 00 40.9
α Virgins	68	46 00 15.1	33 32	+17.2	46 00 32.3
Saturn	35	46 00 05.6	41 42	+22.3	46 00 27.9
α Bootis	34	45 59 46.0	63 53	+36.7	46 00 22.7

Astronomical Observations made for the determination of the 46th degree Latitude and the Boundary between Oregon & the Territory of Washington.

First Station, situated on Cottonwood Creek at the base of the Blue Mountains. Oregon.

November 18th 1863.

(Double Altitudes of a Auriga for Time.)

Observed Time	Double alt	Observed Time	Double Altitudes
8 ^h 46 ^m 03 ^s	95° 01' 10"	9 ^h 00 ^m 05 ^s	99° 28' 45."
8 49 56	96 17 30	9 03 00	100 31 50.
8 53 09	97 19 30	9 06 20	101 35 00.
Observer D.G. Major.		Observer Prof F.G. Heise.	

Observations of a Ursa Minoris (Polaris) for Latitude

Observed Time	Double Altitudes	Observed Time	Double Altitudes.
9 ^h 24 ^m 50 ^s	94° 52' 10"	9 ^h 46 ^m 39 ^s	94° 50' 50"
9 28 28	94 52 10	9 48 20	94 50 30
9 30 45	94 52 05	9 54 43	94 49 40
9 32 50	94 51 55	9 58 05	94 49 00
9 35 40	94 51 20		
Observer Prof F.G. Heise.		Observer D.G. Major.	

Barometer 28.500 Note - These Instruments are
Attached Thermometer 46.0 situated in the open
Detached Thermometer 46.0 air but sheltered from the
The night was windy. sun and rain.

Observations for Index Error. Star's image in coincidence.
Sextant reads -2' 40", -2' 35", -2' 35", -2' 30", -2' 40".

November 19. Cloudy 3^h 30^m Bar. 28.282 Alt Ther 56.0
(Detached Ther 56.0)

(Nov^r 20.) Astronomical 19th
Double Altitude of Sun 23^h 07^m 38^s.5 48° 15' 30" D.G. Major

1863. ~~Nov 20~~ Circum Meridian Altitudes Sun's U. I. Latitude

November 20.	Observed Time	Double Altitudes	
	11 ^h 47 ^m 12 ^s	49° 10' 15"	Measurements of Sun's Semidiameter for Index Error.
	11 49 03	49 09 50	
	11 51 08	49 08 10	
	11 52 38	49 06 30	
	12 00 58	48 56 00	
	12 02 11	48 53 40	
	12 04 18	48 49 30	
	12 05 16	48 47 20	
	12 05 50	48 46 30	
	12 07 18	48 43 10	
	12 08 13	48 41 00	Barometer 28.570
	12 09 07.5	48 39 00	Att. Ther: 46.0
	12 10 19.0	48 35 50	Det ^d Ther 48.0
			Observer Prof. F. G. Heise

(Double Altitudes of Sun's U. I. Time.

November 20.	Observed Time	Double Altitudes	
U. I.	2 ^h 14 ^m 41.0	32° 15' 50"	Measurements of Sun's Semidiameter for Index Error.
"	2 16 24.0	31 55 10	
"	2 17 32.0	31 40 25	
"	2 19 30.0	31 15 20	
"	2 20 51.5	30 58 00	
"	2 21 49.0	30 45 20	
"	2 22 42.0	30 33 40	
"	2 24 3.5	30 15 50	
"	2 24 51.0	30 05 50	
I. I.	2 32 35.5	27 18 50	
"	2 33 57.5	26 58 00	Attached Ther: 44.0
			Detached Ther: 46.0

Observations of U. I. by Prof. F. G. Heise. I. I. by B. G. Major.

November 20.	Observations for Time.	Double alt.	Double Altitude of Polaris.
In coincidence	5 ^h 29 ^m 40.0	90° 02' 10"	5 ^h 59 ^m 26.0 90° 05' 30"
with the reflected	5 37 41.5	87 34 30	Barometer 28.606
image of another	5 46 35.0	84 44 50	Attached Ther: 31.0
star.	5 49 24.5	83 54 55	Detached Ther: 30.0
	5 52 07.0	83 04 30	Night windy + unfavorable.
		Observer D. G. Major.	

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November 21.

Double Altitudes of α Lyrae for Time.

Observed Time	Double alt	Barometer	Therm.
7 ^h 47 ^m 15 ^s .0	65° 18' 50"	28.590	Attached Therm. 29.5
7 48 35.0	64 55 10		Detached Therm 30.0
7 49 35.5	64 35 40		Observer (D. G. Major)
7 51 04.5	64 06 55		

November 21.

Double altitudes of Polaris for Latitude

Observed Time	Double alt ^s	Observed Time	Double Alts
8 ^h 44 ^m 16 ^s	94° 52' 35"	8 ^h 56 ^m 03 ^s	94° 53' 00"
8 49 22	94 52 20	8 57 35	94 54 10
8 51 00	94 52 10	8 59 11	94 54 50
Observer Prof. F. G. Hesse		9 15 45	94 52 30
Barometer 28.594		9 21 12	94 52 35
Attached Therm. 24.0		Observer (D. G. Major)	
Detached Therm. 20.0			

November 21

Double Altitudes for Time

wrong image
in coincidence
with star.

Observed Time	Double alt ^s	α Lyrae	Observed Time	Double alt ^s
9 ^h 36 ^m 45 ^s .5	64° 33' 10"		10 ^h 23 ^m 24 ^s .0	103° 07' 10"
9 39 40.0	65 22 50		10 25 58.0	103 48 00
9 41 05.5	65 45 10		Barometer 28.610	
9 43 26.5	66 24 40		Therm. Attached 23.0	
9 44 51.0	66 49 50		Therm. Detached 18.0	
Observer Prof. F. G. Hesse			Observer D. G. Major	

November 21.

Observations - Polaris for Latitude

Observed Time	Double alt	β Orionis for Time	Obs.
11 ^h 17 ^m 45 ^s	94° 26' 00"	10 ^h 46 ^m 11 ^s .5	55° 57' 10" H.
11 20 38	94 24 00	10 49 25.0	56 44 50 H.
11 22 59	94 22 20	10 57 32.5	58 19 30 H.
11 25 04	94 21 05	10 59 56.5	58 51 10 H.
11 27 13	94 19 25	11 01 25.0	59 08 20 H.

Observer D. G. Major.

Observations for Index Error

Major - 2' 35'	Hesse - 2' 00"	11 02 36.0	59 20 10 M.
- 2 45	- 2 10	11 03 42.5	59 36 05 M.
- 2 50	- 2 20	11 08 27.5	60 28 00 M.
- 2 35	- 2 30	Barometer 28.632	
- 2 30	- 2 30	Att. Therm. 21.0	
		Det. Therm. 16.0	
		Night unfavorable.	

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Circum-Meridian Altitudes of a Yauri. Latitude

November 21

Observed Time	Double alt	Observed Time	Double alt	Obsr
12 ^h 02 ^m 07.0	120° 05' 20"	12 ^h 19 ^m 17.0	120° 34' 05" H	
12 04 58.5	120 13 30	12 20 55.0	120 33 00 "	
12 07 24.0	120 16 40	12 23 17.0	120 31 30 "	
12 10 09.0	120 23 45	12 24 29.0	120 31 10 "	
12 12 43.0	120 29 50	12 26 48.0	120 29 40 "	
12 15 32.0	120 33 25	12 30 19.0	120 24 50 "	
Observer D. G. Major		12 32 59.0	120 19 20 "	
Barometer 28.642		12 35 29.0	120 13 10 M.	
Alt. Ther. 22.0		12 36 47.0	120 09 35 "	
Det. Ther. 17.5		12 37 45.0	120 04 20 "	

Sunday November 22nd 8 a.m. Bar^r 28.654 Alt^r Ther^r 27.5 Det^r Ther^r 28.0
 Cloudy at Noon Bar^r 28.608 alt^r Ther^r 34.0 Det^r Ther^r 32.0

November 23.

Circum Meridian Altitudes of Sun's U.L. Latitude.

Observed Time	Double alt	Barometer	Ther ^r Alt ^r	Ther ^r Det ^r	Measurements of Sun's Semidiameter for Index Error.
11 ^h 36 ^m 55 ^s	47° 54' 00"	28.616	43.0	47.0	
11 40 29	47 54 30				
11 44 21	47 53 40				
11 46 23	47 52 20				
11 47 05	47 52 10				40' - 9' 20" = 30' 40" off arc.
11 48 03	47 50 45				40 - 9 30 = 30 30 " "
11 49 03	47 50 10				40 - 9 20 = 30 40 " "
11 50 14	47 49 30				40 - 9 40 = 30 20 " "
11 51 44	47 48 10	Observer Prof Hesse	34 35	On arc	
11 55 38	47 42 45		34 40	" "	
11 56 49	47 40 55		34 40	" "	
11 58 26	47 38 00		34 40	" "	

Double Altitudes of Sun's U.L. for Time.

November 23.

Observed Time	Double alt	Observed Time	Double alt
8 ^h 57 ^m 27 ^s	28° 46' 50"	9 ^h 04 ^m 09 ^s	30° 13' 10"
8 58 41	29 02 45	9 05 45	30 32 45
8 59 45	29 16 50	9 07 21	30 52 10
9 00 50	29 30 50	9 08 45.5	31 10 20
9 02 26	29 51 20	9 09 47.0	31 23 10
9 03 03	29 59 00	Observations satisfactory.	Observer D. G. Major.
Barometer 28.550	Ther ^r Alt ^r 34.0	Ther ^r Det ^r 35.0	

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November 24

Measurements of Sun's Semidiameter for Index Error.

30' 10" off arc	34' 50" on arc	
30 00 " "	34 55 " "	Observations by Prof Heese
30 05 " "	35 00 " "	Time 10. A.M. Sun steady.

Circum-Meridian Altitudes of Sun's V.L. for Latitude.

November 24

11 ^h 00 ^m 56 ^s	46° 22' 55"	11 ^h 40 ^m 19 ^s	47° 28' 55"
11 01 55	46 25 50	11 41 09	47 29 05
11 03 02	46 29 40	11 41 58	47 28 55
11 03 46	46 32 20	11 43 17	47 28 40
11 22 05	47 16 10	11 44 20	47 27 40
11 22 46	47 17 00	11 44 50	47 27 20
11 23 46	47 18 25	11 45 20	47 27 20
11 24 41	47 19 20	11 46 03	47 26 40
11 25 20	47 20 40	11 47 10	47 26 00
11 26 00	47 21 30	11 48 31	47 24 25
11 27 01	47 22 15	11 49 02	47 24 20
11 28 46	47 24 10	11 49 37	47 23 45
11 30 04	47 25 20	11 50 23	47 22 45
11 31 04	47 26 10	11 51 51	47 21 00
11 32 11	47 27 00	11 52 24	47 20 45
11 34 04	47 28 05	11 53 11	47 19 30
11 35 48	47 28 20	11 54 23	47 18 00
11 36 24	47 29 00	11 56 15	47 15 10
11 38 24	47 29 10	11 56 58	47 14 00
11 39 00	47 29 05	11 58 00	47 12 25

Observations very good.

Observer Prof Heese.

Barometer 28.558 Attached Ther^m 44.5 Detached Ther^m 45.0

Observations of Sun's Semidiameter for Index Error. Time 12 M.

40' - 9' 45" off arc	35' 05" on arc
40 - 9 40 " "	34 50 " "
40 - 9 30 " "	34 50 " "

Measurements by Prof Heese.

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Double Altitudes of Sun's U.I. for Time.

November 24	2 ^h 14 ^m 55 ^s	29° 53' 25"	Measurements of Sun's Semidiameter
	2 16 38	29 32 00	for Index Error.
	2 17 30	29 20 30	40' - 9' 25" = 30' 35" Off arc
	2 18 19	29 09 50	40 - 9 15 = 30 45 " "
	2 20 45	28 38 40	40 - 9 25 = 30 35 " "
	2 21 55	28 23 00	34' 10" On arc
	2 22 47	28 12 10	34 00 " "
	2 23 38	28 00 40	34 05 " "
	2 24 52	27 43 50	Bar ⁿ 28.478 Alt ⁿ Ther ⁿ 39.5 Det ⁿ Ther 40.0

Double Altitudes of Sun's U.I. for Time.

November 26 th	9 ^h 08 ^m 48 ^s	29° 09' 20"	Measurements of Sun's Semidiameter
	9 09 41	29 20 46	Examination of Shades to horizon & Index Glasses
	9 10 44	29 34 10	Colored Glasses 1 st & 4 th 34' 20" On arc
	9 11 11	29 39 45	30' 30" off arc 34 15 " "
	9 11 52	29 48 10	30 25 " 34 20 " "
	9 12 24	29 54 30	30 30 1 st Glass image direct.
	9 13 07	30 03 30	Glasses 2 ^d & 4 th 30' 25 Direct image 34 50 On arc
	9 14 37	30 22 10	off arc 30 20 Glasses 1 st & 2 ^d 34 45 " "
	9 15 27	30 32 20	" 30 10 " 34 40 " "
	9 16 03	30 39 30	Glasses furthest from Mirrors called 1 st
	9 17 01	30 51 25	Prof. Heise Observer
	9 17 33.5	30 57 50	Barometer 28.354 Attached Ther ⁿ 32.0 Detached Ther ⁿ 31.0

Circum Meridian Altitudes of Sun's U.I. for Latitude.

Observed Time	Double alt ^s	Observed Time	Double Alt ^s
November 26 th 11 ^h 35 ^m 59 ^s	46° 37' 55"	11 ^h 44 ^m 19 ^s	46° 41' 40"
11 37 10	46 39 15	11 45 25	46 42 20
11 38 10	46 39 40	11 49 21	46 41 10
11 39 28	46 40 20	11 50 01	46 40 50
11 40 06	46 40 55	11 52 12	46 39 55
11 40 55	46 41 15	11 53 22	46 38 35
11 42 04.5	46 41 40	11 55 50.5	46 36 25.

Barometer 28.368 Attached Therⁿ 35.0 Detached Therⁿ 34.0

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Measurements of Sun's Semidiameter for Index Error

November 26th

34' 20	On arc	30' 30"	off arc	
34 30	" "	30 10	" "	Barometer 28.374
34 35	" "	30 05	" "	Attached Ther ^m 32.0
34 20	" "	30 15	" "	Detached Ther ^m 32.0

Double Altitudes of Sun for Time.

Measurements of Sun's Semidiameter for Index Error. at 3 p.m.

Observed Time	Double alt ^s	34' 30" on arc	30' 20" off arc
2 ^h 31 ^m 21 ^s	27° 03' 00" U.L.		
2 32 29	26 48 00 "	34 50 " "	30 25 "
2 35 40	26 04 50 "	34 35 " "	30 20 "

Double Altitudes of Polaris for Latitude

November 26th

Observed Time	Double alt ^s	Barometer	Attached Ther ^m	Detached Ther ^m
5 ^h 38 ^m 25 ^s	93° 57' 30"	28.416	27.0	
5 39 53	93 58 35			
5 43 56	94 01 15			27.0
5 47 51	94 02 40			
5 52 18	94 04 05	Coincidence of Star & reflected image for Index Error.		
5 54 25	94 05 55			- 2' 05" on arc
5 56 03	94 07 15			- 1' 50" on arc - 2 00 "
5 58 05	94 08 30			- 2' 00 " " - 2 05 "

Double Altitudes of Polaris for Latitude.

November 27th

Observed Time	Double alt ^s	Barometer	Att. ^d Ther ^m	Det. ^d Ther ^m
5 ^h 37 ^m 28 ^s	94° 00' 05"			
5 40 01	94 01 40	28.562		
5 41 31	94 02 50		28.0	
5 42 51.5	94 03 15			27.0
5 44 38	94 04 20	Coincidence of Star & reflected		
5 47 04	94 05 30	for Index Error.		
5 49 18	94 06 45			- 1' 20" on arc 1' 30" on arc
5 50 34	94 07 10			- 2' 00" " " 2 00 " "

Circum Meridian Altitudes of a Pegasi for Latitude

November 27th

Observed Time	Double Alt ^s	Obs ^d Time	Double Alt ^s	6 ^h 33 ^m 48 ^s	117° 01' 10"
6 ^h 19 ^m 58.5	116° 55' 20"	6 ^h 27 ^m 43 ^s	117° 01' 10"	34 58	116 59 10
21 58.0	116 59 10	28 32	02 00	36 45	58 10
24 12.0	116 59 45	30 09.5	01 20	37 59	56 40
26 13.0	117 01 30	32 49	02 00	40 07	53 10

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Double Altitudes of α Lyrae for Time.

November 27 th	6 ^h 46 ^m 24.5	63° 00' 30"	6 ^h 53 ^m 46.0	60° 36' 50"
	6 48 49.0	62 12 40	6 55 08.0	60 09 50
	6 51 06.0	61 28 10	6 58 51.5	58 56 10

Double Altitudes of Sun's U.I. for Time

November 28 th	9 ^h 01 ^m 44.5	27° 04' 50"	Measurements of Sun's Semidiameter	
	9 02 37	27 16 10	for Index Error.	
	9 03 05	27 22 20	30' 15" Off arc	34' 30" On arc
	9 03 43	27 30 25	30 10 " "	34 55 " "
	9 04 44	27 43 10	30 15 " "	34 40 " "
	9 05 10	27 49 00	Bar. 28.608 Ther. Att. 31.5 Det. Ther. 30.5	

Circum-Meridian Altitudes of Sun's U.I.

November 28 th	11 ^h 36 ^m 27.5	45° 55' 40"	11 ^h 47 ^m 25.5	45° 58' 30"
	11 37 25	45 56 10	11 48 01.0	45 58 10
	11 38 42	45 56 30	11 49 00.5	45 57 50
	11 39 36.5	45 57 20	11 50 04.5	45 57 20
	11 41 05.0	45 57 50	11 50 48.0	45 56 55
	11 41 46.	45 58 10	11 51 39.0	45 56 40
	11 43 30.	45 58 30	11 52 09.5	45 56 25
			11 53 23.5	45 55 30

Measurements of Sun's Semidiameter for Index Error.

34' 30" On arc	30' 40" off arc	Barometer	28.628
34' 55 " "	30 30 " "	Att. Ther.	42.0
34' 30 " "	30 30 " "	Det. Ther.	42.0

Double Altitudes of Sun's U.I. for Time

November 28 th	2 ^h 19 ^m 52.5	28° 48' 50"	2 ^h 24 ^m 07.5	27° 54' 50"
	2 20 51	28 36 40	2 25 37	36 20
	2 21 34	28 27 30	2 26 21	26 15
	2 22 25	28 17 10	2 26 56	19 05
	2 23 07.5	28 07 40	2 27 26	12 25

Measurements of Sun's Semidiameter

for Index Error	30' 25"	34' 30" On arc	Barometer	28.604
Off arc	30 30	34 30	Ther. Att.	37.0
	30 40	34 30	Ther. Det.	36.0

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Double Altitudes of α Aquila for Time

November 28 th	6 ^h 50 ^m 29 ^s	60° 17' 45"	Bar 28.568	Ther Att ^d 37° 0'	Det ^d Ther ^m 36°
6	51 44	59 54 15	Index Error.		- 2' 00"
6	56 34.5	58 21 10	Star in coincidence with reflected image - 2 40		
6	58 39	57 38 30	on arc - 2 20		
7	00 41	56 57 00	- 2 00		

Circum Meridian Altitudes of β Ceti for Latitude

November 28 th	7 ^h 53 ^m 08 ^s	50° 33' 20"	8 ^h 09 ^m 00 ^s	50° 37' 50"
7	54 57	50 35 55	8 10 20.	50 37 35
7	56 43	50 37 10	8 11 16.	50 36 50
7	58 13	50 38 30	8 12 42.5	50 34 50
8	04 56	50 38 55	8 14 17.	50 33 25
8	07 27	50 38 25		

Double Altitudes of Polaris for Latitude.

November 28 th	8 ^h 25 ^m 39 ^s	94° 52' 40"	8 ^h 50 ^m 34 ^s	94° 53' 15"*
8	27 18.5	94 51 50	8 52 56	94 53 25
8	28 43	94 52 30	8 54 29	94 52 10
8	29 57	94 52 50	8 56 23	94 52 10
8	34 07	94 52 20	Index Error	
8	36 08	94 52 25	Star in coincidence with reflected image - 1' 35"	
8	39 45	94 51 40	- 2 00	
8	45 16	94 53 10*	* Glass cover over artificial - 2 05	
8	46 33	94 52 10*	horizon. Night windy. - 1 40	
8	47 30	94 52 15*	- 2 20	
8	49 11	94 53 30*		

Barometer 28.580 Attached Ther^m 34° 0' Detached Ther^m 34° 0'

Double Altitudes of Sun U.L. for Time.

November 29 th	Observed Time	Double alt ^s	Obs ^d time.	Double alt ^s	Index Error
2 ^h	08 ^m 13 ^s .0	30° 52' 50"	2 ^h 11 ^m 15 ^s .5	30° 17' 10"	30' 40" off arc
2	08 57.5	30 44 40	2 11 50	30 10 20	30 35 "
2	09 31.5	30 37 40	2 12 20	30 04 30	34 30 on arc
2	09 59.0	30 32 20	2 12 49	29 58 55	34 20
2	10 26.0	30 27 15	2 13 19	29 52 50	
2	10 52.5	30 21 35	2 13 59	29 45 10	

Barometer 28.540 Att^d Ther^m 30° 0' Det^d Ther^m 30° 0'

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Double Altitudes of α Aurigae for Time

November 30 th	2 ^h 12 ^m 55.0	29° 36' 05"	Bar ⁿ 28.416	Alt ⁿ 29° Det ⁿ 29°
	2 13 35.5	29 27 40		
	2 14 16.0	29 19 55	Measurements of α Aurigae Semidiameter	
	2 14 57.0	29 12 25	for Index Error	
	2 15 15.5	29 07 50	34' 10" on arc	31' 10" off arc
	2 15 46.5	29 01 45	34 10 " "	31 00 " "
	2 16 43.0	28 49 30	34 00 " "	31 00 " "
	2 17 18.0	28 42 20		

Double Altitudes of α Aquila for Time

December 1 st	7 ^h 51 ^m 57 ^s	35° 07' 10"	8 ^h 00 ^m 46 ^s	32° 02' 30"	- 1' 10"
	7 54 28	34 13 50	8 01 49	31 40 20	1 05
	7 56 12	33 36 10	8 02 31	31 25 50	2 10
	7 59 40	32 24 40	8 03 26	31 06 35	1 30
	Observations very good;				- 2 05

Double Altitudes of Polaris for Latitude

December 1 st	8 ^h 22 ^m 57 ^s	94° 51' 40"	8 ^h 34 ^m 28 ^s	94° 52' 00"
	8 24 45	51 55	8 37 14	94 52 50
	8 26 06	52 40	8 38 09.5	94 51 45
	8 27 17	52 50	8 39 16	94 52 50
	8 28 50	52 10	8 40 24	94 52 10
	8 29 40	52 00	8 41 10.5	94 52 45
	8 30 49	52 20	8 42 18	94 52 00
	8 32 07	52 00	8 43 50	94 52 00
	8 33 21	52 30	8 44 38.5	94 51 50

Night favorable. Observations taken with-out glass cover over artificial horizon.

Barometer	28.210	Index Error	2' 00"
Ther ⁿ Alt ⁿ	25° 0	Ther ⁿ Det ⁿ	25° 0
		on arc	2 00 2' 10"

Double Altitudes of β Orionis for Time.

December 2 nd	9 ^h 43 ^m 21.5	51° 45' 20"	9 ^h 55 ^m 10.0	54 26 05	Index Error
	9 47 30	52 40 50	9 56 51.5	54 48 30	- 2' 10"
	9 49 34	53 08 10	9 58 30.5	55 10 45	2 20
	9 52 05	53 43 50	10 00 01.0	55 30 40	2 05
	9 53 34.5	54 03 25	10 01 39.5	55 51 05	on arc

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Double Altitudes of α Ceti for Time.

December 2nd

10 ^h 16 ^m 11.0	95° 01' 25"	10 ^h 24 ^m 46.0	94° 41' 10"
10 18 15.5	94 57 05	10 26 14.0	94 37 10
10 19 38.0	94 54 35	10 27 52.5	94 32 30
10 21 07.0	94 51 25	10 29 26.0	94 26 50
10 23 20.0	94 44 15	10 31 26.0	94 20 55

Barometer 28.334 Ther^l Alt.^d 38°:0 Ther^l Det.^d 38°:0.

Double Altitudes of α Ursae Majoris. Sub polo.

December 5th

5 ^h 45 ^m 25 ^s	37° 05' 10"	5 ^h 56 ^m 34.5	37° 04' 30"	Index Error
5 48 21	04 20	5 57 44.0	04 45	2' 10" on arc
5 50 16	03 30	5 59 25	05 40	2 30 " "
5 51 18	03 20	6 00 31.	05 50	1 50 " "
5 53 12	04 15	6 01 29	06 30	2 10 " "
5 54 56.5	37 04 10	6 02 24	37 07 00	2 05 " "

Barometer 28.260 Ther^l Alt.^d 35°:0 Ther^l Det.^d 36°:0

Double Altitudes of α Aquilae + α Lyrae for Time.

December 5th

α Aquilae		7 ^h 49 ^m 24.5	47° 04' 55"
6 ^h 13 ^m 48 ^s	62° 11' 30"	7 51 32.0	46 26 30
6 15 04	61 46 40	7 52 39.0	46 07 00
6 17 19	61 02 50	7 53 36.	45 49 30
6 19 07	60 28 20	7 54 24.	45 35 45
6 20 38	59 58 50	7 55 44	45 11 35
6 22 16	59 25 10	7 56 57	44 51 10

Double Altitudes of Polaris for Latitude.

December 5th

8 ^h 00 ^m 14 ^s	94° 49' 45"	8 ^h 11 ^m 33 ^s	94° 50' 40"
8 01 39	94 50 30	8 12 39	94 51 15
8 03 58	94 50 25	8 14 02	94 49 40
8 05 10	94 50 25	8 15 44	94 50 30
8 07 04	94 49 35	8 17 24	94 50 00
8 08 21	94 50 25	8 18 57	94 50 10
8 10 38	94 50 30	8 20 48	94 50 25
		8 22 01	94 50 50

Barometer 28.240 Ther^l Alt.^d 35°:0 Ther^l Det.^d 37°:0

Index Error on Arc, - 0' 10", - 0' 30", - 0' 10"

Astronomical observations made for the determination of the 46th degree of Latitude and the Boundary between Oregon + Washington Territory.

Second Station - situated on East bank of the Columbia River at foot of Cathedral Bluff.

Washington Territory Approximate Latitude $46^{\circ} 00' 30''$

1864.

May 7th

Double Altitudes of Arcturus for Time.

Observed Time	Double Alt.	Observed Time	Double Alt.
8 ^h 20 ^m 59 ^s	95° 09' 05"	8 ^h 25 ^m 29 ^s	96° 34' 55"
8 22 34	95 39 10	8 26 27	96 52 15
8 24 13	96 11 35	8 27 22	97 10 35

Barometer 29.506 Ther. Alt. $69^{\circ}.5$. Instrument pendent from the branch of tree, and sheltered from rays of Sun.

May 7th

Double Altitudes of α Ursae Minoris. Sub Polo. for Latitude.

Observed Time	Double Alt.	Observed Time	Double Alt.
8 ^h 41 ^m 34 ^s	89° 27' 00"	8 ^h 54 ^m 40 ^s	89° 22' 50"
8 44 31	89 25 00	8 57 52	89 22 55
8 47 14	89 24 50	9 00 32	89 22 20
8 49 34	89 23 45	9 02 16	89 21 40
8 52 43	89 23 00	9 06 33	89 21 30.

Barometer 29.500 Alt^d Ther^d $61^{\circ}.5$ Index Error - 1' 00".

May 8th

Circum-Meridian Altitudes of Sun's I.I. for Latitude

11 ^h 43 ^m 10 ^s	121° 49' 10"	11 ^h 53 ^m 22 ^s	122° 06' 40"
11 44 16	121 53 20	11 54 32	122 07 55
11 45 21	121 55 50	11 55 08	122 08 10
11 46 09	121 57 05	11 55 58	122 07 20
11 48 12	122 02 00	11 57 34	122 07 05
11 49 11	122 03 40	11 59 49	122 07 40
11 52 31	122 05 50	12 02 12	122 07 20

Barometer 29.460 Alt^d Ther^d $78^{\circ}.0$

Measurements of Sun's Semidiameter for Index Error.

On arc 32' 25	On arc 32' 35"	Off arc 31' 10"	Off arc 31' 00"
" " 32 40	" " 32 20	" " 31 10	" " 31 10

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May 9thDouble Altitudes of α Bootis for Time.

Observed Time	Double Alt	Observed Time	Double Alt
8 ^h 42 ^m 37 ^s	104° 36' 30"	8 ^h 46 ^m 13 ^s	105° 40' 40"
8 43 51	105 00 50	8 47 15	105 59 55
8 45 17	105 25 10	8 49 37	106 40 35

Double Altitudes of β Geminorum for Time.May 9th

Observed Time	Double Alts	Observed Time	Double Alts
8 ^h 54 ^m 01 ^s	69° 59' 50"	8 ^h 57 ^m 32 ^s	68° 44' 10"
8 54 39	69 43 45	8 59 41	68
8 56 30	69 07 05	9 02 00	67 51 10

Barometer 29.622 Alt. θ θ 75° 0 Index Error - 0' 50

Circum Meridian Altitudes of α Virginis for LatitudeMay 9th

Observed Time	Double Alts	Observed Time	Double Alts.
10 ^h 00 ^m 16 ^s	67° 08' 20"	10 ^h 10 ^m 21 ^s	67° 06' 40"
10 03 12	67 09 00	10 11 54	67 06 15
10 06 02	67 08 50	10 13 58	67 04 00
10 07 17	67 08 20		

Circum Meridian Altitudes of Polaris S.P. for Latitude.

May 9th

10 ^h 17 ^m 33 ^s	89° 15' 20"	10 ^h 35 ^m 38 ^s	89° 17' 25"
10 20 27	89 15 40	10 38 04	89 18 20
10 22 34	89 16 25	10 40 17	89 19 15
10 25 32	89 16 05	10 42 33	89 18 45
10 28 10	89 16 25	10 45 07	89 18 45
10 32 31	89 17 25	10 48 05	89 19 15

Barometer 29.630 Alt. θ θ 70° 0

Circum Meridian Altitudes of α Bootis for LatitudeMay 9th

Observed Time	Double Alt	Observed Time	Double Alt
10 ^h 54 ^m 15 ^s	127° 49' 35"	11 ^h 00 ^m 19 ^s	127° 47' 00"
10 56 32	127 49 55	11 01 58	127 45 10
10 57 30	127 49 10	11 04 14	127 42 30
10 58 24	127 49 00		

1864 Circum Meridian Altitudes of Sun's U.L. for Latitude

May 10 th	11 ^h 42 ^m 55 ^s	124° 01' 55"	11 ^h 56 ^m 56 ^s	124° 14' 20"
11	43 53	124 03 55	11 58 19	124 13 25
11	45 10	124 08 50	11 58 59	124 12 30
11	47 27	124 09 45	11 59 33	124 11 45
11	49 19	124 11 55	12 00 32	124 11 25
11	50 40	124 12 50	12 01 16	124 11 15
11	51 46	124 13 25	12 03 32	124 08 05
11	53 11	124 13 50	12 04 20	124 07 25
11	55 15	124 14 30	12 05 08	124 06 45
11	55 52	124 14 35	12 06 26	124 02 30

Barometer 29.754 Alt. Ther^o 83° 0 Det. Ther^o 83° 0

Measurements of Sun's Semidiameter for Index Error.

On arc	32' 30"	On arc	32' 20"	Off arc	31' 05"	Off arc	31' 00"
" "	32 30	" "	32 25	" "	30 50	" "	30 50

Double Altitudes for Time.

	β Gemorum		α Bootis	
May 10 th	8 ^h 10 ^m 27 ^s	83° 22' 10"	8 ^h 20 ^m 19 ^s	99° 28' 50"
	8 12 00	82 43 15	8 21 42	99 53 55
	8 13 09	82 19 55	8 24 03	100 36 45
	8 14 13	82 01 05	8 25 20	101 02 35
	8 15 58	81 23 20	8 26 08	101 16 10
	8 17 01	81 01 40	8 27 02	101 32 30
Barometer	29.625	Ther ^o Alt ^o 65° 0	8 28 21	101 57 35

Circum Meridian Altitudes of α Virginis Latitude

May 10 th	9 ^h 44 ^m 35 ^s	66° 57' 50"	9 ^h 57 ^m 46 ^s	67° 08' 40"
9	46 07	67 00 50	9 59 00	67 09 00
9	47 23	67 01 55	10 00 52	67 08 20
9	49 37	67 04 40	10 03 16	67 07 25
9	50 28	67 05 20	10 04 21	67 06 20
9	51 21	67 05 40	10 06 41	67 05 35
9	52 43	67 06 20	10 07 54	67 04 35
9	53 40	67 07 30	10 09 02	67 04 05
9	54 31	67 07 20	10 11 21	67 00 20
9	56 05	67 07 25	10 12 20	66 57 50

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May 10th

Circum Meridian Altitudes of Polaris S.P. Latitude

10 ^h 19 ^m 17 ^s	89° 16' 40"	10 ^h 33 ^m 11 ^s	89° 17' 20"
10 21 33	89 17 00	10 35 31	89 17 40
10 23 35	89 17 00	10 37 04	89 18 20
10 25 48	89 17 10	10 39 45	89 18 50
10 28 05	89 17 00	10 41 09	89 18 50
10 30 17	89 17 15		

May 10th

Circum Meridian Altitudes of Arcturus

Obs ^d Time	Double Alts	Obs ^d Time	Double Alts
10 ^h 44 ^m 48 ^s	127° 45' 05"	10 ^h 51 ^m 57 ^s	127° 49' 00"
10 45 49	127 47 20	10 53 19	48 20
10 46 56	127 48 20	10 56 22	45 35
10 48 58	127 48 20	10 58 00	42 35
10 50 13	127 49 15	11 00 28	127 38 40

Barometer 29.632 Alt. Ther^m 60.5 Del^d Ther^m 60.0
Night favorable. Observations satisfactory.

May 11th

Circum Meridian Altitudes of Sun V.I. Latitude

11 ^h 41 ^m 16 ^s	124° 29' 40"	11 ^h 53 ^m 58 ^s	124° 44' 25"
11 42 13	124 31 30	11 54 39	124 44 30
11 42 59	124 32 40	11 55 34	124 44 30
11 44 04	124 35 50	11 56 43	124 44 10
11 44 56	124 37 45	11 57 23	124 44 15
11 46 03	124 38 20	11 59 03	124 43 30
11 46 59	124 40 00	12 00 16	124 41 20
11 48 42	124 41 55	12 01 33	124 40 20
11 49 31	124 42 25	12 02 44	124 38 55
11 50 30	124 43 15	12 03 30	124 36 50
11 51 16	124 43 30	12 05 29	124 33 00
11 52 26	124 44 40	12 06 31	124 30 55
11 53 22	124 44 40	12 07 18	124 29 00

Barometer 29.700 Ther^m Alt^d 82.0

Measurements of Sun's Semidiameter for Index Error

On arc	32' 45"	Off arc	31' 15"	
" "	32 40	" "	31 20	Night Cloudy
" "	32 35	" "	31 15	
" "	32 40	" "	31 20	

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Double Altitudes of Sun's L.I. for June

Obs. Time	Double alt ^s	Obs. Time	Double alt ^s
8 ^h 58 ^m 22 ^s	88° 54' 30"	9 ^h 08 ^m 17 ^s	92° 03' 50"
9 01 03	89 49 10	9 09 32	92 27 35
9 02 49	90 19 00	9 10 24	92 42 50
9 05 46	91 16 05	9 11 30	93 04 10

Barometer 29.716 Ther. alt. 81.5 Ther. Det. 75.0

Circum Meridian Altitudes of Sun's V.L. Latitude

Obs. Time	Double alt ^s	Obs. Time	Double alt ^s
May 12 th 11 ^h 45 ^m 44 ^s	125° 10' 15"	11 ^h 55 ^m 40 ^s	125° 15' 20"
11 46 15	125 11 55	11 56 37	125 14 30
11 47 22	125 12 05	11 57 28	125 13 35
11 48 32	125 14 45	11 58 13	125 12 00
11 49 27	125 14 20	11 59 09	125 11 40
11 50 25	125 14 25	12 00 35	125 9 55
11 51 32	125 14 50	12 01 26	125 9 05
11 52 14	125 15 30	12 02 11	125 7 40
11 52 57	125 15 30	12 02 47	125 7 25
11 53 33	125 15 15	12 03 22	125 6 50
11 54 15	125 15 20	12 03 52	125 5 45

Barometer 29.664 Ther alt. 87.0 Mercury agitated by wind

Measurements of Sun's Semidiameter for Index Error

Used Large Telescope 32' 45" On arc 31' 00" off arc

32 40 " " 31 05 "

32 40 " " 31 00 "

Small Telescope 33 40 On arc 32 00 off arc

33 30 " " 31 30 " "

33 30 " " 31 20 " "

33 30 " " 31 45 " "

Double Altitudes of Arcturus for June.

May 12 th 8 ^h 22 ^m 52 ^s	103° 18' 10"	8 ^h 27 ^m 02 ^s	104° 25' 15"
8 24 21	103 39 20	8 28 32	104 53 05
8 25 51	104 01 10	8 29 20	105 07 05
Night windy, star misty.	8 30 25	105 26 30	

Bar. 29.580 Ther. alt. 73.0 Det. Ther. 73.0

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May 12th

Circum Meridian Altitudes of Saturn. Latitude

Observed Time	Double alt?	Obs Time	Double alt?
9 ^h 09 ^m 46 ^s	83° 19' 20"	9 ^h 19 ^m 36 ^s	83° 25' 10"
9 11 38	83 20 35	9 21 57	83 25 20
9 13 26	83 22 25	9 23 45	83 24 50
9 16 01	83 24 10	9 25 14	83 23 25
9 17 12	83 24 50	9 25 55	83 23 10
9 18 14	83 25 05	9 26 47	83 22 40

Double Altitudes of α Leonis. TimeMay 12th

Obs Time	Double alt?	Obs Time	Double alt?
9 ^h 33 ^m 54 ^s	86° 20' 00"	9 ^h 38 ^m 49 ^s	84° 46' 00"
9 35 05	85 56 50	9 40 02	84 21 15
9 37 29	85 11 50		

May 12th

Circum Meridian Altitudes of Spica Latitude

Obs Time	Latitude	Obs Time	Latitude
9 ^h 45 ^m 17 ^s	67° 08' 10"	9 ^h 53 ^m 10 ^s	67° 07' 35"
9 46 40	67 08 20	9 55 04	67 06 30
9 49 51	67 08 20	9 57 41	67 03 15
9 51 11	67 07 45		

Barometer 29.560 Alt. Ther. 69.5 Det. 69.5

May 12thDouble Altitudes of Polaris near Lower Cul^m for Latitude

Obs Time	Latitude	Obs Time	Latitude
10 ^h 05 ^m 58 ^s	89° 14' 50"	10 ^h 15 ^m 47 ^s	89° 16' 40"
10 07 50	89 16 25	10 22 49	89 17 25
10 09 29	89 16 20	10 24 14	89 17 25
10 10 46	89 16 20	10 25 49	89 18 00
10 12 42	89 16 35	10 29 14	89 18 40

May 12thCircum Meridian Altitudes of α Bootis Latitude

Obs Time	Latitude	Obs Time	Latitude
10 ^h 34 ^m 19 ^s	127° 46' 15"	10 ^h 42 ^m 45 ^s	127° 47' 20"
10 35 58	127 46 10	10 44 52	127 46 45
10 37 48	127 47 35	10 47 33	127 43 03
10 39 26	127 48 40	10 49 45	127 39 00
10 41 26	127 47 35		

Double Altitudes of Sun^{Tr} for Time

May 13

Bar^m 29.528

Ther. Alt. 75.0

Obs Time	Latitude	Obs Time	Latitude
9 ^h 05 ^m 49 ^s	92° 00' 50"	9 ^h 09 ^m 36 ^s	93° 12' 20"
9 06 31	92 14 00	9 10 11	93 22 25
9 08 39	92 54 45	9 11 16	93 44 20
		9 11 55	93 55 00

1864 Circum Meridian Altitudes of Sun's D.I. Latitude

Obs'd Time	Double alt.	Obs'd Time	Double alt.
11 ^h 49 ^m 23 ^s	125° 43' 50"	11 ^h 56 ^m 30 ^s	125° 42' 00"
11 50 05	125 44 50	11 56 47	125 41 05
11 51 05	125 45 55	11 57 34	125 40 40
11 54 17	125 44 50	11 58 06	125 40 00
11 54 47	125 44 00	11 58 36	125 39 40
11 55 23	125 43 10	11 59 03	125 39 00
11 55 52	125 43 10	11 59 29	125 38 45

Observations good. Barⁿ 29.474 Alt^d Ther. 84.5

Measurements of Sun's Semidiameter for Index Error

On arc	Off arc	Bar ⁿ	Ther. Alt ^d
32' 00"	31' 00"	29.425	89.0
32 00	31 00		5 ^h 30 ^m p.m.
32 00	31 00		

Double Alts for Latitude

Saturn

Polaris 9^h 28^m 17^s 89° 15' 00"

a Virginis

Obs'd Time	Double alt.	Obs'd Time	Double alt.
9 ^h 12 ^m 56 ^s	83° 25' 10"	9 ^h 36 ^m 48 ^s	67° 05' 50"
9 15 53	83 27 10	9 38 58	67 07 25
9 16 58	83 25 00	9 40 36	67 07 20

Night cloudy & windy. Observations not as good as usual.

Circum Meridian Altitudes of Sun's D.I. for Latitude.

Obs'd Time	Double alt.	Obs'd Time	Double alt.
11 ^h 41 ^m 55 ^s	126° 04' 55"	11 ^h 52 ^m 46 ^s	126° 13' 50"
11 42 30	126 06 05	11 53 28	126 13 10
11 43 13	126 07 25	11 54 23	126 12 55
11 43 59	126 08 40	11 54 55	126 11 25
11 44 49	126 09 55	11 55 34	126 11 25
11 45 33	126 10 45	11 56 16	126 10 40
11 46 27	126 11 30	11 56 53	126 10 25
11 47 21	126 12 25	11 57 29	126 09 55
11 48 06	126 12 55	11 58 15	126 08 20 Bar ⁿ
11 49 23	126 13 45	11 59 05	126 08 10 29.560
11 49 59	126 13 35	11 59 53	126 06 25 Alt ^d Ther
11 50 32	126 13 45	12 00 44	126 05 50 78.0
11 51 10	126 13 50	12 01 30	126 04 00
11 51 48	126 13 20	12 02 12	126 03 55

1864 Measurements of Sun's Semidiameter for Index Error.

May 14 th	31' 25" off arc	31' 20" off arc	32' 25" on arc	32' 15" on arc
"	31 30 " "	31 25 " "	32 30 " "	32 20 " "

Double Altitudes of Sun's V.L. for Time.

May 14 th	Obs. Time	Double Alt.	2 ^h 44 ^m 29 ^s	90° 58' 55"
"	2 ^h 38 ^m 59 ^s	92° 43' 40"	45 18	90 43 05
"	2 39 54	92 36 10	46 31	90 20 25
"	2 40 34	92 12 45	47 13	90 06 30
"	2 41 56	91 47 00	47 40	89 57 00
"	2 42 57	91 27 25	Observations good	
"	2 43 45	91 12 00		

Double Altitudes of α Bootis for Time.

May 14 th	8 ^h 07 ^m 08 ^s	101° 21' 10"	8 ^h 13 ^m 47 ^s	103° 13' 20"
"	8 09 08	101 56 40	8 14 55	103 41 05
"	8 10 47	102 27 10	8 16 24	104 07 20
"	8 12 12	102 51 15	8 17 55	104 34 10

Double Altitudes of β Geminorum for Time

May 14 th	8 ^h 26 ^m 25 ^s	71° 40' 00"	8 ^h 31 ^m 37 ^s	69° 52' 40"
"	8 27 08	71 24 55	8 32 41	69 30 55
"	8 30 13	70 21 10	Night calm. no glass cover	
Bar ^m 29.440 Alt. Ther ^m 64.5. on Artificial horizon.				

Circum-Meridian Altitudes of Saturn. Latitude

May 14 th	8 ^h 57 ^m 12 ^s	83° 19' 00"	9 ^h 11 ^m 08 ^s	83° 29' 00"
"	8 58 20	83 21 05	9 12 22	83 29 00
"	9 01 13	83 24 10	9 13 52	83 28 35
"	9 02 16	83 25 00	9 15 37	83 27 10
"	9 03 29	83 26 45	9 17 29	83 25 30
"	9 04 32	83 27 00	9 18 15	83 24 40
"	9 05 45	83 28 30	9 19 27	83 23 35
"	9 06 56	83 28 20	9 20 36	83 22 15
"	9 09 08	83 29 30	9 21 39	83 20 25
"	9 10 14	83 29 00	9 22 45	83 18 50

1864

May 14th *Circum Meridian Altitudes of α Virginis for Latitude*

Obs. Time	Double alt.	Obs. Time	Double alt.
9 ^h 30 ^m 12 ^s	67° 03' 30"	9 ^h 44 ^m 54 ^s	67° 05' 20"
9 32 13	67 05 20	9 46 38	67 04 55
9 35 49	67 07 05	9 48 49	67 02 25
9 39 36	67 08 20	9 51 40	67 00 00
9 42 22	67 07 00	9 53 59	66 55 05

May 14th *Double Altitudes of Polaris near Lower Culmination for Latitude*

Obs. Time	Double alt.	Obs. Time	Double alt.
9 ^h 59 ^m 06 ^s	89° 15' 20"	10 ^h 09 ^m 03 ^s	89° 16' 50"
10 02 13	89 15 55	10 12 41	89 17 05
10 03 36	89 16 30	10 14 39	89 17 15
10 04 55	89 16 20	10 17 47	89 17 50
10 06 07	89 16 15	10 20 58	89 17 40

May 14th *Circum Meridian Altitudes of α Bootis.*

Obs. Time	Double alt.	Obs. Time	Double alt.
10 ^h 24 ^m 06 ^s	127° 43' 50"	10 ^h 32 ^m 45 ^s	127° 48' 20"
10 25 17	127 44 55	10 35 05	127 47 05
10 26 57	127 46 00	10 37 54	127 43 05
10 28 39	127 47 15	10 40 16	127 39 15
10 31 00	127 49 50	Bar ⁿ 29.456 Alt Ther 63.0 Det ⁿ 62.0	

May 15th *Double Altitudes of Sun's I.L. for Time.*

Obs. Time	Double alt.	Obs. Time	Double alt.
8 ^h 46 ^m 07 ^s	86° 45' 30"	8 ^h 48 ^m 33 ^s	87° 33' 55"
8 47 07	87 05 10	8 49 11	87 47 50
8 47 56	87 21 15	8 49 45	87 57 35

Barometer 29.512 Alt. Ther. 69.0.

Measurements of Sun's Semidiameter for Index Error

Off are 31' 20", 31' 20", 31' 20", On are 32' 45", 32' 30", 32' 35,"

May 15th *Circum Meridian Altitudes of Sun's I.L. for Latitude.*

Obs. Time	Double alt.	Obs. Time	Double alt.
11 ^h 44 ^m 00 ^s	125° 33' 10"	11 ^h 52 ^m 01 ^s	125° 37' 25"
11 45 25	34 40	53 06	36 45 Observations
11 46 10	35 10	54 12	36 25 very good.
11 47 04	36 00	54 52	36 00
11 48 12	36 55	55 41	35 35 Bar ⁿ 29.439
11 49 13	37 35	56 08	35 00 Alt. Ther. 69.5.
11 50 10	37 55	56 39	34 15
11 51 13	125 37 30	57 13	33 20
		57 33	33 00

1864
May 15th

Double Altitudes of Sun's I.V. for Time.

Obs'd Time	Double alt ^s	Obs'd Time	Double alt ^s
2 ^h 46 ^m 14 ^s	90° 37' 20"	2 49 39	89° 31' 00"
2 47 22	90 16 00	2 50 44	89 10 40
2 48 06	90 01 10	2 51 09	89 02 20
2 48 37	89 50 50	2 53 23	88 17 55
2 49 10	89 40 25	2 53 56	88 07 30

Barometer 29.387 Ther. Alt. 82°.0 Obs. good.

May 17th

Circum Meridian Altitudes of Spica. Latitude.

Time	Altitude	Time	Altitude
9 ^h 00 ^m 51 ^s	66° 42' 20"	9 ^h 28 ^m 25 ^s	67° 05' 30"
9 04 29	66 50 10	9 29 20	67 04 45
9 06 37	66 53 30	9 30 37	67 03 50
9 07 59	66 56 05	9 32 39	67 01 40
9 09 32	66 59 00	9 33 42	67 00 30
9 11 19	67 00 30	9 35 12	66 59 00
9 12 53	67 02 20	9 36 35	66 57 10
9 14 00	67 03 05	9 38 43	66 53 00
9 16 20	67 05 15	9 40 10	66 50 45
9 20 14	67 06 50	9 41 47	66 47 10
9 22 46	67 07 45		
9 27 19	67 06 20		

May 17th

Double Altitudes of Polaris near Lower Culmination for Latitude.

Time	Altitude	Time	Altitude
9 ^h 44 ^m 55 ^s	89° 16' 00"	10 ^h 05 ^m 17 ^s	89° 18' 20"
9 48 55	89 16 15	10 06 24	89 18 35
9 52 10	89 16 20	10 08 37	89 18 45
9 53 12	89 16 30	10 09 25	89 18 50
9 54 11	89 16 40	10 10 35	89 19 05
9 55 50	89 16 45	10 12 33	89 19 10
9 57 06	89 17 20	10 14 56	89 19 55
9 59 20	89 17 25	10 15 45	89 20 00
10 00 13	89 17 30	10 17 13	89 20 10
10 01 56	89 17 50	10 20 08	89 20 40
10 03 09	89 18 00		

Barometer 29.550 Attached Ther. 65°.0.

1864
May 17th

Double Altitudes of β Leonis for June.

Obs'd Time	Double Alts	Obs'd Time	Double Alts.
10 ^h 31 ^m 09 ^s	88° 00' 00"	8 ^h 39 ^m 10 ^s	85° 30' 00"
10 33 16	87 20 00	8 41 33	84 43 55
10 34 08	87 03 20	8 43 13	84 13 30
10 37 04	86 08 20	8 44 18	83 53 10
10 38 09	85 48 45		

The night was windy, but observations are generally good.

Image of Star in Coincidence, for Index Error - - 0.50"

Astronomical Observations made for the determination of the 46th Degree of Latitude and the Boundary between Oregon & Washington Territory.

Third Station. Situated near the confluence of two creeks which form the easterly tributary of Grand Ronde River, and 6 1/2 miles east of Snake Riv^r.

1864 Double Altitudes of α Bootis for June.

Obs ^d Time	Double Alt	Obs ^d Time	Double Alt
9 ^h 18 ^m 27 ^s	53° 30' 50"	9 ^h 22 ^m 58 ^s	51° 55' 15"
9 20 17	52 51 45	9 24 46	51 18 25
9 21 41	52 23 40		

Double Altitudes of α Aquila for June.

Obs ^d Time	Double Alt	Obs ^d Time	Double Alt
9 ^h 29 ^m 42 ^s	103° 25' 55"	9 ^h 35 ^m 45 ^s	103° 53' 30"
9 32 35	103 39 35	9 38 16	104 04 50
9 34 00	103 44 50	9 40 06	104 13 00

Double Altitudes of Polaris near Upper Culmination for Latitude

Obs ^d Time	Double Alt	Obs ^d Time	Double Alt
2 ^h 32 ^m 51 ^s	94° 47' 15"	2 ^h 59 ^m 59 ^s	94° 52' 00"
2 34 40	94 47 30	3 01 38	94 52 15
2 36 33	94 48 20	3 02 56	94 52 20
2 38 17	94 48 20	3 06 54	94 52 00
2 41 03	94 49 00	3 09 08	94 52 00
2 43 59	94 49 40	3 10 00	94 52 10
2 46 57	94 49 40	3 13 09	94 52 10
2 47 57	94 50 00	3 15 26	94 52 45
2 50 28	94 50 10	3 17 22	94 52 30
2 52 55	94 50 35	3 20 01	94 52 40
2 55 17	94 51 10	3 21 35	94 52 55
2 56 46	94 51 15	3 23 52	94 53 00
2 58 20	94 51 30	3 26 34	94 53 10

1864
August 26th

Double Altitudes of Sun's L.I. for Time.

Obs ^d Time	Double alt ^s	Obs ^d Time	Double alt ^s
9 ^h 27 ^m 14 ^s	69° 25' 55"	9 ^h 33 ^m 00 ^s	71° 13' 45"
9 27 50	69 37 20	9 33 35	71 25 05
9 28 52	69 56 45	9 34 14	71 37 25
9 30 15	70 22 30	9 34 58	71 51 25
9 30 51	70 33 20	9 35 30	72 00 40
9 31 40	70 49 00	9 36 16	72 14 50

Barometer 28.916 Alt Ther^m 77.5.

Measurements of Sun's Semidiameter for Index Error.

Off arc	On arc	Off arc	On arc
32' 05"	31' 00"	32' 20"	30' 50"
" " 32 10	" " 31 00	" " 32 12	" " 30 57

August 26th

Circum Meridian Altitudes of Sun's L.I. for Latitude

Obs ^d Time	Double Alt ^s	Obs ^d Time	Double Alt ^s
12 ^h 26 ^m 07 ^s	107° 20' 25"	12 ^h 45 ^m 54 ^s	107° 44' 40"
12 26 46	107 22 05	12 46 43	107 44 25
12 27 32	107 23 50	12 47 12	107 43 40
12 28 09	107 25 35	12 47 50	107 43 30
12 28 53	107 26 55	12 48 30	107 43 20
12 29 51	107 29 55	12 49 12	107 42 50
12 30 43	107 31 00	12 50 50	107 41 50
12 31 28	107 31 50	12 52 17	107 40 45
12 32 37	107 34 40	12 52 47	107 39 35
12 33 22	107 36 10	12 53 25	107 39 10
12 34 14	107 37 45	12 54 17	107 37 20
12 34 58	107 38 50	12 55 02	107 36 30
12 35 33	107 39 35	12 57 06	107 32 50
12 37 03	107 40 35	12 57 38	107 31 30
12 38 09	107 42 00	12 58 14	107 30 25
12 39 48	107 43 40	12 58 39	107 29 00
12 40 37	107 44 35	12 59 29	107 27 20
12 41 42	107 45 25	1 00 16	107 25 45
12 42 19	107 46 00	1 00 57	107 24 30
12 42 48	107 45 20	1 02 05	107 20 55
12 43 27	107 45 00	1 02 35	107 19 35
12 44 26	107 44 50		

Barometer 28.888 Ther^m Alt^d 88.5 Ther^m Det^d 89.0

1864

Double Altitudes of α Bootis for Time.

Obs. Time	Double Alt.	Obs. Time	Double Alt.
8 ^h 30 ^m 37 ^s	69° 43' 40"	8 ^h 35 ^m 11 ^s	68° 08' 15"
8 32 29	69 05 50	8 36 12	67 48 10
8 34 08	68 31 50	8 37 24	67 23 00

Double Altitudes of α Aquila for Time.

Obs. Time	Double Alt.	Obs. Time	Double Alt.
8 ^h 42 ^m 15 ^s	97° 00' 35"	8 ^h 45 ^m 02 ^s	97° 29' 25"
8 43 09	97 09 05	8 47 56	98 00 00
8 44 10	97 20 10	8 48 42	98 09 40

Barometer 28.862 True Alt. 80° 0

Circum Meridian Altitudes of α Aquila

Obs. Time	Double Alt.	Obs. Time	Double Alt.
August 26 th 9 ^h 43 ^m 14 ^s	104° 26' 55"	10 ^h 05 ^m 43 ^s	105° 03' 20"
9 46 02	104 37 10	10 06 44	105 03 50
9 47 31	104 39 45	10 08 58	105 03 25
9 48 47	104 44 20	10 10 05	105 02 05
9 50 15	104 49 10	10 11 45	105 01 30
9 51 08	104 50 10	10 13 31	104 59 00
9 52 12	104 51 50	10 14 55	104 57 05
9 54 20	104 55 55	10 16 38	104 54 25
9 55 55	104 57 40	10 18 03	104 51 25
9 57 29	104 58 35	10 19 07	104 50 10
9 58 36	105 00 00	10 20 45	104 46 25
9 59 55	105 01 45	10 22 35	104 42 20
10 01 23	105 02 55	10 23 32	104 39 55
10 02 37	105 03 05	10 25 07	104 35 00
10 04 11	105 03 20	10 26 50	104 30 30
Star dim and unsteady		10 28 01	104 25 40

Circum Meridian Altitudes of β Ceti.

Obs. Time	Double Alt.	Obs. Time	Double Alt.
August 26 th 2 ^h 54 ^m 22 ^s	50° 35' 25"	3 ^h 03 ^m 53 ^s	50° 34' 25"
2 57 14	50 37 20	3 05 47	50 33 40
2 59 45	50 36 20	3 12 48	50 14 40
3 02 02	50 35 30	Indifferent Observations	

1864

Circum Meridian Altitudes of Sun's D.I.
for Latitudes, observed at the terminating monument
on Snake River. Oregon & Washington Boundary.

August 28th

Old Time	Double Alt	Old Time	Double Alt
12 ^h 20 ^m 47 ^s	106° 22' 10"	12 ^h 45 ^m 57 ^s	107° 24' 30"
12 22 00	106 27 45	12 46 36	107 25 40
12 22 41	106 31 20	12 47 00	107 25 25
12 23 16	106 33 15	12 48 42	107 25 25
12 24 04	106 36 30	12 49 23	107 27 10
12 24 45	106 39 45	12 50 29	107 25 40
12 25 22	106 41 15	12 51 07	107 26 30
12 26 22	106 45 30	12 52 10	107 25 50
12 26 47	106 46 10	12 52 51	107 24 55
12 27 17	106 47 20	12 53 53	107 24 10
12 27 53	106 49 45	12 54 37	107 23 55
12 28 27	106 51 00	12 55 23	107 23 40
12 29 22	106 53 45	12 56 02	107 22 55
12 30 03	106 55 40	12 57 18	107 21 55
12 30 31	106 57 25	12 57 55	107 21 00
12 31 19	107 00 00	12 58 22	107 20 30
12 32 04	107 02 00	12 58 58	107 19 30
12 32 36	107 03 00	12 59 40	107 19 10
12 33 10	107 04 30	1 00 13	107 18 00
12 34 21	107 07 10	1 00 40	107 17 05
12 35 13	107 08 30	1 01 17	107 16 20
12 36 22	107 11 30	1 01 50	107 15 35
12 37 24	107 13 50	1 02 38	107 14 00
12 38 32	107 16 00	1 03 18	107 13 00
12 39 14	107 17 10	1 04 07	107 10 30
12 39 50	107 17 50	1 04 35	107 09 05
12 40 24	107 18 30	1 05 00	107 08 15
12 41 06	107 19 25	1 05 41	107 07 50
12 42 07	107 20 50	1 06 09	107 06 35
12 43 10	107 22 15	1 06 58	107 04 10
12 43 43	107 22 40	1 07 27	107 02 55
12 44 11	107 23 05	1 08 04	107 01 30
12 44 42	107 23 55	1 08 35	107 00 55
12 45 17	107 23 50	1 09 40	106 57 30

Circum Meridian Altitudes observed at terminating
Monument Snake River - Sun's V.L. Latitude

1864

Obs'd Time Double Alts
1^h 10^m 09^s 106° 55' 00"

August 28th

Obs'd Time	Double Alts	Measurements of the Sun's Semidiameter for Index Error.
1 10 50	106 53 05	
1 12 20	106 48 05	
1 12 58	106 45 35	
1 13 33	106 43 55	
1 14 17	106 41 10	On arc 32' 05"
1 15 00	106 38 45	" " 32 10
1 16 35	106 33 45	" " 32 10
1 17 00	106 30 20	Off Arc 31 45
1 17 34	106 28 45	" " 31 30
1 17 59	106 27 15	" " 31 20
1 18 29	106 25 05	
1 19 38	106 20 00	

Measurements of Sun's Semidiameter for Index Error.

August 29th

Obs'd Time	Double Alts	Measurements of Sun's Semidiameter for Index Error.
On arc 32' 30"	32' 10"	Off arc 31' 35" 31' 30"
" " 32 35	32 15	" " 31 35 31 30

Circum Meridian Altitudes of Sun's V.L. made at
Monument on Boundary Line. Latitude

August 29th

Obs'd Time	Double Alts	Obs'd Time	Double Alts
12 ^h 22 ^m 53 ^s	105° 36' 25"	12 ^h 36 ^m 42 ^s	106° 23' 30"
12 24 16	105 42 10	12 37 31	106 24 45
12 24 44	105 44 55	12 38 30	106 27 10
12 25 13	105 46 50	12 39 31	106 29 20
12 26 19	105 51 00	12 40 25	106 30 35
12 27 04	105 53 25	12 41 06	106 31 50
12 27 45	105 56 45	12 42 52	106 34 40
12 28 15	105 58 50	12 43 33	106 36 25
12 29 00	106 01 20	12 44 05	106 36 40
12 32 39	106 13 00	12 44 38	106 37 15
12 33 22	106 14 35	12 45 06	106 37 40
12 34 35	106 18 10	12 45 43	106 38 50
12 35 15	106 19 40	12 46 58	106 39 30
12 35 50	106 21 30	12 47 39	106 39 55

1864 Circum Meridian Altitudes of Sun's U.L.
made at Monument on Boundary Line.

	Obs. Time	Double Alt.	Obs. Time	Double Alt.
August 29 th	12 ^h 48 ^m 23 ^s	106° 40' 40"	1 ^h 05 ^m 55 ^s	106° 29' 40"
	12 48 59	106 41 05	1 06 43	106 27 55
	12 49 58	106 41 35	1 08 48	106 22 50
	12 50 36	106 41 55	1 09 31	106 21 25
	12 51 15	106 42 25	1 10 17	106 19 30
	12 52 03	106 42 20	1 11 08	106 17 20
	12 52 53	106 42 50	1 11 45	106 16 15
	12 55 37	106 42 00	1 12 16	106 14 10
	12 56 10	106 41 25	1 12 51	106 12 35
	12 56 53	106 41 25	1 13 32	106 10 30
	12 57 43	106 40 35	1 14 09	106 09 10
	12 58 17	106 40 20	1 14 40	106 07 10
	12 58 48	106 39 55	1 15 12	106 05 05
	12 59 33	106 39 00	1 15 41	106 04 10
	1 00 17	106 38 35	1 16 11	106 02 35
	1 01 07	106 37 05	1 16 47	106 00 00
	1 01 50	106 36 10	1 17 36	105 57 40
	1 02 26	106 35 45	1 18 23	105 54 00
	1 03 15	106 34 30	1 18 57	105 52 00
	1 03 59	106 33 20	1 19 32	105 49 55
	1 04 53	106 31 45	1 20 10	105 47 20
	1 05 21	106 30 35	1 20 43	105 44 50
			1 21 35	105 41 30
Bar. ^h	28.750	Alt. Sun 88° 0	1 22 28	105 38 00
			1 23 07	105 34 55

1864
August 26

Circum Meridian Altitudes of Polaris &c.

Observations taken at Third Station. Latitude

Obs ^d Time	Double Alt ^s	3 ^h 36 ^m 54 ^s	94° 53' 30"
3 ^h 18 ^m 05 ^s	94° 52' 20"	3 40 18	94 53 10
3 20 38	94 52 40	3 43 23	94 53 20
3 23 42	94 52 30	3 44 36	94 53 00
3 25 17	94 53 00	3 46 58	94 52 40
3 30 13	94 53 20	3 49 03	94 52 40
3 32 16	94 53 30	3 51 10	94 52 00
3 34 47	94 53 40	3 54 08	94 51 50

Unreliable. Night unfavorable.

Circum Meridian Altitudes of α Aquila. Latitude

Obs ^d Time	Double Alt ^s	Obs ^d Time	Double Alt ^s
August 29 th 9 ^h 41 ^m 09 ^s	104° 30' 00"	9 ^h 58 ^m 29 ^s	105° 02' 15"
9 42 43	104 34 00	10 00 45	105 02 30
9 43 55	104 37 10	10 02 25	105 03 50
9 45 20	104 40 40	10 03 43	105 03 25
9 47 49	104 46 50	10 07 12	105 03 30
9 49 07	104 50 00	10 10 46	104 59 55
9 52 11	104 54 40	10 12 10	104 58 00
9 53 24	104 56 10	10 13 14	104 55 25
9 55 42	105 00 10	10 14 49	104 53 20
Bar ^o 28.800	66° 0' Alt Ther ^o	10 16 43	104 49 45

Night partially cloudy.

Double Altitudes of α Lyrae for Time.

Obs ^d Time	Double Alt ^s	Obs ^d Time	Double Alt ^s
August 29. 10 ^h 49 ^m 21 ^s	134° 16' 10"	11 ^h 02 ^m 57 ^s	129° 32' 10"
10 50 01	134 04 20	11 05 33	128 41 40
10 52 54	133 03 00	11 07 37	127 56 50
10 56 15	131 52 55	11 08 54	127 29 25
10 56 55	131 37 35		

Reduction of Observations made at Station
first, Cotton Wood Creek. 2nd Computation.

Double altitudes of a single for Chron. Error.

1863.
 November 18.

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \cdot \sin (\frac{1}{2} s - A) \sec I \times \operatorname{Cosec} \Delta$$

	Double alt ^s	Double alt ^s	
	95° 01' 10"	99° 28' 45"	* ^s A.R. 5 ^h 06 ^m 41.4
	96 17 30	100 31 50	Sid. M. Noon 15 49 26.1
	97 19 30	101 35 00	* ^s Decl. 45° 51' 14".5
Mean Double Alt ^s	96 12 43.3	100 31 51.7	Approx. Long. 2 ^h 45 ^m 21 ^s
Index Error	- 2 36.0	- 2 36.0	Approx. Lat 45° 59' 10"
Cor ^d M. Double Alt ^s	96 10 07.3	100 29 15.7	Bar ^m 28.500
Obs ^d alt	48 05 03.6	50 14 37.8	True alt? 46° 0'
Refraction	- 50.2	- 46.5	True Det.? 46.0
Cor ^d Alt. = A	48 04 13.4	50 13 51.3	Refraction
polar Dist. = Δ	44 08 45.5	44 08 45.5	β log 9.9772
Approx ^d Lat = I	45 59 10	45 59 10.	t " 36
Sum = s	138 12 08.9	140 21 46.8	z " 2
1/2 s	69 06 04.4	70 10 53.4	r " 1.7195
(1/2 s - A)	21 01 51	19 57 02.1	log. ref ⁿ 1.7005
Sec I	0.15812	0.15812	ref ⁿ 50."2
Cosec Δ	0.15708	0.15708	
Cos 1/2 s	9.55233	9.53025	
Sin (1/2 s - A)	9.55494	9.53302	log. p.t.c. 9.9810
Sin ² 1/2 p	9.42247	9.37847	log. r 1.6864
Sin 1/2 p	9.71123	9.68924	log ref ⁿ 1.6674
hour angle p	4 07 36.7	3 54 09.3	ref ⁿ - 46."5
* A.R.	5 06 41.4	5 06 41.4	
Sid. time Obs ^d	0 59 04.7	1 12 32.1	Obs ^d times
Sid. time M. Noon	15 49 26.1	15 49 26.1	8 ^h 46 ^m 03 ^s 9 ^h 00 ^m 05 ^s
Sid. interval past M.N.	9 09 38.6	9 23 06.0	9 49 56 9 03 00
Retardation.	1 30.0	1 32.2	53 09 9 06 20
Mean Time obs ^d	9 08 08.6	9 21 33.8	8 49 42.7 9 03.08.3
Obs ^d Time	8 49 42.7	9 03 08.3	
Chronometer slow.	18 25.9	18 25.5	

Mean Correction to Chronometer at 9^h 15^m 18^m 25^s 7.

7.80

Reduction of Observations of Polaris

$$I = A - (\Delta \cos p) + a(\Delta \sin p)^2 \tan A - \beta R$$

1863

November 18 th	Obs ^d Times	Obs ^d Times	Obs ^d Times	Obs ^d Times		
	9 ^h 24 ^m 50 ^s	9 ^h 32 ^m 50 ^s	9 ^h 46 ^m 39 ^s	9 ^h 54 ^m 43 ^s		
	9 28 28	9 35 40	9 48 20	9 58 05	* ^s AR	1 ^h 10 ^m 15.4
	9 30 45				Sid. M. Noon	15 49 26.1
Mean Obs ^d time	9 28 01.	9 34 15.0	9 47 29.5	9 56 24.0	Sid. interval	9 20 49.3
Chron slow	+ 18 25.7	+ 18 25.7	+ 18 25.7	+ 18 25.7	Retardation	- 1 31.9
Cor ^d time Obs ^d	9 46 26.7	9 52 40.7	10 05 55.2	10 14 49.7	M. Time Cul ⁿ	9 19 17.4
Mean Time * ^s Cul ⁿ	9 19 17.4	9 19 17.4	9 19 17.4	9 19 17.4		
Hour angle in M. T.	27 09.3	33 23.3	46 37.8	55 32.3	* ^s Dec ⁿ	88° 35' 18.4
					Δ	1 24 41.6
Sid. equivalents	6° 46' 06".5	8° 16' 21".3	11° 31' 53".3	13° 47' 15".5	"	84 41.6
in arcs	2 15.4	5 49.9	9 16.5	8 01.3	Δ in seconds	5081.6
	4.5	4.5	12.0	4.5		
hour angle in arc = p	6 48 26.4	8 22 11.7	11 41 21.8	13 55 21.3	Refraction	
					Bar	28.500
log cos p	9.996927	9.995350	9.990899	9.987050	Ther. Alt ^d	46°
log Δ in seconds	3.706000	3.706000	3.706000	3.706000	Ther. Det ^d	46°
$\Delta \cos p$	3.702927	3.701350	3.696899	3.693050	9.9772	β
	5045".8	5027".5	4976".2	4932.3	36	t
1 st term	1 24 05.8	1 23 47.5	1 22 56.2	1 22 12.3	2	r
Obs ^d Double alt ^s	94° 52' 10"	94° 51' 55"	94° 50' 50"	94° 49' 40"	1.7298	r
	52 10	94 51 20	50 30	49 00.	1.7108	log ref
	52 05				51.4	
Mean Double alt ^s	94 52 08.3	94 51 37.5	94 50 40	94 49 20	$\tan A \times a(\Delta \sin p)^2$	
Index Corr ⁿ	- 2 36.0	- 2 36	- 2 36	- 2 36	Δ	3.7060 3.7060
Cor ^d Double alt	94 49 32.3	94 49 01.5	94 48 04	94 46 44	$\sin p$	9.3813 9.0738
Altitude	47 24 46.1	47 24 30.7	47 24 02	47 23 22	$\Delta \sin p$	3.0873 2.7798
Ref ⁿ	- 51.4	- 51.4	- 51.4	- 51.5	a	4.3845 4.3845
Cor Alt = A	47 23 54.7	47 23 39.3	47 23 10.6	47 22 30.6	$\tan A$	0.0360 0.0365
1 st term	1 24 05.8	1 23 47.5	1 22 56.2	1 22 12.3	2 nd term	0.5951 9.9806
Approx Lat	45 59 48.9	45 59 51.8	46 00 14.4	46 00 18.3	+ 3.7	+ 0.9
2 nd term	+ 0.9	+ 1.3	+ 2.6	+ 3.7		
Latitude	45 59 49.8	45 59 53.1	46 00 17.0	46 00 22.0		
Weight	3	2	1	1		
Mean Latitude from 9 Obs ^s	46° 00' 03".7					

Reduction of Observations of Sirius U.L. Time.

1863

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} \delta \sin (\frac{1}{2} s - A) \operatorname{Cosec} \Delta \sec I.$$

November

20th

	Obs'd Time.	Obs'd Time.	Obs'd Time.	
	2 ^h 19 ^m 30 ^s	2 ^h 22 ^m 42.0	2 ^h 32 ^m 35.5	Bar ⁿ 28.578
	2 20 51.5	2 24 03.5	2 33 57.5	Alt. Ther ⁿ 44°
	2 21 49.0	2 24 51.0		Obs'd Ther ⁿ 46°
Mean of Obs'd times	2 20 43.5	2 23 52.2	2 33 16.5	Refraction
Line	U L	U L	L. L.	log β 9.9790
Obs'd Double Alt ^s	31° 15' 20"	30° 33' 40"	27° 18' 50"	" t 3
" " "	30 58 00	30 15 50	26 58 00	" r 36
" " "	30 45 20	30 05 50		log r 2.3279
Mean Obs'd Double Alts	30 59 33.3	30 18 26.7	27 08 25	2.3108
Index Error	- 2 15.0	- 2 15.0	- 2 15	3' 24.5" = 204.5"
Cor ^d Obs'd Double alt	30 57 18.3	30 16 11.7	27 06 10	
Altitude	15 28 39.1	15 08 05.8	13 33 05	p.t.r 9.9829
Refn	- 3 19.9	- 3 24.5	- 3 48.7	log r 2.3180
Cor Alt	15 25 19.2	15 04 41.3	13 29 16.3	2.3009
Par	+ 8.4	+ 8.4	+ 8.4	3' 19.9" 199.95
Cor ^d alt \ominus	15 25 27.6	15 04 49.7	13 29 24.7	
Semidiam	- 16 14.1	- 16 14.1	+ 16 14.1	p.t.r 9.9829
Cor ^d alt \ominus 's center = A	15 09 13.5	14 48 35.6	13 45 38.8	log r 2.3764
polar Dist 1 = Δ	109 45 36.7	109 45 38.2	109 45 43.7	2.3593
Approx Lat	L 45 59 10	45 59 10	45 59 10	3' 48.7" 228.7
Sum = s	170 54 00.2	170 33 23.8	169 30 32.5	
$\frac{1}{2} s$	85 27 00.1	85 16 41.9	84 45 16.2	
$(\frac{1}{2} s - A)$	70 17 47	70 28 06.	70 59 37.0	
Sec I	0.15812	0.15812	0.15812	3 ^m 08.4
Cosec Δ	0.02635	0.02635	0.02635	3 08.4
Cos $\frac{1}{2} s$	8.89943	8.91549	8.96106	3 08.4
Sin $(\frac{1}{2} s - A)$	9.97379	9.97427	9.97566	3 09.7
Sin ² $\frac{1}{2} p$	9.05769	9.07423	9.12119	3 09.7
Sin $\frac{1}{2} p$	9.52884	9.53711	9.56059	3 09.7
hour angle = p	2 38 00.8	2 41 10.8	2 50 33.5	3 08.2
Equation of time	14 08.9	14 08.9	14 08.8	3 08.2
Cor ^d Time	2 23 51.9	2 27 01.9	2 36 24.7	
Obs'd Time	2 20 43.5	2 23 52.2	2 33 16.5	
Chro ⁿ slow	- 3 08.4	- 3 09.7	- 3 08.2	
Chro ⁿ slow at 2 ^h 29 ^m			3 ^m 08.8	

Reduction of Circum Meridian Observations of Sirius U.I. No. 20th 1863

Obs. Time	Druse alt	Cor Obs ^{ns}	K	log K	Cor Double alt	altitude	Refr ⁿ	semd. r.p.	cor alt. 0
11 ^h 47 ^m 12.0	49° 10' 15"	12 ^h 04 ^m 25.4	38.4	1.58433	49° 07' 53.3	24° 33' 56.7	2 01.6	18 07.6	24 15 49.1
11 49 03.	09 50	06 16.2	77.2	1.88762	07 28.3	33 42.2	2 01.6	07.6	15 36.6
11 51 08	08 10	08 21.6	137.2	2 13735	05 48.3	32 54.1	2 1.8	07.8	14 46.3
11 52 38	06 30	09 51.7	190.9	2 28081	04 08.3	32 42	2 1.8	07.8	13 56.4
12 00 58	48 56 00	18 11.9	649.8	2 81278	48 53 38.3	26 49.1	2 2.4	08.4	8 40.7
12 02 11	53 40	19 24.9	739.7	2.86906	57 18.3	25 39.2	2 2.6	08.6	7 30.6
12 04 18	49 30	21 32.0	909.8	2 95895	47 08.3	23 34.1	2 2.7	08.7	5 25.4
12 05 16	47 20	22 30.0	993.2	2.99704	44 58.3	22 29.2	2 2.7	08.7	4 20.5
12 05 50	46 30	23 4.2	1044.1	3.01874	44 08.3	22 4.1	2 2.8	08.8	3 55.3
12 07 18	43 10	24 32.2	1181.0	3.07225	40 48.3	20 24.2	2 2.9	08.9	2 15.3
12 08 13	41 00	25 27.3	1270.8	3.10408	38 38.3	19 19.1	2 3.0	09.0	1 10.1
12 09 07.5	39 00	26 21.9	1363.3	3.13459	36 38.3	18 19.2	2 3.2	09.2	0 10.0
12 10 19 0	48 35 50	12 27 33.2	1488.9	3.17286	48 33 28.3	24 16 44.1	2 3.2	18 09.2	23 58 34.9

Red to head	ΔS	Sum of Red ^{ns}	True Alt	Cor. Lat.	Latitude	Elev of true	Par. in alt	Index Error	ΔS limb	log I	log D	log Z	log L
27.6	+ 0.1	0 27.7	24° 16' 16.8	44° 00' 26.8	45° 59' 33.2	14 10.6	14	10.6	16	14.2	14	10.6	14
55.5	1.1	56.6	16 33.2	00 43.2	16.8	16	14.2	16	14.2	16	14.2	16	14.2
98.6	2.2	1 40.8	16 27.1	00 37.1	22.9	16	14.2	16	14.2	16	14.2	16	14.2
137.2 - 0.0	3.1	2 20.3	16 16.7	00 26.7	33.3	16	14.2	16	14.2	16	14.2	16	14.2
466.9 - 0.2	7.8	7 54.5	16 35.2	00 45.2	14.8	16	14.2	16	14.2	16	14.2	16	14.2
531.5 - 0.3	8.5	8 59.7	16 30.3	00 40.3	19.7	16	14.2	16	14.2	16	14.2	16	14.2
653.7 - 0.5	9.6	11 02.8	16 28.2	00 38.2	21.8	16	14.2	16	14.2	16	14.2	16	14.2
713.6 - 0.5	10.3	12 03.4	16 23.9	00 33.9	26.1	16	14.2	16	14.2	16	14.2	16	14.2
750.3 - 0.6	10.5	12 40.2	16 35.5	00 45.5	14.5	16	14.2	16	14.2	16	14.2	16	14.2
848.5 - 0.8	11.5	14 19.2	16 34.5	00 44.5	15.5	16	14.2	16	14.2	16	14.2	16	14.2
913.1 - 0.9	12.0	15 24.2	16 34.3	00 44.3	15.7	16	14.2	16	14.2	16	14.2	16	14.2
979.6 - 1.1	12.5	16 31.0	16 41.0	00 51.0	09.0	16	14.2	16	14.2	16	14.2	16	14.2
1069.8 - 1.2	+ 13.1	18 01.7	24 16 36.6	44 00 46.6	45 59 13.4	24	16	36.6	44	00	46.6	45	59

Par. 28.570	True alt 46°	True. Dist ⁿ 48	log r	Refn - 121.6	2.10424	2.08500
9.84188	Chal. Error + 3.02.8	9.97371	" rate 2.5 limb	0.04021	65	9.85645
Mean result of 13 Obs ^{ns} 45° 59' 19.7						

Reduction of Observations of a Lyrae for Time

1863

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin(\frac{1}{2} s - A) \sec I \cos c \Delta.$$

November 21st

Observed Time	7 ^h 47 ^m 15. ^s 0	7 ^h 49 ^m 35. ^s 5	* ^s AR 18 ^h 32 ^m 19. ^s 0
" " "	7 48 35.0	7 51 04.5	δ + 38° 39' 48"
Mean of Obs ^d Time	7 47 55.0	7 50 20.0	Sid. M. H. 16 ^h 01 ^m 15. ^s 8

Obs ^d Double Alt	65° 18' 50"	64° 35' 40"	Bar 28.590
" " "	64 55 10	64 06 55	Ther Alt 29.5
Mean Double alt	65 07 00.	64 21 18.5	Ther Det? 30.0
Index Error	- 2 29.6	- 2 29.6	
Cor Double alt	65 04 30.4	64 18 49.	Refraction
altitudes	32 32 15.2	32 09 24	log β 9.9791
Refraction	- 1 31	- 1 32	" t 185
Cor alt.?	32 30 44	32 07 52	" r 9
polar dist Δ	51 20 12	51 20 12	" r 1.9605
Assu ^d Lat I	45 59 10	45 59 10	log ref ^a 1.9590
sum = s	129 50 06	129 27 14	Ref - 91.0
1/2 s	64 55 03	64 43 37	
(1/2 s - A)	32 24 19	32 35 45	log β 9.9791
sec I	0.15812	0.15812	" t 185
cos c Δ	0.10744	0.10744	" r 9
cos 1/2 s	9.62729	9.63036	" r 1.9669
sin(1/2 s - A)	9.72908	9.73136	Ref ^a 1.9654
sin ² 1/2 p	9.62193	9.62728	Ref - 92.3
sin 1/2 p	9.81096	9.81364	
hour angle: p	5 22 34.5	5 24 59.0	
* ^s AR	18 32 19.0	18 32 19.0	
Sidereal time Obs	23 54 53.5	23 57 18.0	
Sidereal Time M. noon	16 01 15.8	16 01 15.8	
Sid. interval post M. n	7 53 37.7	7 56 02.2	
Retardation	- 1 17.6	- 1 18.0	
Mean Time	7 52 20.1	7 54 44.2	
Observed Time	7 47 55.0	7 50 20.0	
Chro ^d slow	+ 4 25.1	+ 4 24.2	

1863

Reduction of Observations of June.

November 21 st	$\sin \frac{1}{2} p = \cos \frac{1}{2} s \sin(\frac{1}{2} s - A) \sec I \operatorname{cosec} \Delta$			
* Name	α Tauri	β Orionis	β Orionis	β Orionis.
Obs ^d Times	10 ^h 23 ^m 24 ^s .0	10 ^h 46 ^m 11 ^s .5	10 ^h 59 ^m 56 ^s .5	11 03 42.5
" "	10 25 58.0	10 49 25.0	11 01 25.0	11 08 27.5 Bar: 28.610
Mean Obs ^d Time	10 24 41.0	10 47 48.2	11 02 36.0	11 06 05.0 Alt. Ther ² 22.5
			11 01 19.2	Det ² Ther 18°
Double Alts	103° 07' 10"	55 57 10	58 51 10	59 36 05
" "	103 48 00	56 44 50	59 08 20	60 28 00 Refraction
Mean Double Alts	103 27 35	56 21 00	59 06 33.3	60 02 03 β 9.9792
Index Error	- 2 30	- 2 30	- 2 30.0	- 2 30 12
Cor Double Alt	103 25 05	56 18 30	59 04 03	59 59 33 300
Altitude	51 42 32	28 09 15	29 32 02	29 59 46.5 1.6636
Refraction	- 0 47	- 1 52	- 1 45.6	- 1 43.6 1.6730
Cor ^d Altitude A	51 41 45	28 07 23	29 30 16	29 58 03. - 47".0
John Diet Δ	73 46 02	98 21 42	98 21 42	98 21 42
Assumed Lat I	45 59 10	45 59 10	45 59 10	45 59 10 0.0117
$\sin = S$	171 26 57	172 28 15	173 51 08	174 18 55 0364
$\frac{1}{2} S$	85 43 28	86 14 07	86 55 34	87 09 27.5 0.0481
$(\frac{1}{2} S - A)$	34 01 43	58 06 44	57 25 18	57 11 24 - 111".7
Sec I	0.15812	0.15812	0.15812	0.15812 - 1' 51".7
Cosec Δ	0.01767	0.00465	465	465
Cos $\frac{1}{2} S$	8.87246	8.81730	8.72936	8.69537 9.9795
$\sin(\frac{1}{2} S - A)$	9.74788	9.92895	9.92565	9.92452 309
$\sin^2 \frac{1}{2} p$	8.79613	8.90902	8.81778	8.78266 12
$\sin \frac{1}{2} p$	9.39807	9.45451	9.40889	9.39133 2.0119
p	1 55 51.2	2 12 22	1 58 50.7	1 54 02.0 2.0235
* ^s A.R.	4 28 09.1	5 08 02	5 08 01.9	5 08 01.9 105".6
Sid. time Obs ^d	2 32 17.9	2 55 40	3 09 11.2	3 13 59.9 - 1' 45".6
Sid. M. noon	16 01 15.8	16 01 15.8	16 01 15.8	16 01 15.8
Sid. interval post M.	10 31 02.1	10 54 24	11 07 55.4	11 12 44.1 0.0117
Retardation	- 1 43.4	- 1 47	- 1 49.4	- 1 50.0 2.0037
Cor Time of Obs ^d	10 29 18.7	10 52 37	11 06 06.0	11 10 54.1 2.0154
Obs ^d time	10 24 41.0	10 47 48	11 01 19.2	11 06 05.0 103".6
Cher ^d slow	4 37.7	4 49	4 46.8	4 49.1 1' 43".6

1863

Reduction of Observations of Polaris

$$I = A - (\Delta \cos p) + \alpha (\Delta \sin p)^2 \tan A - \nu$$

November 21st

	Obs ^d time	Obs ^d time	Obs ^d time	Obs ^d time	
	8 ^h 44 ^m 16.0	8 ^h 51 ^m 00.0	8 ^h 57 ^m 35.0	9 ^h 15 ^m 45.0	* ^s AR 1 ^h 10 ^m 13.6
	8 49 22.0	8 56 03.0	8 59 11.0	9 21 12.0	sid m. n 16 01 15.8
Mean of Obs ^d times	8 46 49.0	8 53 31.5	8 58 23.0	9 18 28.5	sid interval 9 08 57.8
Chro ^d Error	+ 4 38.6	4 38.9	4 39.1	4 39.9	Reduction 1 29.9
Cor ^d time of Obs ^d	8 51 27.6	8 58 10.4	9 03 02.1	9 23 08.4	Mean Time Cul ⁿ 9 07 27.9
Mean time * Cul ⁿ	9 07 27.9	9 07 27.9	9 07 27.9	9 07 27.9	Declination 88° 35' 19".4
Hour angle in M.T.	16 00.3	9 17.5	4 25.8	15 40.5	Δ 1 24 40.6
					84 40.6
Sidereal Equiva ^l	4 00 39.4	2 15 22.2	1 00 09.9	3 45 36.9	Δ in seconds 50 80.6
lewis in arc	4.5	4 15.7	6 16.0	10 01.6	log Δ 3.705915
		7.5	12.0	7.5	Bar 28.594
hour angle in arc p	4 00 43.9	2 19 45.4	1 06 37.9	3 55 46.1	alt then 24.0
					Det then 20.0
Cos p	9.998934	9.999641	9.999919	9.998978	Refraction
log Δ in seconds	3.705915	3.705915	3.705915	3.705915	9.9791
Δ Cos p	3.704849	3.705556	3.705834	3.704893	11
	5068.1	5076.4	5079.6	5068.6	280
1 st term	-1 24 28.1	1 24 36.4	1 24 39.6	1 24 28.6	1.7295
					1.7387
Obs ^d Double Alt	94° 52' 35"	94° 52' 10"	94° 52' 10"	94° 52' 30"	refn - 54".8
	94 52 20	94 53 00	94 54 50	94 52 35	$\alpha (\Delta \sin p)^2 \tan A$
Mean Obs ^d Double Alt ^d	94 52 27.5	94 52 35	94 54 30	94 52 32.5	Δ 3.7059
Index Cor ⁿ	- 2 29.6	- 2 29.6	- 2 29.6	- 2 29.6	$\sin p$ 8.8436
Cor ^d Double Alt	94 49 57.9	94 50 05.4	94 52 00.4	94 50 02.9	$\Delta \sin p$ 2.5495
Altitude	47 24 58.9	47 25 02.7	47 26 00.2	47 25 01.4	α 4 3845
Refraction	- 54.8	- 54.8	- 54.8	- 54.8	$\tan A$ 0.0365
Cor ^d Alt ^d = A	47 24 04.1	47 24 07.9	47 25 05.4	47 24 06.6	2 nd term 9.5200
1 st term	-1 24 28.1	-1 24 36.4	-1 24 39.6	-1 24 28.6	+ .3
Approx Lat ^d	45 59 36.0	45 59 31.5	46 00 25.8	45 59 38.0	
2 nd term	+ 0.3	+ 0.2	+ 0.0	+ 0.3	
Latitude	45 59 36.3	45 59 31.7	46 00 25.8	45 59 38.3	

Mean Latitude from 8 Obsⁿ 45° 59' 48".0

Reduction of Observations of Polaris.

1863

November 21

$$I = A - (\Delta \cos p) + a (\Delta \sin p)^2 \tan A + k$$

Obs ^d time	11 ^h 17 ^m 45 ^s 0	11 ^h 20 ^m 38 ^s 0	11 ^h 22 ^m 59 ^s 0	11 ^h 25 ^m 04 ^s 0	11 ^h 27 ^m 13 ^s 0	Bar
Chr ^s slow	+ 4 45.8	+ 4 46.1	+ 4 46.4	+ 4 46.7	+ 4 47.0	28.632
Cor ^d time Obs ^d	11 22 30.8	11 25 24.1	11 27 45.4	11 29 50.7	11 32 00.0	All Ther
Mean Time * Cal ⁿ	9 07 27.9	9 07 27.9	9 07 27.9	9 07 27.9	9 07 27.9	21.0
hour angle - p	2 15 02.9	2 17 56.2	2 20 17.5	2 22 22.8	2 24 32.1	Ex. Ther 16.0
Sidereal	30 04 52.7	30 04 52.7	30 04 52.7	30 04 52.7	30 04 52.7	Refr
equivalents	3 45 37.0	4 15 41.9	5 00 49.3	5 30 54.2	6 0 59.1	9.9792
in arc	30.1	14 02.3	4 15.7	5 30.9	8 01.3	5
	13.5	3.0	7.5	12.0	1.5	13
hour angle p in arc	33 51 13.3	34 34 39.9	35 10 05.2	35 41 29.8	36 13 54.6	319 1.7333
log cos p	9.919320	9.915587	9.912470	9.909646	9.906676	1.7462
" Δ in seconds	3.705915	3.705915	3.705915	3.705915	3.705915	55.7
Δ cos p	3.625235	3.621502	3.618385	3.615561	3.612591	2 nd term sin p 9.7459
	4219".2	4183".1	4153".2	4126".3	4098".2	
1 st term	1 10 19.2	1 09 43.1	1 09 13.2	1 08 46.3	1 08 18.2	Δ 3.7059 sin p Δ 3.4518
Obs ^d Double Alt.	94 26 00	94 24 00	94 22 20	94 21 05	94 19 25	α 4.3845
Index Error	- 2 29.6	- 2 29.6	- 2 29.6	- 2 29.6	- 2 29.6	tan A 0.0330
Cor ^d D. Alt	94 23 30.4	94 21 30.4	94 19 50.4	94 18 35.4	94 16 55.4	1.3211
Altitude	47 11 45.2	47 10 45.2	47 09 55.2	47 09 17.7	47 08 27.7	20".9
Refraction	- 55.7	- 55.7	- 55.7	- 55.8	- 55.8	sin p 9.7716
Cor ^d alt?	47 10 49.5	47 09 49.5	47 08 59.5	47 08 21.9	47 07 31.9	Δ 3.7059
1 st term	-1 10 19.2	-1 09 43.1	-1 09 13.2	-1 08 46.3	-1 08 18.2	sin p Δ 3.4775
Approt Lat.	46 00 30.3	46 00 06.4	45 59 46.3	45 59 35.6	45 59 13.7	α 4.3845
2 nd term	+ 20.9	+ 21.7	+ 22.5	+ 23.3	+ 24.1	0.0322
Latitude	46 00 51.2	46 00 28.1	46 00 08.8	45 59 58.9	45 59 37.8	1.3717 23".6

Mean Latitude from 5 Obs^{ns} 46° 00' 12".9

1863 Reduction of Circum Meridian Altitudes of a Tauri for Latitude
 November 21st

Obsd time	hour	angle	Obs'd double alt	Cor'd D. alt	altitude	Ref ⁿ	Cor'd alt
12 ^h 02 ^m 07.0	-	17 ^m 54 ^s	120° 05' 20"	120° 02' 50.4	60° 01' 25".2	- 34.7	60° 00' 50".5
04 58.5		15 03	13 30	11 00.4	05 30.2	34.7	04 55.5
07 24		12 37	16 40	14 10.4	07 05.2	34.6	06 30.6
10 09		9 52	23 45	21 15.4	10 37.7	34.5	10 03.2
12 43		7 18	29 50	27 20.4	13 40.2	34.4	13 05.8
15 32		4 29	33 25	30 55.4	15 27.7	34.3	14 53.4
19 17	-	0 44	34 05	31 35.4	15 47.7	34.3	15 13.4
20 55	+	0 54	33 00	30 30.4	15 15.2	34.3	14 40.9
23 17		3 16	31 30	29 00.4	14 30.2	34.4	13 55.8
24 29		4 28	31 10	28 40.4	14 20.2	34.4	13 45.8
26 48		6 47	29 40	27 10.4	13 35.2	34.4	13 00.8
30 19		10 18	24 50	22 20.4	11 10.2	34.5	10 35.7
32 59		12 58	19 20	16 50.4	08 25.2	34.5	07 50.7
35 29		15 28	13 10	10 30.4	05 15.2	34.6	04 40.6
36 47		16 46	09 05	07 05.4	03 32.7	34.7	02 58.0
12 37 45		17 44	120 04 20	120 01 50.4	60 00 55.2	- 34.7	60 00 20.5

K	log K	log Red to Merid	Red to Merid	Red to Merid	Merid alt	Latitude
628.8	2.79851	2.93001	851.2 - 3.1	14' 08".1	60° 14' 58".6	45° 58' 59".9
444.6	2.64797	2.77947	601.8 - 1.5	10 00.3	14 55.8	59 02.7
312.5	2.49485	2.62635	423.0 - 0.8	7 02.2	13 32.8	Reject
191.1	2.28126	2.41276	258.7 - 0.3	4 18.4	14 21.6	59 36.9
104.6	2.01953	2.15103	141.6 - 0.1	2 21.5	15 27.3	58 31.2
39.5	1.59660	1.72810	53.5	53.5	15 46.9	58 11.6
1.1	0.04139	0.17289	1.5	01.5	15 14.9	58 43.6
1.6	0.20412	0.33562	2.2	02.2	14 43.1	59 15.4
20.9	1.32015	1.45165	28.3	28.3	14 24.1	59 34.4
39.2	1.59329	1.72479	53.1	53.1	14 38.9	59 19.6
90.3	1.95569	2.08719	122.2 - 0.1	2 02.1	15 02.9	58 55.6
208.3	2.31869	2.45019	282.0 - 0.3	4 41.7	15 17.4	58 41.1
330.0	2.51851	2.65001	446.7 - 0.9	7 25.8	15 16.5	58 42.0
469.5	2.67164	2.80314	635.5 - 1.7	10 33.8	15 14.4	58 44.1
551.7	2.74170	2.87320	746.8 - 2.4	12 24.4	15 22.4	58 36.1
617.2	2.79043	2.92193	835.5 - 3.0	13 52.5	60 14 13.0	45 59 45.5
Cos L		9.84188	Chord Cor ⁿ 4 ^m 51.5			
Cos S		9.98233	Mean Result of 15 Obs ^{ns}		45° 58' 58".6	
		9.82421				

Reduction of Circum Meridian Altitudes of Sun's U.L.

1863

November 23 rd	Obs ^d time	Obs ^d D. alt	Cor D. alt	alt [?]	semid. ref. pa	
11	36 ^m 55 ^s	47° 54' 00"	47° 51' 56.8"	23° 55' 58.4"	-18' 18.7"	
11	40 29	54 30	52 26.8	56 13.4	18.7	Semidiam 16' 14.7"
11	44 21	53 40	51 36.8	55 48.4	18.7	∠ 20° 23' 12.6"
11	46 23	52 20	50 16.8	55 08.4	18.8	Eg ^t of time
11	47 05	52 10	50 06.8	55 03.4	18.8	13 ^m 23.4
11	48 03	50 45	48 41.8	54 20.9	18.8	par. in alt +7.9
11	49 03	50 10	48 06.8	54 3.4	18.9	Obs ^d slow
11	50 14	49 30	47 26.8	53 43.4	18.9	6 ^m 43.0
11	51 44	48 10	46 06.8	53 03.4	19.0	Chro. Time 0° Cal ^m
11	55 38	42 45	40 41.8	50 20.9	19.2	11 ^m 39 ^s 54.
11	56 49	40 55	38 51.8	49 25.9	19.3	Index Error
11	58 26	47 38.00	35 56.8	23 47 58.4 -18	19.5	-2 03.2

Cor ^d alt ^d	hour angle	A	log A+k	AK	∠	cor merid alt	Latitudes
23° 37' 39.7	- 2 ^m 59 ^s	17.5	1.09554	+ 12.5	-1.6	23° 37' 50.6	45° 58' 56.8
37 54.7	+ 0 35	0.7	9.69760	0.5	+0.2	37 55.4	58 52.0
37 29.7	4 27	38.9	1.44245	27.7	+2.3	37 59.7	58 47.7
36 49.6	6 29	82.5	1.76895	58.7	+3.4	37 51.7	58 55.7
36 44.6	7 11	101.3	1.85811	1 12.0	+3.7	37 60.3	58 47.1
36 02.6	8 09	130.4	1.96778	1 32.8	+4.2	37 39.1	58 68.3
35 44.5	9 09	164.4	2.06840	1 57.1	+4.7	37 46.3	58 61.1
35 24.5	10 20	209.6	2.17389	2 29.2	+5.2	37 58.9	58 48.5
34 44.4	11 50	274.9	2.29167	3 15.7	+6.0	37 66.1	58 41.3
32 01.7	15 44	485.8	2.53896	5 45.9	+8.2	37 55.8	58 51.6
31 06.6	16 55	561.6	2.60193	6 39.0	+8.7	37 54.3	58 53.1
23 29 38.9	+ 18 32	674.1	2.68122	8 00.0	+9.6	23 37 48.5	45 58 58.9

Formulae of reduction

$$x = A \times \frac{\cos I \cos d}{\sin Z}$$

$$B \times \left(\frac{\cos I \cos d}{\sin Z} \right)^2 \cot Z$$

$$A = \frac{2 \sin^2 \frac{1}{2} P}{\sin 1''}$$

$$B = \frac{2 \sin^4 \frac{1}{2} P}{\sin 1''}$$

L	45° 59' 10"	Cos	9.84187
∠	-20 23 12.6	Cos	9.97191
Z	66 22 22.6	Cosec	0.03802
		log i	70
Coefficient K		log	9.85250

Mean Result of 12 Observations 45° 58' 53.5"

Reduction of Observations of Sun's V.I. for Time.

1863

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin (\frac{1}{2} s - A) \sec I \cos \Delta$$

November 24 th	8 ^m 57 ^m 27 ^s	28° 46' 50"		
	8 58 41	29 02 45	30° 13' 10"	9 ^m 04 ^m 09 ^s
	8 59 45	29 16 50	30 32 45	9 05 45
	9 00 50	29 30 50	30 52 10	9 07 21
	9 02 26	29 51 20	31 10 20	9 08 45.5
	9 03 03	29 59 00	31 23 10	9 09 47.0
	9 00 22	29 24 36		
Mean Obs ^d Alt	29 24 36		30° 50' 15".5	9. 07 09.5
Index Error	- 2 25		2 25	
Cor ^d D. alt	29 22 11		30 47 50.5	Bar ^m 28.550
Altitude	14 41 05		15 23 55.7	Ther Alt ^d 34.0
Ref & par. i alt	- 3 28		- 3 17.4	Ther Det ^d 35.0
Altitude to Cor ^d	14 37 37		15 20 38.3	Refraction
Semidiam	- 16 15		16 14.9	β 9.97848
Cor alt O'center	14 21 22		15 04 23	+ 13 79
polar Dist	110 34 08		110 34 13	2 70
Latitude	45 59 10		45 59 10	9.99297
Sun	170 54 40		171 37 46	log ⁿ 2.34 137
$\frac{1}{2} s$	85 27 20		85 48 53	1 st rep ⁿ 2.33 434
$(\frac{1}{2} s - A)$	71 05 58		70 44 30	- 3' 36" 2.16"
Sec I	0. 15812		0. 15812	
Cosec Δ	0. 02861		0. 02861	9.99297
Cos $\frac{1}{2} s$	8. 89890		8. 86321	2.32 026
Sin $(\frac{1}{2} s - A)$	9. 97593		9. 97499	2.31 323
$\sin^2 \frac{1}{2} p$	9. 06156		9. 02493	- 3' 25".7 205".7
Sin $\frac{1}{2} p$	9. 53 078		9. 51 246	
p	2 ^m 38 ^m 45 ^s		2 ^m 31 ^m 56 ^s	
time App. ^t	9 21 15		9 28 04.0	
Eqs ⁿ of time	13 08.2		13 08.2	
Mean Time Obs ⁿ	9 08 06.8		9 14 55.8	
Obs ^d time	9 00 22.0		9 07 09.5	
Chro ^m slow	7 44.8		7 46.3	

Mean of Chro^m Error 7^m 45.5 slow

Reduction of Observations of Sun's V.L. Time

1863	Obs ^d Double Alt ^s	Obs ^d Times		Obs ^d Double Alt	Obs ^d Times
	29° 53' 25"	2 ^h 14 ^m 55 ^s	$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} S \sin(\frac{1}{2} S - A) \sec I \operatorname{Cosec} \Delta$		
November	29 32 00	16 38			
24 th	29 20 30	17 30			
	29 09 50	18 19		28° 12' 10"	2 ^h 22 ^m 47 ^s
	28 38 40	20 45		28 00 40	2 23 38
	28 23 00	2 21 55		27 43 50	2 24 52
Mean Obs ^d Alt ^s	29 09 34	2 18 20.3		27 58 53.3	2 23 45.7
Index Error	- 1 43			- 1 43.3	
Cor ^d D. Altitude	29 07 51			27 57 10.0	Bar 28.478
Altitude	14 33 55.5			13 58 35	Att ^d Ther ^o 39.5
Refraction	- 3 34.6			- 3 43.8	Det ^d Ther ^o 40.0
Cor ^d Alt ^s O ^r U ^L	14 30 20.9			13 54 57	
Parallax in Alt	+ 8.3			+ 8	Refraction
Semidiameter	- 16 14.8			- 16 15	
Altitude O ^r Center	14 14 14			13 38 44	log B 9.97742
polar dist Δ	110 36 50			110 36 52	+ 43
Latitude I	45 59 10			45 59 10	2 914
Sum	170 50 14			170 14 46	r 2.34475
1/2 S	85 25 07			85 07 23	2.33174
(1/2 S - A)	71 10 53			71 28 39	Refn 214"6
Sec I	0.15812			0.15812	3' 34" 6
Cosec Δ	0.02873			0.02873	
Cos 1/2 S	8.90242			8 92950	9.98699
Sin (1/2 S - A)	9.97614			9.97690	2.36300
Sin ² 1/2 p.	9.06541			9.09325	2.34999
Sin 1/2 p	9.53270			9.54662	Refn 223.8
p = hour angle	2 39 29 0			2 44 54.5	- 3 43.8
Eqt ^h of time	13 04.5			13 04.5	
Mean Time Obs ^d	2 26 24.5			2 31 50.0	
Obs ^d Time	2 18 20.3			2 23 45.7	
Chro ^d slow.	8 04.2			- 8 04.3	

Mean of Chro^d Errors 8^h 04.5 2

omission

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Reduction of Observations of Sirius U.I. Time

1863

November 26th

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin (\frac{1}{2} s - A) \sec I \operatorname{Cosec} \Delta$$

Obs ^d Double Alt	29° 09' 20"	9 08 ^m 48 ^s	30° 03' 30"	9 ^h 13 ^m 07 ^s
	20 40	9 09 41	30 22 10	14 37
	34 10	9 10 44	30 32 20	15 27
	39 45	9 11 11	30 39 30	16 03
	48 10	9 11 52	30 51 25	17 01
	54 30	9 12 24	30 57 50	17 33.5
Mean Obs ^d Double Alt ^s	29 34 26	9 10 46.7	30 34 27.5	9 15 38.1
Index Error	-1 55		-1 55	
Cor ^d O. D. Alt ^s	29 32 31	$\delta - 20^\circ 57' 41''$	30 32 32.5	$\delta - 20^\circ 57' 43''$
Altitude	14 46 15.5		15 16 16.2	
Refraction	- 3 34.6		- 3 30.8	Bar 28.354
Cor ^d Altitude ^o	14 42 40.9		15 12 45.4	alt ^d then 32.0
Par in alt	+ 8.4		+ 8.4	Cor ^d then 31.0
Semi-diam	- 16 15.2		16 15.2	
Cor Alt O ^c Center	14 26 34.1		14 56 38.6	Refraction
polar dist.	110 57 41.		110 57 43	9.97473
Latitude	45 59 10		45 59 10	78
Sum	171 23 25		171 53 32	1754
$\frac{1}{2} s$	85 41 42		85 56 46	2.33866
$(\frac{1}{2} s - A)$	71 15 8		71 00 07	2.33171
Sec I	0.15812		0.15812	- 3' 34".6
Cosec Δ	0.02974		0.02974	
Cos $\frac{1}{2} s$	8.87543		8.84939	9.99305
Sin $(\frac{1}{2} - A)$	9.97633		9.97567	2.32397
Sin ² $\frac{1}{2} p$	9.03962		9.01292	207.6 2.31712
Sin $\frac{1}{2} p$	9.51981		9.50646	- 3' 27".6
p	9 25 22.5		9 30 13.6	
Eqt ^d of time	12 31.6		12 31.6	
Mean Time	9 12 50.9		9 17 42.0	
Obs ^d time	9 10 46.7		9 15 38.1	
Chro ^d . slow	2 04.2		- 2 03.9	

Mean Chro^d. Error 2^m 04.5

Reduction of Observations of Sun Nov^r 26th

Obs ^d times	Obs ^d Double alt.					
2 ^h 31 ^m 21 ^s	27° 03' 00"	L	45° 59' 10"	sin 1/2 p	9.55420	
32 29	26 48 00	Δ	111 00 12	haz angle	2 47 56.7	
35 40	26 04 50	A	12 58 10	8 th time	12 29.1	
2 33 10.	26 38 37.0	sun	169 57 32	cor time	2 35 27.6	
Index Error	- 2 08.0	1/2 s	84 58 46	Obs ^d time	2 33 10.0	
Cor Double Alt	26 36 29.0	(1/2 s - A)	72 00 36	Obs ^d slow	2 17.6	
altitude	13 18 14.5	True	0.15812			
Ref ⁿ	- 3 57.7	Δ Cor	2986	δ	- 21° 00' 12"	
Cor Alt UL	13 14 16.8	cor 1/2 s	8.94220			
Semidiam ^s per	16 07.0	sin (1/2 s - A)	9.97823			
Cor alt - 0° Center	12 58 10	sin 1/2 p	9.10841			

Refraction
2.38402
9 37466
1660
78
10
2.37616
237.7

Reduction of Observations of Sun's V.L. Nov^r 26th 1863

Obs ^d times	Cor times	haz angle	H	1 st time	2 nd time	Obs ^d Double Alt.
11 ^h 35 ^m 59 ^s	11 ^h 38 ^m 10 ^s	- 9 ^m 21 ^s	171.6	120.9	-4.4	46° 37' 55"
37 10	39 21	8 10	130.9	92.4	3.8	46 39 15
38 10	40 21	7 10	100.8	70.5	3.4	46 39 40
39 28	41 39	5.52	67.6	47.9	2.8	46 40 20
40 06	42 17	5 14	53.8	38.1	2.5	46 40 55
40 55	43 06	4 25	38.3	26.7	2.1	46 41 15
42 04.5	44 15	3 16	20.9	14.8	1.6	46 41 40
44 19.0	46 30	- 1 01	2.0	1.4	-0.5	46 41 40
45 25	47 36	+ 0 05	0.0	0.0	± 0.0	46 42 20
49 21	51 52	4 01	31.7	22.5	+ 1.9	46 41 10
50 01	52 12	4 41	43.1	30.3	2.3	46 40 50
52 12	54 23	6 52	92.6	65.7	3.2	46 39 35
53 22.5	55 33	8 02	126.7	89.5	3.8	46 38 35
11 55 50.5	11 58 01	+10 30	216.4	152.3	+4.8	46 36 25

Index Error - 2' 05".5 L 45° 59' 10" cos 9.84188
 hazily Δ 28".3 δ 20 58 54 cos 9.97020
 par in. alt. 7.9 γ 66 58 4 Correc 0.03593
 Refraction 2 11.9 Coefficient 0.708 9.84801
 Obs^d slow 2^m 10".8

Reduction of Observations of Sun's U.I. Latitude

Number

26th

Cor. Double alt.	Cor. alt. 0° center.	Cor. Mer. alt.	
46° 35' 49.5	22° 59' 35.5	23° 01' 32.0	
46 37 09.5	23 00 15.5	23 01 44.1	Mean 23° 01' 37.0
46 37 34.5	23 00 28.0	23 01 35.1	δ 20 58 53.8
46 38 14.5	23 00 48.0	23 01 33.1	Clat 44 00 30.8
46 38 49.5	23 01 05.5	23 01 41.1	1406 ^m 45 59 29.2
46 39 09.5	23 01 15.5	23 01 40.1	
46 39 34.5	23 01 28.0	23 01 41.2	
46 39 34.5	23 01 28.0	23 01 28.9	
46 40 14.5	23 01 48.0	23 01 48.0	
46 39 04.5	23 01 13.0	23 01 37.4	
46 38 44.5	23 00 03.0	23 01 35.6	
46 37 49.5	23 00 35.5	23 01 44.4	
46 36 29.5	22 59 55.5	23 01 28.8	
46 34 19.5	22 58 50.5	23 01 27.6	

Reduction of Observations of Polaris.

Nov. 26th

1 st time	2 nd time	3 rd time	Double alt.	altitude	
5 38 25	5 40 44	22 02 38.4	93° 57' 30"	46° 57' 45"	
39 53	42 12	4 06.6	58 35	58 17.5	
43 56	46 15	8 10.2	94 01 15	59 36.5	
47 51	50 10	12 05.9	02 40	47 00 20	
52 08	54 27	16 23.7	04 05	01 02.5	
54 25	56 44	18 41.0	05 55	01 57.5	
5 56 03	58 22	20 19.0	07 15	02 37.5	
5 58 05	6 00 24	22 21.0	94 08 30	47 03 15.0	
Cor. alt.?	1 st term	2 nd term	3 rd term	Sum	Latitude
46° 56' 49.5	- 58' 24.3	+ 35.0	+ 34.0	= -57' 15.3	45° 59' 34.2
46 57 22.0	- 58 48.4	34.4	34.0	= 57 40.4	59 41.6
46 58 41.1	59 53.2	33.4	34.0	= 58 46.2	59 54.9
46 59 24.6	60 54.7	33.0	33.0	= 59 48.7	59 35.9
47 00 07.1	62 00.7	31.0	33.0	= 60 56.7	59 10.4
47 01 02.1	62 35.5	30.4	33.0	= 61 32.5	59 29.6
47 01 42.1	62 59.5	30.0	33.0	= 61 56.5	59 45.6
47 02 25.0	64 00.0	+ 29.0	+ 33.0	= -62 58.0	45 59 27.0
Index Error - 2' 00.0	δ = 88° 35' 20.7	Chol. slow	2 ^m 19.0		
Ref ⁿ - 55.4	AR 1 ^m 10 ^m 11.6				
Mean Result of 8 Obs ^s 45° 59' 34.9					

Reduction of Circum Meridian Altitudes of Juis V.L.

1863			rate	Cor time	Obs ⁿ	hour	Angle	K	Log K	Coeff x K	1 st term	2 ^d	Red to hor?	
11 ^h	22 ^m	05 ^s	0.0	11 ^h	29 ^m	58 ^s	4 - 16 ^m	55 ^s	562.2	2.74989	2.60045	398.5	-8.7	6' 29.8
	22	46	0.0	30	39.4	16	14.5	517.7	71408	56464	367.0	8.2	5 58.8	
	23	46	0.1	31	39.5	15	14.4	456.3	65897	50953	323.2	7.6	5 15.6	
	24	41	0.1	32	34.5	14	19.4	402.7	60498	45554	285.5	7.3	4 38.2	
	25	20	0.1	33	13.5	13	40.4	367.0	56467	41523	260.2	6.9	4 13.3	
	26	00	0.2	33	53.6	13	00.3	332.0	52114	37170	235.3	6.6	3 48.7	
	27	01	0.2	34	54.6	11	59.3	282.1	45040	30096	200.0	6.0	3 14.0	
	28	46	0.3	36	39.7	10	14.2	205.7	31323	16379	145.8	5.1	2 20.7	
	30	04	0.4	37	57.7	8	56.2	156.8	19535	2.04591	111.2	4.5	1 46.7	
	31	04	0.4	38	57.8	7	56.1	123.6	2.09202	1.94258	87.6	4.0	1 23.6	
	32	11	0.5	40	04.5	6	49.4	91.2	1.96000	1.81056	64.6	3.8	1 00.8	
	34	04	0.6	41	57.9	4	56.0	47.8	1.67943	1.52999	33.9	2.5	31.4	
	35	48	0.6	43	42.0	3	11.9	20.1	1.30320	1.15376	14.2	1.5	12.7	
	36	24	0.7	44	18.0	2	35.9	13.3	1.12385	0.97441	9.4	1.3	8.1	
	38	24	0.8	46	18.1 - 0	0	35.8	0.7	9.84510	9.69566	0.5	-0.2	0.3	
	39	00	0.8	46	54.2 + 0	0	00.3	0.0					0.0	
	40	19	0.8	48	13.2	1	19.3	3.4	0.53148	0.38204	2.4	+0.7	3.1	
	41	09	0.9	49	03.3	2	09.4	9.1	0.95904	0.80960	6.4	1.1	7.5	
	41	58	0.9	49	52.3	2	58.4	17.3	1.23805	1.08861	12.3	1.5	13.8	
	43	17	1.0	51	11.4	4	17.5	36.1	1.55751	1.40807	25.6	2.1	27.7	
	44	20	1.0	52	14.4	5	20.5	56.0	1.74819	1.59875	39.7	2.7	42.4	
	44	52	1.0	52	46.4	5	52.5	67.8	1.83123	1.68179	48.1	3.0	57.1	
	45	22	1.1	53	16.5	6	22.6	79.8	1.90200	1.75256	56.6	3.2	59.8	
	46	03	1.1	53	57.5	7	03.6	97.8	1.99034	1.84090	69.3	3.5	1 12.8	
	47	10	1.2	55	04.6	8	10.7	131.3	2.11826	1.96882	93.1	4.1	1 37.2	
	48	31	1.2	56	25.6	9	31.7	178.2	2.5091	2.10147	126.3	4.8	2 11.1	
	49	02	1.2	56	56.6	10	02.7	198.0	2.9667	2.14723	140.4	5.0	2 25.4	
	49	37	1.3	57	31.6	10	37.7	221.6	3.4557	1.9613	157.1	5.3	2 42.4	
	50	23	1.3	58	17.7	11	23.8	255.0	4.0654	2.5710	180.8	5.7	3 06.5	
	51	51	1.4	59	45.8	12	51.9	325.0	5.1188	3.6244	230.4	6.4	3 56.8	
	52	24	1.4	60	18.8	13	24.9	353.3	5.4814	3.9870	250.4	6.7	4 17.1	
	53	11	1.4	61	05.8	14	11.9	395.7	5.9737	4.4793	280.5	7.0	4 47.5	
	54	23	1.6	62	17.9	15	24.0	465.5	6.6792	5.1848	330.0	7.6	5 37.6	
	56	15	1.6	64	10.0	17	16.1	585.2	7.6730	6.1786	414.8	8.5	7 03.3	
	56	58	1.6	64	53.0	17	59.1	634.8	8.0244	6.5320	450.0	8.9	7 38.9	
11	58	01	1.7	11	65	55.1	19	01.2	709.7	2.85107	2.70163	503.1	+9.3	8 32.4

Reduction of Circum Meridian Altitudes of Sun U.L. Latitude (Continued).							
Obs ^d Double alt	Cor Double alt	Altitude	Mer ^d Alt	O ^c center	Colat	Latitude	E ^q of Time
47° 16' 10"	47° 13' 53.4	23° 36' 56.7	23° 25' 11.8	44° 00' 41.3	45° 59' 18.7	13 ^m 06 ^s .14	
17 00	14 43.4	37 21.7	25 05.8	35.3	24.7	Ch ^d slow at	
18 25	16 08.4	38 04.2	25 05.5	35.0	25.0	Mean noon	
19 20	17 03.4	38 31.7	24 56.1	25.6	34.4	7 ^m 54 ^s .8	
20 40	18 23.4	39 11.7	25 10.3	39.8	20.2	rate 3 ^s .00	
21 30	19 13.4	39 36.7	25 10.7	40.2	19.8	per hour	
22 15	19 58.4	39 59.2	24 58.5	28.0	32.0	Semi-diameter	
24 10	21 53.4	40 56.7	25 04.9	34.4	25.6	16' 14".9	
25 20	23 03.4	41 31.7	25 03.9	33.4	26.6	Refraction	
26 10	23 53.4	41 56.7	25 06.9	36.4	23.6	2.12211	
27 00	24 43.4	42 21.7	25 08.1	37.6	22.4	9.97772	
28 05	25 48.4	42 54.2	25 10.8	40.3	19.7	91	
28 20	26 03.4	43 01.7	25 00.1	29.6	30.4	21	
29 00	26 43.4	43 21.7	25 15.5	45.0	15.0	455	
29 10	26 53.4	43 26.7	25 12.7	42.2	17.8	2.10550	
29 05	26 48.4	43 24.2	25 09.4	38.9	21.1	Ref ⁿ - 127".5	
28 55	26 38.4	43 19.2	25 07.5	37.0	23.0	Par. in alt 8".0	
29 05	26 48.4	43 24.2	25 16.9	46.4	13.6	I. 45° 59' 10"	
28 55	26 38.4	43 19.2	25 18.2	47.7	12.3	J - 20 35 29.5	
28 20	26 03.4	43 01.7	25 15.1	44.6	15.4	J 66 34 39.5	
27 20	25 03.4	42 31.7	24 59.8	29.3	30.7		
27 20	25 03.4	42 31.7	25 08.5	38.0	22.0	Cor I. 9.84188	
27 40	25 23.4	42 41.7	25 27.1	56.6	03.4	Cor ^d 9.97133	
26 40	24 23.4	42 11.7	25 10.0	39.5	20.5	Cor ^d 0.03735	
26 00	23 43.4	41 57.7	25 14.3	43.8	16.2	Co ^{eff} 9.85056	
24 25	22 08.4	41 04.2	25 00.7	30.2	29.8	0.7089	
24 20	22 03.4	41 01.7	25 12.6	42.1	17.9		
23 45	21 28.4	40 44.2	25 12.0	41.5	18.5	Co ^{eff} of 2 nd term	
22 45	20 28.4	40 14.2	25 06.1	35.6	24.4	= - 0".22	
21 00	18 43.4	39 21.7	25 04.8	34.3	25.7	Mean Result	
20 45	18 28.4	39 14.2	25 16.5	46.0	14.0	of 36 Obs ^{ns}	
19 30	17 13.4	38 36.7	25 09.5	39.0	21.0		
18 00	15 43.4	37 51.7	25 14.6	44.1	15.9	45° 59' 20".6	
15 10	12 53.4	36 26.7	25 15.3	44.8	15.2		
14 00	11 43.4	35 57.7	25 16.0	45.5	14.5		
47 12 25	47 10 08.4	23 35 04.2	23 25 21.3	44 00 50.8	45 59 09.2		

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Reduction of Observations of α Aquila for Time.

$$\sin^2 \frac{1}{2} p = \cos \delta \sin \left(\frac{1}{2} s - A \right) \sec I \csc \Delta$$

November 27 th	Obs. Double Alt	Obs. Time		Obs. Double Alt	Obs. Time
	63° 00' 30"	6 ^h 46 ^m 24 ^s .5		60° 36' 50"	6 53 46
	62 12 40	6 48 49.0		60 09 50	6 55 08
	61 28 10	6 51 06.0		58 56 10	6 58 57.5
Mean Obs. Double Alt	62 13 47	6 48 46.5		59 54 17	6 55 55.2
Index Error	- 1 42.5			1 42.5	
Cor. M. D. Alt?	62° 12' 04.5	Refraction		59 52 34.5	Refraction
Altitude	31 06 02.2	1.98646		29 56 17.2	2.00658
Refraction	1 36.7	170		1 41.3	183
Cor. Altitude	31 04 25.5	9.97772		29 54 35.9	2.00475
* Polar Dist = Δ	81 29 07	80		81 29 07	79
Latitude = I	45 59 10	95		45 59 10	2.00554
Sun	158 32 42	2132		157 22 52.9	101".3
$\frac{1}{2}$ Sun	79 16 21	1.98555		78 41 26.4	Ref ⁿ i 41".3
$(\frac{1}{2} s - A)$	48 11 56	Ref 96".7		48 46 50.5	
sec I	0.15812			0.15812	
Cosec Δ	482			482	
Cor $\frac{1}{2} s$	9.26983			9.29249	
$\sin(\frac{1}{2} s - A)$	9.87242			9.87633	
$\sin^2 \frac{1}{2} p$	9.30519			9.33176	
$\sin \frac{1}{2} p$	9.65259			9.66588	
hour Angle p	3 33 37.4			3 40 48.7	
$X^s R$	19 44 08.4			19 44 08.4	
AR of Merid.	23 17 45.8			23 24 57.1	
Sid Mean Noon	16 24 55.0			16 24 55.0	
Sid interval	6 52 50.8			7 00 02.1	
Retardation	1 07.6			1 08.8	
Mean Time Obs	6 51 43.2			6 58 53.3	
Observed Time	6 48 46.5			6 55 55.2	
Chas. slow	2 56.7			2 58.1	

Mean of Chas. Errors 2^m 57.4
 Hourly rate 1.75

1863.

Reduction of Altitudes of Polaris. Latitude.

November
24th

Obs ^d Time	Cor Time	Sid Time at G ^h	Double Alt	Cor Double Alt
5 ^h 37 ^m 28 ^s .0	5 ^h 40 ^m 24 ^s	22 ^h 06 ^m 15 ^s	94° 00' 05"	93° 58' 23"
40 01.0	42 57	8 48	94 01 40	93 59 58
41 31.0	44 27	10 19	94 02 50	94 01 08
42 57.5	45 47	11 39	94 03 15	94 01 33
44 38.0	47 34	13 26	94 04 20	94 02 38
47 04.0	50 00	15 52	94 05 30	94 03 48
49 18.0	52 14	18 06	94 06 45	94 05 03
5 50 34.0	5 53 30	22 19 23	94 07 10	94 05 28

Altitude	Ref ⁿ	1 st tan	2 nd tan	3 rd tan	Red	Latitude.
46° 59' 11".5	- 0' 55"	- 59' 23"	+ 34"	+ 34"	- 59' 10	46° 00' 01".5
46 59 59.0	0 55	60 03	33	34	59 51	46 00 08.0
47 00 34.0	0 55	60 27	32	34	60 16	46 00 18.0
47 00 46.5	0 55	60 48	32	34	60 37	46 00 09.5
47 01 19.0	0 55	61 15	31	34	61 05	46 00 14.0
47 01 54.0	0 55	61 53	31	34	61 43	46 00 11.5
47 02 31.5	0 55	62 26	30	34	62 17	46 00 14.5
47 02 44.0	- 0.55	- 62 46	+ 30	+ 34	- 62 37	46 00 07.0

Longitude West of G ^h	7 ^h 53 ^m 32 ^s	Mean Result of 8 Observations
Cor ^d Time Observation	5 40 24	
Greenwich Mean Time Obs ^d	13 33 56	46° 00' 10".4
Sid. Mean Noon Greenwich	16 23 37	
Cor ^d time Obs ^d	5 40 24	
Acceleration	2 14	
Sid Time G ^h Obs ^d	22 06 15	

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Reduction of Observations of α Pegasi for Latitude

November 27th

Obs ^d Time	Cor ^d Time	Time	h ^{rs} m ⁱⁿ s ^{ec}	sec int	K	Red to land	Obs ^d Double alt	
6 ^h 19 ^m 58.5	6 ^h 22 ^m 54.5	9 ^m 07.5	9.9	164.4	212.0	116° 55' 20"	R 22 ^m 58 ^m 00 ^s	
21 58.0	24 54	7 07.0	7.8	99.9	128.9	59 10	S + 14 28 40.6	
24 12.0	27 08	4 53.0	4.54	47.1	60.7	116	Z 31 30 29.4	
26 13.0	29 09	2 52.2	2.52	16.1	20.0	117	cos L 9.84188	
27 43.0	30 39	1 22.0	1.22	3.7	5.0	01 10	cos S 9.98599	
28 52.0	31 48	-0 13.0	0.13	0.1	0.0	02 00	cos Z 0.28181	
30 09.5	33 06.5	+1 05.5	1.05.6	2.3	3.0	01 20	log Coeff ^t 0.10968	
32 49.0	35 45	3 44.0	3.45	27.6	36.0	02 00	Coeff 1.29	
33 48.0	36 44	4 43.0	4.44	44.0	56.8	117	01 10	
34 58.0	37 54	5 53.0	5.54	68.3	88.1	116	59 10	Obs ^d slow 2 ^m 56.0
36 45.0	39 41	7 40.0	7.41	115.9	149.4	58 10	Index Error - 1' 42.0	
37 59.0	40 55	8 54.0	8.55	156.1	201.3	56 40		
6 40 07.0	6 43 03.0	+ 11 02	11 04	240.4	310.1	116 53 10		

Cor ^d Double alt.	Altitude	Cor ^d alt.	Mean alt.	Colat.	Latitude.
116° 53' 38.0	58° 26' 49"	58° 26' 13.0	58° 29' 44.3	44° 01' 02.7	45° 58' 57.3
116 57 28.0	28 44	28 08	30 16.9	01 36.3	58 23.7
116 58 03.0	29 01.5	28 25.5	29 26.2	00 45.6	59 16.4
116 59 48.0	29 54	29 18	29 38.0	00 57.4	59 02.6
116 59 28.0	29 44	29 08	29 13.0	00 32.4	59 27.6
117 00 18.0	30 09	29 33	29 33.0	00 52.4	59 07.6
116 59 38.0	29 49	29 13	29 16.0	00 35.4	59 24.6
117 00 18.0	30 09	29 33	30 09.0	01 28.4	58 31.6
116 59 28.0	29 44	29 08	30 04.8	01 24.2	58 35.8
116 57 28.0	28 44	28 08	29 36.1	00 55.5	59 04.5
116 56 28.0	28 14	27 38	30 07.4	01 26.8	58 33.2
116 54 58.0	27 29	26 53	30 14.3	01 33.7	58 26.3
116 51 28.0	58 25 44.	58 25 08.0	58 30 18.1	44 01 37.5	45 58 22.5

Refraction 1. 5538
 9. 9777
 19
 213
 Refⁿ - 35.9 1. 5547

Mean Result of 13 Obs^s. 45° 58' 57.8

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Reduction of Observations of Sun's V.I. for Time.

November 28 th	Double Alts	27° 04' 50"	28° 48' 50"	Obs'd Times	Bar 28.608
		16 10	36 40	9 ^h 01 ^m 44 ^s .0	Alt. Ther. 31.5
		22 20	27 30	2 37.0	Det Ther 30.5
		30 25	28 07 40	3 05.0	Refraction
		43 10	27 54 50	3 43.0	2. 37121
		27 49 00	36 20	4 44.0	9. 97924
Mean Double Alt.		27 27 39.2	26 15		83
Index Error		- 2 14.2	19 05		1754
Cor Mean Double Alt		27 25 25.0	27 12 25	9 5 10.0	233.8
Altitude		13 42 42.5	27 58 40.5	9 03 30.5	2. 36882
Refraction		- 3 53.8	1 59.1		Mean of obs'd times
Altitude		13 38 48.7	27 56 41.4		
Parallax		+ 7.6	13 58 20.7		
Cor Altitude U.L.		13 38 56.3	- 3 46.8	Observed Times	
Semidiameter		- 16 15.6	13 54 33.9	2 ^h 19 ^m 52 ^s .0	
Cor Alt 0° Center		13 22 40.7	+ 7.6	20 51.0	
polar dist Δ		111 19 33.0	13 54 41.5	21 34.0	
Latitude		45 59 10	- 16 15.6	22 25.0	
Sum		170 41 24	13 38 26.	23 07.5	
1/2 S		85 20 42	111 21 53	24 07.0	
(1/2 S - A)		71 58 01	170 59 29	25 37.0	
Sec T		0.15812	85 29 45	26 21.0	
Cosec Δ		3081	71 57 19	26 56.0	
Cosines 1/2 S		8.90932	0.15812	2 27 26.0	
Sin (1/2 S - A)		9.97812	3082	2 23 49.7	
Sin 1/2 P		9.07637	8.89505		Bar 28.604
Sin 1/2 p		9.53818	9.97785		Ther Alt 37.0
tan angle = p		9.18241	9.06184		Ther Det 36.0
Exp of time		11 51.9	9.53092		
Cor Times		9 06 32.2	2 38 48.0		
Obs'd time		9 03 30.5	11 47.3		
Obs'd slow		- 3 01.7	2 27 00.7		
			2 23 49.6		
			3 11.1		

Mean Obs'd Error at Noon 03^m 06^s.4

Reduction of Observations Circum Meridian Alt. δ .

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November 28th

Obs. Time	hour	angle	K		
11 ^h 36 ^m 27.5	- 8 ^m	35.5	144.9	Equation of time	11 ^m 50.0
37 25.0	7	38.0	114.4	Chro. slow	3 07.0
38 42.0	6	21.0	79.2	Chro. time Cul ^m	11 45 03.0
39 36.5	5	26.5	58.1	δ at App ^t horizon	- 21 20 43.6
41 05.0	3	58.0	30.9	Semidiameter	16 15.6
41 46.0			21.2	parallel in alt	+ 8.0
43 30.0	3	17.0	21.2		
47 25.5	- 7	33.0	4.7		
48 01.0	+ 2	22.5	11.1	Refraction	
49 00.5	2	58.0	17.3		9.97962
50 14.5	3	57.5	30.7		34
50 48.0	5	01.5	49.6		730
51 39.0	5	45.0	64.9		2.13687
52 09.5	6	36.0	85.5		2.12413
11 53 23.5	+ 7	06.5	99.2	Refu	- 133.1
	+ 8	20.5	136.6		
			63.22		

Obs. Double Alt. δ	Mean Obs. Double Alt. δ				
45 ^o 55' 40"	45 ^o 57' 10.0"	I	45 ^o 59' 10"		9.84188
56 10 Index Error	- 2 02.5	δ	21 20 44		9.96913
56 30	45 55 07.5	γ	67 19 54		0.03492
57 20	22 57 33.7	rate			20
57 50 Refr	- 2 13.1	K	63.22		1.80085
58 10	22 55 20.6		44.36		1.64698
58 30	+ 8.0	par in alt. δ			
58 30	22 55 28.6	alt-Sun, V.L.		Par	28.628
58 10	- 16 15.6	Semidiam		True Alt	42.0
57 50	22 39 13.0	alt- δ Center		True Dist ^d	42.0
57 20	+ 44.4	Red to Merid.			
56 55	21 20 43.6	δ at horizon			
56 40	44 00 41.0	Colat.			
56 25	45 59 19.0	Mean of 15 Obs			
45 55 30					
Mean	45 57 10				

Reduction of Observations of α Aquila for Time

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November 28th

Obs ⁿ	Time	δ	α	β
6	50 29	$19^{\circ} 44' 08.4''$	28.568	
	51 14	$8^{\circ} 30' 53''$	37.0	
	56 34.5		36.0	
	58 39.0			

Mean of Obsⁿ time 6 55 37.5 $\sin \frac{1}{2}[(L-D)+z] 49^{\circ} 06' 07''$ 9.87845
 $\sin \frac{1}{2}[(L-D)-z] 11 37 50$ 9.30450

Obs^d Double Altⁿ $60^{\circ} 17' 45''$ $\sin \text{Colt} \times \sin \Delta$ 9.18295
 9.83707

59 54 15 $\sin^2 \frac{1}{2} p$ 19.34588

58 21 10 $\sin \frac{1}{2} p$ 9.67294

57 38 30 p 3 44 44.7

56 57 00 α R 19 44 08.4

Mean Obs^d Double Alt 58 37 44 Sid. Mean Hour 16 28 57.6

Index Error - 2 15 Sid. interval 3 15 16.8

Cor^d Mean Double Alt 58 35 29 Hour angle = p 3 44 44.7

Altitude 29 17 44.5 Sid. time past Noon 7 00 01.5

Refraction - 1 42.0 Retardation - 1 08.8

Cor^d Alt 29 16 02.0 Cor^d Mean Time 6 58 52.7

Length Dist = z 60 43 58 Obs^d Mean Time 6 55 37.5

Latitude 45 59 10 Chas. slow 3 15.2

Declination 8 30 53

$L - D$ 37 28 17

Length dist 60 43 58

$(L - D) + z$ 98 12 15

$(L - D) - z$ 23 15 41

$\frac{1}{2}[(L - D) + z]$ 49 06 07

$\frac{1}{2}[(L - D) - z]$ 11 37 50

$$\sin \frac{1}{2} p = \sqrt{\frac{\sin \left[\frac{z + (L - D)}{2} \right] \times \sin \left[\frac{z - (L - D)}{2} \right]}{\cos L \times \cos \delta}}$$

Reduction of Circum Meridian Altitudes of β Ceti for Latitude

1863

November 28th

Obs ^d times	Cor Obs ^d times	hour angle min ¹ sec ²	K.	Red. to Merid. ⁿ
7 ^h 53 ^m 08.0	7 ^h 56 ^m 24.0	-10 11 ^s -10 13 ^s	204.9	149.3
7 54 57.0	58 13	8 22 8 23	138.0	100.5 Bar 28.57
7 56 43.0	59 59	6 36 6 37	86.0	62.6 The Alt 36
7 58 13.0	8 01 29	- 5 06 - 5 07	51.4	37.4 The Dist ⁿ 35
8 04 56.0	08 12	+ 1 37 + 1 37	5.1	3.7
8 07 27.0	10 43	4 08 4 09	33.8	24.6 Refraction
8 09 00.0	12 16	5 41 5 42	63.8	46.3 2.08917
8 10 20.0	13 36	7 01 7 02	97.1	70.7 96
8 11 16.0	14 32	7 57 7 58	124.6	90.7 9.97772
8 12 42.5	15 58.5	9 23 9 24	173.5	126.3 106
8 14 17.0	8 17 33.0	+10 58 +11 00	237.5	172.9 57 1285
				2.08233
				120.9

Obs ^d Double Alt	Cor ^d Double Alt	altitude	cor ^d alt	Merid alt	Colat
50° 33' 20"	50° 31' 14"	25° 15' 37.0"	25° 13' 36.0"	25° 16' 05.3"	44° 00' 06.6"
35 55	33 49	16 54.5	14 53.5	34.0	35.3
37 10	35 04	17 32.0	15 31.0	33.6	34.9
38 30	36 24	18 12.0	16 11.0	48.4	49.7
38 55	36 49	18 24.5	16 23.5	27.2	28.5
38 25	36 19	18 09.5	16 08.5	33.1	34.4
37 50	35 44	17 52.0	15 51.0	37.3	38.6
37 35	35 29	17 44.5	15 43.5	54.2	55.5
36 50	34 44	17 22.0	15 21.0	51.7	53.0
34 50	32 44	16 22.0	14 21.0	27.3	28.6
50 33 25	50 31 19	25 15 39.5	25 13 38.5	25 16 31.4	44 00 32.7
				Mean	44 00 36.2

* R	0 ^h 36 ^m 46.8	I 45° 59' 10"	9.84188	Result of 11 Obs ^s
sid. Mean Noon	16 28 57.6	8 - 18 44 01	9.97636	45 59 23.8
sid. interval	8 07 55.2	7 64 43 11	4372	
Retardation	- 1 19.9	log rate	24	
Mean Time Cul ^m	8 06 35.3	log Coeff ^t 0.728	9.86220	

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November 28th

Reduction of Observations of Polaris

Obs Time	Cor ^d Obs Time	Sid Time Obs ⁿ	1 st Term	2 nd	3 rd		
8 ^h 25 ^m 39 ^s .0	8 ^h 28 ^m 55 ^s .	0 ^h 59 ^m 10 ^s	1° 24' 54"	0.0	0.24	Obs ^d Time	8 ^h 28 ^m 54 ^s
27 18.5	30 34	1 00 49	1 24 56	0.0	0.24	Long ^d ?	7 53 32
28 43.0	31 59	1 02 14	1 24 57	0.0	0.23	G ^h Mean Time	16 22 26
29 57.0	33 13	1 03 28	1 24 57	0.0	0.23	Sid. M. N. G ^h	16 27 33.9
34 07.0	37 23	1 07 39	1 24 59	0.0	0.23	Obs ^d Time	8 28 54
36 08.0	39 24	1 09 40	1 25 00	0.0	0.23	Acceleration	2 41.4
39 45.0	43 01	1 13 18	1 24 58	0.0	0.22	Sid. Time Obs ⁿ	24 59 09.3
45 16.0	48 32	1 18 50	1 24 55	0.1	0.22		
46 33.0	49 49	1 20 07	1 24 54	0.1	0.22	Obs ^d Time	8 ^h 56 ^m 12 ^s
47 30.0	50 46	1 21 04	1 24 52	0.1	0.22	Longitude	7 53 32
49 11.0	52 27	1 22 45	1 24 51	0.1	0.22	G ^h M. Time	16 49 44
50 34.0	53 50	1 24 10	1 24 48	0.1	0.21	Sid. M. N. G ^h	16 27 33.9
52 56.0	56 12	1 26 32	1 24 44	0.1	0.21	Obs ^d Time	8 56 12.0
54 29.0	58 45	1 29 05	1 24 40	0.1	0.21	Acceleration	2 45.8
8 56 23.0	8 59 39	1 29 59	1 24 39	0.1	0.20	Sid. Time Obs ⁿ	1 26 31.7

Double Alts	Cor Double Alts	Altitudes	Red. to alt.	Lat.	2 nd G ^h M. Time		
94° 52' 40"	94° 50' 44"	47° 25' 22"	-1° 25' 23"	45° 59' 59"	16 53 11	Obs ^d Time	8 ^h 59 ^m 39 ^s
51 50	49 54	24 57	25 25	59 32	16 27 33.9	Longitude	7 53 32
52 30	50 34	25 17	25 27	59 50	2 46.4	Acceleration	
52 50	50 54	25 27	25 27	60 00	8 59 39	Obs ^d Time	
52 20	50 24	25 12	25 29	59 43+32	1 29 59.3	Sid. Time Obs ⁿ	
52 25	50 29	25 14.5	25 30	59 44.5		Refraction	
51 40	49 44	24 52	25 29	59 23	1.72826		
53 10	51 14	25 37	25 25	60 12	126		
52 10	50 14	25 07	25 24	59 43	9.97772		
52 15	50 19	25 09.5	25 22	59 47.5	192		
53 30	51 34	25 47	25 21	60 26.0	1472		
53 15	51 19	25 39.5	25 19	60 20.5	1.72388		
53 25	51 29	25 44.5	25 15	60 29.5	Ref ⁿ - 52.95		
52 10	50 14	25 07.0	25 11	59 56			
94 52 00	94 50 04	47 25 02.0	-1 25 11	45 59 57			
Mean Result				15 Obs ⁿ	45° 59' 55."8		

Reduction of Observations of Stars U.L. for June

1863

November 29th

Obs ^d Times	Obs ^d Times	Obs ^d Double Alt	Obs ^d D. Alt		
2 ^h 08 ^m 13 ^s	2 ^h 11 ^m 15 ^s .5	30° 52' 50"	30° 17' 10"	A	14° 48' 47".3
2 08 57.5	11 50.0	44 40	30 10 20	Δ	111 32 04
2 09 31.5	12 20	37 40	30 4 30	I	45 59 10
2 09 59.0	12 49	32 20	29 58 55	S	172 20 01
2 10 26.0	13 19	27 15	29 52 50	1/2 S	86 10 01
2 10 52.5	2 13 59	30 21 35	29 45 10	(1/2 S-A)	71 21 13

Mean of Obs^d Times

2 11 07.5	Obs ^d Double Alt	30 18 46.2	Sec. I	0.15872
	Index Error	1 53.7	Correc Δ	3142

Refraction

2. 32 774	Cor. ^d Double alt	30 16 52.5	Cor 1/2 S	8. 82573
9. 97772	Altitude	15 08 26.2	Sec (1/2 S-A)	9. 97658
14 7	Refraction	- 3 31.5	Sec 1/2 p	8.99125
18 48	Parallax in Alt	+ 8.4	Sec 1/2 p	9.49562
	Cor. ^d Alt	15 05 03.1	hor angle	2 ^h 25 ^m 56.7
211.5	Semidiam.	- 16 15.8	Eg ^t time	11 27.0

Mean Time 2 14 29.7

Obs^d time 2 11 07.5

Chro^d slow 3 22.2

1863

Reduction of Observations Stars U.L.

November 30th

Obs ^d Times	Obs ^d 2 alt			
2 ^h 12 ^m 55 ^s	29° 36' 05"	δ	21° 41' 38"	
13 35.5	29 27 40	cos I	9. 84 188	
14 16	29 19 55	cos δ	9. 96 810	
14 51	29 12 25		9. 80 998	
15 15.5	29 07 50	sin 71°	43 18	9. 97751
15 46.5	29 01 45	sin 4	02 25	8. 84793
16 43 0	28 49 30			8. 82544
2 17 18.0	28 42 20	cos δ cos I		9. 80998

Mean Obs^d Times

2 15 05.0	29 09 41	sin ² 1/2 p		9. 01546
	Index Error	1 31.7	Sec 1/2 p	9. 50773
	Refraction	29 08 09.3	hor angle = p	2 30 13.5
9. 97620		14 34 04.7	Eg ^t of time	11 08.2
91		3 39.4	Mean Time Obs ^d	2 19 05.3
19.42		14 30 25.3	Obs ^d Time	2 15 05.0
2. 34 470		+ 8.4	Chro ^d slow	4 00.3
2 34 123		- 16 15.9		
Ref ⁿ =		- 3 39.4		
		14 14 17.8		

1863

Reduction of Observations of α Aquila for Time

December 1st

Obs ^d Lines	Obs ^d Double alt				
7 ^h 51 ^m 57 ^s	35° 07' 10"	α	19 ^m 44 ^s 08.4		
54 28	34 13 50	δ	+ 8° 30' 52".6		
56 12	33 36 10.	Γ	45 59 10	Rec	0.15812
7 59 40	32 24 40	Δ	81 29 07	Correc	482
8 00 46	32 02 30	A	16 17 00		9.49284
01 49	31 40 30	S	143 45 17		9.91648
02 31	31 25 50	$\frac{1}{2}$ S	71 52 38		9.57226
8 03 26	31 06 35	($\frac{1}{2}$ S-A)	55 35 38		9.78613
Refracton	7 58 51.1		32 42 08.	horiz angle = p	5 ^h 01 ^m 22 ^s
2.29391	Index Error	- 1 36	*AR - sid time mean hour		3 03 27.2
9.97313	Cor ^d Double Alt	32 40 32	Sid. interval		8 04 49.2
108	Altitude	16 20 16	Retardation		1 19.4
23 23	Refracton	- 3 16	Mean Time		8 03 29.8
2.29135	Cor Altitude	16 17 00	Obs ^d Time		7 58 57.1
195. "6			slow		4 38.7

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Reduction of Observations β Orionis for Time

December 2nd

Obs ^d Lines	Obs ^d Double alt				
9 ^h 43 ^m 21.5	51° 45' 20"	α	5 ^h 08 ^m 02.1	Refr	9.9752
47 30.0	52 40 50	δ	- 8° 21' 43.7		115
49 34.0	53 08 10	Γ	45° 59' 10"		2.0569
52 05.0	53 43 50	Γ - δ	54 20 54 111.0		2.0436
53 34.5	54 03 25	γ	62 59 31	Cos Γ	9.84188
55 10.	54 26 05		117 20 25	Cos δ	9.99536
56 51.5	54 48 30		8 38 37	Cos Γ Cos δ	9.83724
58 30.5	55 10 45		58 40 12		9.93156
10 00 01.0	55 30 40		4 19 18		8.87711
10 01 39.5	55 51 05				8.80867
9 53 49.7	54 06 52.0	horiz angle	7 ^h 22 ^m 32.6		9.83724
Index Error	- 2 12	*A	5 08 02.1		8.97143
Cor D. alt	54 04 40	sid R. Mer.	2 45 29.5		9.48571
Altitude	27 02 20	sid. M. N.	16 44 37.9		
Refracton	- 1 51	sid time	10 00 51.6		
Cor ^d Altitude	27 00 29	Retardation	1 38.4		
		Cor Mean Time	9 59 13.2		
		Obs ^d time	9 53 49.7		
		Chro ^d slow	5 23.5		

1863. Reduction of Observations of Polaris.

December 1 st	Cor. ^d	Obs. ^d	Time	Side	Time	Obs. ⁿ	1 st term	2 ^d term	Refr.	Red to alt	Obs. time	8 ^h 27 ^m 37 ^s
8 ^h 22 ^m 57 ^s	8 ^h 27 ^m 37 ^s	1 ^h 09 ^m 41 ^s	-1° 25' 00"	0.21	-53.3	-1	25	32.3	Long ⁿ	7 53 32		
24 45	29 25	11 29	25 00	0.21			25	32	Y.M. 7.	16 21 09		
26 06	30 46	12 50	24 59	0.21			25	31	Sid. M. h.	16 39 23.1		
27 17	31 57	14 01	24 58	0.21			25	30	Continue Obs ⁿ 8	27 37		
28 50	33 30	15 35	24 57	0.21			25	29	Acceleration	2 41		
29 40	34 20	16 25	24 57	0.21			25	29	sid time Obs ⁿ 1	09 41.		
30 49	35 29	17 34	24 56	0.21			25	28				
32 07	36 47	18 52	24 55	0.21			25	27	Refraction			
33 21	38 01	20 08	24 54	0.21			25	26	g. 97328			
34 28	39 08	21 15	24 52	0.21			25	24		108		
37 14	41 54	24 01	24 48	0.21			25	20		23 23		
38 9.5	42 49	24 56	24 46	0.21			25	18	1.	72 9 5 2		
39 16	43 56	26 03	24 45	0.21			25	17	1.	72 7 1 1		
40 24	45 04	27 11	24 43	0.21			25	15				
41 10.5	45 50	27 57	24 42	0.20			25	14				
42 18	46 58	29 05	24 40	0.20			25	12				
43 50	48 30	30 38	24 38	0.20			25	10				

8 ^h 44 ^m 38.5 ^s	8 ^h 49 ^m 18 ^s	1 ^h 31 ^m 26 ^s	-1	24	36	0.20	-53.3"	-1	25	08
obs ^d Dulle alt	Cor (D. alt	altitude	latitude							
94 51 40	94 49 36.7	47 24 48.3	45 59 16.0							
51 55	49 51.7	24 55 8	59 23.5							
52 40	50 36.7	25 18.3	59 47.0							
52 50	50 46.7	25 23.4	59 53.1							
52 10	50 06.7	25 03.4	59 34.1							
52 00	49 56.7	24 58.3	59 29.0							
52 20	50 16.7	25 08.3	59 40.0							
52 00	49 56.7	24 58.4	59 31.1							
52 30	50 26.7	25 13.4	59 47.1							
52 00	49 56.7	24 58.3	59 34.0							
52 50	50 46.7	25 23.4	59 63.1							
51 45	49 41.7	24 50.8	59 32.5							
52 50	50 46.7	25 23.4	59 66.1							
52 10	50 06.7	25 03.3	59 48.0							
52 45	50 41.7	25 20.8	59 66.5							
52 00	49 56.7	24 58.3	59 46.0							
52 00	49 56.7	24 58.4	59 48.0							
Means	94 51 50	94 49 46.7	47 24 53.3	45 59 45.0						

Mean Result of 18 Observations
 45° 59' 42" 8

1863

Reduction of Observations of α Aquilae June

Obs'd times	Obs'd Double alt	alt		Refraction
December 5 th 6 ^h 13 ^m 48 ^s	62° 11' 30"	30° 23' 22".6	α 19 ² 44 ^m 08 ^s .4	1.99692
6 15 04	61 46 40	ref ^m -1 36.5	δ +8 30 52	9.97313
6 17 19	61 02 50	30 21 46.1	I Cos	9.84188 91
6 19 07	60 28 20	45 59 10	δ Cos	9.99518 65
6 20 38	59 58 50	8 30 52		9.83706 1285
6 22 16	59 25 10	37 28 18		1.98446
6 18 02	60 48 53.3	59 38 14		Ref ^m 96".5
Index Error	-2 08.1	97 06 32	48" 33' 16".5	9.87482
3 38 02.3	60 46 45.2	22 09 56	11 04 58	9.28390
19 44 08.4	* AR	Bar 28.260	Ther 35.0	9.15872
23 22 10.7				9.83706
16 56 27.6	Chr ^m slow 6 ^m 37 ^s .9			9.32166
6 25 43.1				9.66083
6 24 39.9	NB. Adjusted Instrument after this observation			3 ^h 38 ^m 02.3
6 18 02.0				

Reduction of Observations of α Lyrae for June.

Obs'd times	Obs'd Double alt			
7 ^h 49 ^m 24 ^s	47° 04' 55"	M. N. A. 45° 52' 04".0	I 45° 59' 10"	9.84188
51 32	46 26 30	alt ^d 22 56 02.0	δ 38 39 44	9.89256
52 39	46 07 00	Ref ^m 2 13.0	7 19 26	9.73444
53 36	45 49 30	Cor ^d alt 22 53 49.0		
54 24	45 35 45	67 06 11.0		
55 44	45 11 35	7 19 26.0		
56 57	44 51 10	74 25 37.0	37° 12' 48" in	9.78160
7 53 28.0	45 52 20.7	59 46 45.0	29 53 23 in	9.67752
Index Error	-16.7			9.47912
Refraction				9.73444
2 13603	α 18 ² 32 ^m 18 ^s .9			9.74468
139	Obs'd M. N. 16 56 29.6			9.87234
9.97313	1 35 51.3	AR - S. M. N. cor		6 25 30.0
76	6 25 30.0	horn angle		
65	8 01 21.3	red intervals		
11 92	1 18.9	Retardation		
2 12 388	8 00 02.4	Mean Time		
Ref ^m 133".0	7 53 28.0	Obs'd time		
Chr ^m slow	6 34.4			

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Reduction of Observations of a Ursa Majoris sub polo

December 5th

Obsd time	Cor time	hour angle	Red to true?	Obsd Double alt ^s
5 ^h 45 ^m 25 ^s	5 ^h 52 ^m 00 ^s	- 5 ^m 53 ^s	68". 23"	37° 05' 10"
48 21	54 56	2 57	17.0 06	37 04 20
50 16	56 51	- 1 02	02.0 01	37 03 30
51 18	57 53	± 0 00	0.0 0.0	37 03 20
53 12	5 59 47	+ 1 54	07.0 02	37 04 15
54 56	6 01 31	3 38	26.0 08	37 04 10
56 34	03 09	5 16	54.0 18	37 04 30
57 44	04 19	6 26	81.3 28	37 04 45
5 59 25	06 00	8 07	129.0 44	37 05 40
6 00 31	07 06	9 13	167.0 57	37 05 50
01 29	08 04	10 11	204.0 67	37 06 30
6 02 24	6 08 59	+ 11 06	214.0 82	37 07 00

Cor Double Alt	altitude	True alt. + R	Bar	Ther. alt	Ther. Dist
37° 03' 01.0	18° 31' 30.5	18° 31' 07"	62° 28' 41.3	Bar ~ 28.260	
02 11.0	31 05.5	31 00	Δ 27 31 18.7	Ther. alt 35°	
01 21.0	30 40.5	30 39	Cos I, 9.84 188	Ther. Dist 36"	
01 11.0	30 35.5	30 36	Cos 0 9.66 472		
02 06.0	31 03.0	31 01	9.50 660		
02 01.0	31 00.5	30 52	Cos A 9.97 702		
02 21.0	31 10.5	30 52	Coeff ^t 0.34 9.52 958		
02 36.0	31 18.0	30 50			
03 31.0	31 45.5	31 01			
03 41.0	31 50.5	30 53			
04 21.0	32 10.5	31 01			
37 04 51.0	18 32 25.5	18 31 03			
Mean	18 30 54.6				
Refraction	- 2 47.8				
Cor alt	18 28 06.8				
polu Dist.	27 31 18.7				
Mean Result 12 obs ^{ns}	45 59 25.5				

Refraction

2. 23 72 3
9. 97 40 4
65
1285
2. 22 477
167". 8

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Reduction of Observations of Polaris Latitude

December 5th

Obs ^d time	Cor. ^d Obs ^d time	Sid time	Obs ⁿ	1 st term	2 nd term, Ref ⁿ	Red. to Merid.
8 ^h 00 ^m 14 ^s	8 ^h 06 ^m 52 ^s	1 ^h 04 ^m 40 ^s		1° 24' 58" + 22" - 52"		1° 25' 28"
01 39	08 17	1 06 05		24 58	22 - 52	1 25 28
03 58	10 36	08 24		24 59	21 - 52	1 25 30
05 10	11 48	09 37		25 00	21 - 52	1 25 31
07 04	13 42	11 31		24 59	21 - 52	1 25 30
08 21	14 59	12 48		24 58	21 - 52	1 25 29
10 38	17 16	15 05		24 57	21 - 52	1 25 28
11 33	18 11	16 00		24 56	21 - 52	1 25 27
12 39	19 17	17 07		24 56	21 - 52	1 25 27
14 02	20 40	18 30		24 55	21 - 52	1 25 26
15 44	22 22	20 12		24 54	21 - 52	1 25 25
17 24	24 02	22 52		24 50	21 - 52	1 25 21
18 57	25 35	23 26		24 49	21 - 52	1 25 20
20 48	27 26	25 17		24 46	21 - 52	1 25 17
8 22 01	8 28 39	1 26 30		1 24 44 + 20 - 52		1 25 16

Jan 28. 240

Mer. Alt? 35.0 The Det. 37.0

Obs ^d Double Alt	Cor. ^d Double alt	altitude	Latitude	Refraction
94° 49' 45"	94° 49' 28.3	47° 24' 44"	45° 59' 16"	
50 30	50 13.3	25 07	59 39	9. 97389
50 25	50 08.3	25 04	59 34	.00065
50 25	50 08.3	25 04	59 33	0 11 91
49 35	49 18.3	24 39	59 09	1. 72952
50 25	50 08.3	25 04	59 35	1. 71598
50 30	50 13.3	25 07	59 39	Ref ⁿ - 52".0
50 40	50 23.3	25 12	59 45	
51 15	50 58.3	25 29	60 02	Mean Result of
49 40	49 23.3	24 42	59 16	15 observations
50 30	50 13.3	25 07	59 42	45° 59' 36."4
50 00	49 43.3	24 52	59 31	
50 10	49 53.3	24 57	59 37	
50 25	50 08.3	25 04	59 47	
94 50 50	94 50 33.3	47 25 17	45 60 01	

Recapitulation of Results of Latitude uncorrected for Eccentricity of Instrument.

1863

Date	Object	No. Obs ^{ns}	Result
November 18 th	Polaris	9	45° 59' 63".7
" 20	Sun	13	59 19.7
" 21	Polaris	8	59 48.0
" 21	Polaris	5	59 72.9
" 21	α Tauri	16	58 58.6
" 23	Sun.	12	58 53.5
" 24	Sun	36	59 20.6
" 26	Sun	14	59 29.2
" 26	Polaris	8	59 34.9
" 27	Polaris	8	59 70.4
" 27	α Pegasi	13	58 51.8
" 28	Sun	15	59 19.0
" 28	β Ceti	11	59 23.8
" 28	Polaris	15	59 55.8
December 1 st	Polaris	18	59 42.8
" 5	α Ursae Majoris S.P.	12	59 25.5
" 5	Polaris	15	45 59 36.4

Number of Observations taken at Station 1st Cottonwood Creek
for Latitude 228.

Mean Result of 228 Observations uncorrected for error of Eccentricity
in the Sextant. 45° 59' 27".9

Latitude by Observations of Polaris corrected for error of Eccentricity

Date	Latitude	Cor. ⁿ e	Correct Latitude	
November 18 th	9 45° 59' 63".7	-25.9	45° 59' 37".8	47.4 alt.
21	8 45 59 48.0	-25.9	45 59 22.1	47.4 "
21	5 45 59 72.9	-25.8	45 59 47.1	47.2 "
26	8 45 59 34.9	-25.9	45 59 09.0	47.0 "
27	8 45 59 70.4	-25.9	45 59 44.5	47.0 "
28	15 45 59 55.8	-25.9	45 59 29.9	47.4 "
December 1 st	18 45 59 42.8	-25.9	45 59 16.9	47.4 "
5	15 45 59 36.4	-25.9	45 59 10.5	47.4 "
Mean of 86 Observations by weight			45 59 22.9	

Latitude by Observations of Sun, corrected for error of eccentricity

Date	No. Obs ^{ns}	Latitude	Cor ^{re} e.	Correct Latitude	alt. ^d
Nov ^r 20	13	45° 59' 19".7	+ 11".8	45° 59' 31".5	24.4
23	12	45 58 53.5	11.5	45 59 05.0	23.9
24	36	45 59 20.6	11.4	45 59 32.0	23.6
26	14	45 59 29.2	11.0	45 59 40.2	23.3
28	15	45 59 19.0	+ 10.7	45 59 29.7	23.0
Mean of 90 observations, by weight				45 59 29.2	

Date	Object	Weight	Latitude	Alt ^d	Eccentricity	Cor ^d Latitude
Nov ^r 21	α Tauri	16	45° 58' 58".6	60.2	+ 34.2	45° 59' 32.8
27	α Pegasi	13	45 58 57.8	58.5	+ 33.1	45 59 24.9
28	β Ceti	11	45 59 23.8	25.3	+ 12.3	45 59 36.1
Dec ^r 5	α Ursae Majoris S.P.	12	45 59 25.5	18.5	- 8.6	45 59 16.9

Final Results.

Object	No. Obs ^{ns}	alt	Cor ^{re} e	Cor ^d Mean Results
Sun	90	- 23.7	+ 11.4	45° 59' 29".2
Polaris	86	+ 47.3	- 25.9	45 59 22.9
α Tauri	16	+ 60.2	+ 34.2	45 59 32.8
α Pegasi	13	+ 58.5	+ 33.1	45 59 24.9
α Ursae Majoris S.P.	12	- 18.5	- 8.6	45 59 16.9
β Ceti	11	+ 25.3	+ 12.3	45 59 36.1

Latitude deduced from mean of 228 observations corrected 45 59 26.5.
 The most probable result for the latitude deduced from a discussion of 580 observations, vide page 6 to 10.

45° 59' 24".86

116 chains of 33 feet = $\frac{3828}{3600}$ log 3.582972
 3646.35 4.438142

37".8 1.577416 the location of the line south of 1st station

Barometric Observations for Altitudes of
Astronomical Station 1st above sea level.

Barometer	Ther. Alt. ⁹	Ther. Det. ⁹	Barometer	Ther. Alt. ⁹	Ther. Det. ⁹
28.500	46.0	46.0	28 416	27.0	27.0
.282	56.0	56.0	562	28.0	27.5
570	46.0	48.0	608	31.5	30.5
578	44.0	46.0	628	42.0	42.0
590	29.0	30.0	604	37.0	36.0
594	24.0	20.0	568	37.0	36.0
632	21.0	16.0	580	34.0	34.0
642	22.0	17.5	540	30.0	30.0
654	27.5	28.0	416	29.0	29.0
608	34.0	32.0	210	25.0	25.0
616	43.0	47.0	334	38.0	38.0
550	39.0	35.0	260	35.0	36.0
558	44.5	45.0	248	35.0	37.0
478	39.5	40.0	244	35.0	34.5
354	32.0	31.0	225	34.0	34.0
368	35.0	34.0	225	29.8	28.7
28.374	32.0	32.0			
Mean of 33 readings			28.473	34.6	34.2

altitude of Barometer at level of sea 30.060 Det⁹ Ther 64°
temperature of mercury reduced to 32° Fah.

30.060 27661.5 sea level

28.470 26242.1 Camp Cottonwood Creek Oregon.

1419.4

$$\frac{1419.4}{900} (64^\circ + 34.2 - 64^\circ) = 53.8$$

1473.2 feet altitude of Camp above sea

Barometric Observations of Altitude for
Town of Walla Walla above Sea level

Barometer	Ther. alt. ^d	Ther. Det. ^d	Barometer	Ther. alt. ^d	Ther. Det. ^d
29.306	61.0	61.0	28.992	53.0	53.0
29.408	49.0	49.0	29.200	58.0	58.0
29.400	56.0	56.0	28.875	57.0	55.0
29.380	59.0	59.0	28.720	58.0	60.0
29.325	55.5	55.0	29.188	60.0	62.0
29.198	61.0	60.0	29.416	52.5	53.0
28.896	56.0	56.0	29.490	57.0	48.0
28.870	55.0	55.0	29.350	54.5	55.0
28.868	58.0	58.0	28.840	52.0	54.0
29.088	56.0	57.0	29.010	57.0	60.0
29.094	56.0	56.0	28.890	57.0	55.0
28.090	55.0	56.0	29.198	59.0	57.0
29.213	52.0	51.0	28.898	67.0	56.0
29.070	56.0	56.0	29.138	61.0	55.0

Mean of 28 Readings 29.122 Bar. 56.5 Ther. Alt. 55.8 Ther. Det.

The altitude of Barometer at the level of the sea when the Mercury was at 32° Fah^o 30.060. Temperature of air 64°.

$$\begin{array}{r}
 30.060 \quad 27661.5 \\
 29.100 \quad 26813.9 \\
 \hline
 \quad \quad \quad 847.6 \\
 \frac{847.6}{900.} (64^\circ + 55.8 - 64^\circ) \quad 52.7
 \end{array}$$

900.3 feet altitude of town of Walla Walla above level of sea.

Reduction of Observations made at Station Second East bank Columbia River 2nd Computation

1864 Assumed Latitude of Station 46° 00' 30"
 Approximate Longitude 2^h 47^m 46^s West of Washington
 Sidereal increase for Mean Noon 27° 56.

May 7th α Bootis for Time. R 14^h 09^m 30^s.3 δ + 19° 53' 20.7

	Obs Double alt	Obs time	Obs Double alt	Obs time
	95° 09' 05"	8 ^h 20 ^m 59 ^s	96° 34' 55"	8 ^h 25 ^m 29 ^s
	95 39 10	8 22 34	96 52 15	8 26 27
	96 11 35	8 24 13	97 10 35	8 27 22
Mean Double alt	95 39 57	mean 8 22 35.3	96 52 35	mean 8 26 26.0
Index Error	- 1 00		- 1 00	
Cor M. D. alt	95 38 57		96 51 35	
Obs alt	47 49 28.5		48 25 47.5	
Refr ⁿ	- 50.8		- 49.7	
Cor alt	47 48 37.7		48 24 57.8	
polar dist Δ	70 06 39		70 06 39	
Latitude	46 00 30		46 00 30	
Sum	163 55 47		164 32 07	
1/2 s	81 57 53.5		82 16 03.5	
(1/2 s - A)	34 09 15.8		33 51 06	
sec I	0.15829		0.15829	
Cosec Δ	2671		2671	
cos 1/2 s	9.14545		9.12887	
Sin(1/2 s - A)	9.74929		9.74589	
Sin 1/2 p	9.07974		9.05976	
Sin 1/2 p	9.53987		9.52988	
hour angle	2 42 15.0		2 38 24.5	
* R	14 09 30.3		14 09 30.3	
Sid R of Merid	11 27 15.3		11 31 05.8	
Sid M. Noon	3 03 37.4		3 03 37.4	
Sid time fact M. N.	8 23 37.9		8 27 28.4	
Retardation	- 1 22.5		- 1 23.1	
Comp ^t M. Time	8 22 15.4		8 26 05.3	
Obs Time	8 22 35.3		8 26 26.0	
Chro ⁿ fact	- 19.9		- 20.7	

sin 1/2 p = cos 1/2 s
 sin(1/2 s - A) sec I
 Cosec Δ

Refraction
 9.97270
 9.99950
 9.99016
 1.72334
 1.70570
 Bar 29.506
 Ther. Alt 69.5

Chroⁿ fact at 8^h.4 - 20.3

Reduction of Observations of Polaris. Latitude

1864

May 7th

$$L = A - (\Delta \cos p) + \alpha (\Delta \sin p)^2 \tan A$$

Obs. times	Obs. times	Obs. times		Refraction
8 ^h 41 ^m 34 ^s	8 ^h 49 ^m 34 ^s	8 ^h 57 ^m 52 ^s	$R = 13^h 08^m 61.0$	
8 44 31	8 52 43	9 00 32	sid. h. 3 03 37.4	9.9927
8 47 14	8 54 40	9 02 16	Intermed 10 05 23.6	9.9897
8 44 26.3	8 52 19.0	9 06 33	Retardation 1 39.2	9.9995
Obs. dist - 19.7	- 19.4	- 19.2	M. time Cal. 10 03 44.4	1.7705
8 44 06.6	8 51 59.6	9 01 29.0		1.7524
10 03 44.4	10 03 44.4	10 03 44.4	$\beta = 88^\circ 35' 02.6$	
1 19 37.8	1 11 44.8	1 02 15.4	$1^\circ 24' 57.4$	
			$84' 57.4$	9.9819
15 ^o 02' 27.8	15 ^o 02' 27.8	15 02 27.8	Δ in sec ² 50.97.4	1.7712
4 45 46.8	2 45 27.1	30 04.9	log 3.707349	1.7531
9 16.5	11 01.8	3 45.6		
12.0	12.0	6.0	log Δ^2 7.4147	
19 57 43.2	17 59 08.8	15 36 24.4 = β	sin β 9.5332	Bar ⁿ 29.500
			sin β 9.5332	Ther Alt 61.5
Cor β 9.973091	9.978241	9.983686	tan A 9.9953	Ther Det 61.0
log Δ 3.707349	3.707349	3.707349	α 4.3845	
3.680440	3.685590	3.691035	2 nd term 0.8609	
4791.1	4848.3	4909.4		
1 19 51.1	1 20 48.3	1 21 49.4	$\Delta \cos \beta$	
	Obs. D. alt ^s	Obs. D. alt ^s	Obs. D. alt ^s	
	89 ^o 27' 00"	89 ^o 23' 45"	89 ^o 22' 55"	Δ^2 7.4147
	89 25 00	89 23 00	89 22 20	sin β 9.4298
	89 24 50	89 22 50	89 21 40	sin β 9.4298
Mean of Obs. D. alt ^s	89 25 53.3	89 23 11.7	89 21 30	sin A 9.9948
Index Error	- 1 00.0	- 1 00.0	89 22 06.2	α 4.3845
Cor Double alt ^s	89 24 53.3	89 22 11.7	89 21 06.2	2 nd term 0.6536
Altitude	44 42 26.7	44 41 05.8	44 40 33.1	
Refraction	- 56.5	- 56.6	- 56.6	Mean Result
Cor ^d Altitude	44 41 30.2	44 40 09.2	44 39 36.5	from 10 observations
1 st term	+1 19 51.1	+1 20 48.3	+1 21 49.4	
approx Lat.	46 01 21.3	46 00 57.5	46 01 25.9	46 ^o 01' 21.6
2 nd term	+ 7.3	+ 5.5	+ 4.5	
Latitude	46 01 28.6	46 01 03.0	46 01 30.4	

Reduction of Circum Meridian altitudes of Sim's I.I.

1864

May 8th

Obs. Times	hour	angle	R	
11 ^h 43 ^m 10 ^s	-13 ^m	01.0	332.6	Eq ⁿ of time 3 ^m 43 ^s .14
44 16	11	55.0	278.8	Chro ^t . time of Sun's transit 11 ^h 56 ^m 11.0
45 21	10	50.0	230.4	Chro ^t slow 5 ^s .9
46 09	10	02.0	197.6	Daily rate 43 ^s .9
48 12	07	59.0	125.1	Increase of Eq ⁿ of time 2 ^s .92
49 11	07	00.0	96.2	$r = 41^{\circ} 0'$ $\Delta \delta$ for 4 ^m = 2".9
52 31	03	40.0	26.4	
53 22	02	49.0	15.6	$1 + \frac{82}{86400 - 41} = 1 + \frac{82}{86359}$
54 32	01	39.0	5.3	
55 08	01	03.0	2.2	1.913814
55 58	00	13.0	0.1	4.936308
57 34	01	23.0	3.8	6.977506
59 49	03	38.0	25.9	
12 02 12	+ 06	01.0	71.1	$I = 46^{\circ} 00' 30'' \cos 9.84170$
			100.8	$\delta = 17 19 09.4 \cos 9.97985$
				$Z_1 = 28 41 20.6 \cos 0.31860$
				rate = 6 0.40
				100.8 log 2.00346
				139".3 2.14401

Obs. Double Alt

121 ^o 49' 10"	Mean of Obs. D. alt ^o	122 ^o 02' 47".5	Bar 29.460
121 53 20	Index Error	- 42.0	Ther. alt 78.50
121 55 50	Cor ^d Double alt.	122 02 05.5	" Det ^d 78.0
121 57 05	Altitude	61 01 02.7	Index Error - 42".0
122 02 00	Ref ⁿ	- 29.9	Refraction
03 40	Altitude	61 00 32.8	9.9921
05 50	parallax in alt.	+ 4.1	9.9754
06 40	Semi-diameter	+ 15 52.3	9.9988
07 55	Cor alt of 0 ^o center	61 16 29.2	1.5099
08 10	Red to Meridian	2 19.3	1.4762
07 20	Cor ^d Alt on Merid	61 18 48.5	Ref ⁿ - 29".9
07 05	Declination	17 19 09.4	
07 40		43 59 39.1	
122 07 20	$\Delta \delta$	+ 2.9	
	Colatitude	43 59 42.0	
		46 00 18.0	Mean Result 14 Obs ^{ns}

Reduction of Observations of Stars Altitude for June

1864

May 9th

	α Bootis			β Gemmorum			
	Obs. times			Obs. times			Refraction
	8 ^h 42 ^m 37 ^s		8 ^h 46 ^m 13 ^s	8 ^h 54 ^m 01 ^s			
	43 51		8 47 15	54 39			α Bootis
	45 17		8 49 37	56 30			9.99455
	8 43 55		8 47 41.7	57 32			9.99891
				55 40.5			9.97795
Obs. D. Alts	104 36 30		105 40 40	69° 59' 50"			9.97141
	105 00 50		105 59 55	69 43 45			1 6513
	105 25 10		106 40 35	69 07 05			1.6227
Mean of D. Alts	105 00 50		106 07 03	69 23 42.5			Ref ⁿ 41.9
Index Error	- 50.		- 50.	50.0			
Cor. M. D. Alts	105 00 00		106 06 13	69 22 52.5			β Gemmorum
Altitudes	52 30 00		53 03 06.5	34 41 26.2			9.97141
Ref ⁿ	- 42		- 41.	- 1 18.8			1.92533
Cor. Alt ^s A	52 29 18.		53 02 25.5	34 40 07.4			1.89674
polar dist Δ	70 06 39		70 06 39	61 39 02.0			Ref ⁿ 1 18.8
Latitude I	46 00 30		46 00 30	46 00 30.			
Sum s	168 36 27		169 09 34	142 19 39.			
1/2 s	84 18 13		84 34 47	71 09 49.5			
1/2(s - A)	31 48 55		31 32 22	36 29 42			Ch ^d . slow at 8.8.
sec I	0.15829		0.15829	0.15829			
Cosec Δ	2671		2671	5549			1 ^m 06.2
Cos 1/2 s	8.99677		8.97524	9.50902			
Sin 1/2(s - A)	9.72996		9.71858	9.77434			Bar ⁿ 29.622
Sin ² 1/2 p	8.90373		8.87882	9.49714			True Alt ^d 75.°
sin 1/2 p	9.45186		9.43941	9.74857			
hour angle p	2 11 32.3		2 07 43.1	4 32 43.0			
* ^s R.	14 09 30.3		14 09 30.3	7 37 00.8			
R of Mer. d.	11 57 58.0		12 01 47.2	12 09 43.8			
sid. M. noon	3 11 30.5		3 11 30.5	3 11 30.5			
sid. time post mer.	8 46 27.5		8 50 16.7	8 58 13.3			
Retardation	1 26.2		1 26.9	1 28.2			
Mean Time	8 45 01.3		8 48 49.8	8 56 45.1			
Obs. time	8 43 55.0		8 47 41.7	8 55 40.5			
Ch ^d . slow	1 06.3		1 08.1	1 04.6			

1864
May 9th

Reduction of Circum Meridian Altitudes of α Virginis

Obs'd Times	hour	min	sec	hor angle	K	* ^s AR	h ² m ² s ²	Refraction
10 00 16	-	3	31	24.3		13 18 04.9		
10 03 12	-	0	35	0.7	Sid Mer Noon	3 11 30.5		9.9819
10 06 02	+	2	15	9.9	AR Merid	10 06 34.4		1.9438
10 07 17	+	3	30	24.0	Retardation	1 39.4		1.9257
10 10 21	+	6	34	84.7	Mean Time Cul ^m	10 04 55.0		84".3
10 11 54	+	8	07	129.3	Chor slow	1 08.0		Ref ⁿ 1' 24".3
10 13 58	+	10	11	203.6	Chor ⁿ time of Cul ⁿ	10 03 47.0		
7) 476.5 = 68.07						Mean D. alt	67° 07' 20".7	
cos δ	- 10° 27' 18".9			9.99273	obs'd double Alts.	67° 08' 20"	Index Error	- 50.0
cos I	46 00 30			9.84170			cor D. alt	67 06 30.7
Coef z	56 27 49			0.07907		09 00	alt	33 33 15.3
Red to M.7. const.				0.237		08 50	Refn	- 1 24.3
rate				50		08 20	Cor Alt	33 31 51.0
log 68.07				1.83296		06 40	Red. to Merid	+ 56.1
56".15				1.74933		06 15	Merid alt	33 32 47.1
Mean result from 7 Observations						67 04 00	δ	- 10 27 18.9
								44 00 06.0

May 9th

Reduction of Circum Meridian Altitudes of α Bootis.

Obs'd times	hour	min	sec	hor angle	K	* ^s AR	h ² m ² s ²	Refraction
10 54 15	-	48				14 09 30.3		
10 56 32	+	1	29			Sid M. Noon	3 11 30.5	
10 57 30	+	2	27			AR Merid	10 57 59.8	
10 58 24	+	3	21			Retardation	- 1 47.8	
11 00 19	+	5	16			Mean Time Cul ⁿ	10 56 12.0	
11 01 58	+	6	55			Chor. slow	- 1 09.0	
127 49 35						Chor ⁿ Time Cul ⁿ	10 55 03.0	
Index Error	- 50							
cor D. altitudes	48 45							
Altitudes	63 54 22.5	63 54 32.5	63 54 10	63 54 05	63 53 05	63 52 10		
Refract	27.4	27.4	27.4	27.4	27.4	27.4		
Cor alts	63 53 55.1	63 54 05.1	63 53 42.6	63 53 37.6	63 52 37.6	63 51 42.6		
Red to Merid	1.9	6.4	17.6	32.9	1 21.4	2 20.2		
Merid alts	63 53 57.0	63 54 11.5	63 54 00.2	63 54 10.5	63 53 59.0	63 54 02.8		
declination	19 53 20.8	19 53 20.8	19 53 20.8	19 53 20.8	19 53 20.8	19 53 20.8		
Colatitude	44 00 36.2	44 00 50.7	44 00 39.4	44 00 49.7	44 00 38.2	44 00 42.0		
Mean Result of 6 Observations						45° 59' 17".3		
K	1.3	4.3	11.8	22.0	54.5	93.9		
log Coeff ^{alt}	0.17418	0.17418	0.17418	0.17418	0.17418	0.17418		
	0.11394	0.63347	1.07188	1.34242	1.73640	1.87267		
	0.28812	0.80765	1.24606	1.51660	1.91058	2.14685		
	1".9	6".4	17".6	32".9	81".4	140".2		

1864

May 9th

Reduction of Observations of Polaris.

Obs'd Times	10 ^h 17 ^m 33 ^s 20 27 22 34	10 ^h 25 ^m 32 ^s 28 10 32 31	10 ^h 35 ^m 38 ^s 38 04 40 17	10 ^h 42 ^m 33 ^s 45 07 R 13 ^m 08 ^s 02 ^s 48 05 S.M. 3 11 30.5
Mean of Obs'd Times	10 20 11.3	10 28 44.3	10 37 59.7	10 45 15.0 S.I 9 56 31.5
Chrod. Cor. ⁿ	+ 1 08.1	+ 1 08.3	+ 1 08.6	+ 1 08.8 Ref ⁿ 1 37.7
True time Obs ⁿ	10 21 19.4	10 29 52.6	10 39 08.3	10 46 23.8 x alt ^g 54 53.8
Mean time Cul. ⁿ	9 54 53.8	9 54 53.8	9 54 53.8	9 54 53.8
Hour angle p	26 25.6	34 58.8	44 14.5	51 30.0
Sidereal	6° 31' 04".1	8° 31' 23".8	11° 01' 48".4	12° 47' 05".6 S 88° 35' 02".2
Equivalents	6 16.0	14 32.4	3 30.6	7 31.2 Δ 1 24 57.8
in arc	9.0	12.0	7.5	0.0 84 57.8
p	6 37 29.1	8 46 08.2	11 05 26.5	12 54 36.8 Δ ⁿ 50 97.8
cos p	9.997091	9.994894	9.991812	9.988881
log Δ	3.707383	3.707383	3.707383	3.707383 Refraction
Δ cos p	3.704474	3.702227	3.699195	3.696264 9.9946
1 st term	50 63".8	50 38".2	50 02".6	49 68".9 9.9814
	84 23".8	83 58".2	83 22".6	82 48".9 9.9990
Δ ⁿ	7.4147	7.4147	7.4147	7.4147 1.7718
sin p	9.0620	9.1830	9.2840	9.3490 1.7468
sin p	9.0620	9.1830	9.2840	9.3490
tang A	9.9941	9.9942	9.9943	9.9944 9.9750
log Δ	4.3845	4.3845	4.3845	4.3845 1.7713
2 nd term	9.9173 0.8	0.1594 1.4	0.3615 2.3	0.4916 3.1 1.7463
Obs'd Sulle alt	89° 15' 48"	89° 16' 38".3	89° 18' 20"	89° 18' 55"
Index Error	- 50	- 50	- 50	- 50
Cor'd. alts	89 14 58	89 15 48.3	89 17 30	89 18 05
altitude	44 37 29	44 37 54.1	44 38 45	44 39 02.5
Ref ⁿ	- 55.8	- 55.8	- 55.8	- 55.7
Cor'd alts	44 36 33.2	44 36 58.3	44 37 49.2	44 38 06.8
1 st term	+ 1 24 23.8	1 23 58.2	1 23 22.6	1 22 48.9
2 nd term	+ 0.8	1.4	2.3	3.1
Latitude	46 00 57.8	46 00 57.9	46 01 14.1	46 00 58.8

Mean Result of 12 obs^{ns} 46° 01' 02".15

1864
May 10th

Reduction of Observations of Sun's U.L. Latitude

Obs ^d times	hour	angle	R	Obs ^d Double alt ^s
11 ^h 42 ^m 55 ^s	-11 ^m	24.6	255.6	124° 01' 55"
43	53	10 26.6	214.1	03 55
45	10	9 09.6	164.8	08 50
47	27	6 52.6	92.8	09 45
49	19	5 00.6	49.3	11 55
50	40	3 39.6	26.3	12 50
51	46	2 33.6	12.9	13 25
53	11	-1 08.6	2.6	13 50
55	15	+0 55.4	1.6	14 30
55	52	1 32.4	4.6	14 35
56	56	2 36.4	13.3	14 20
58	19	3 59.4	31.2	13 25
58	59	4 39.4	42.6	12 30
11 59	33	5 13.4	53.5	11 45
12 00	32	6 12.4	75.7	11 25
01	16	6 56.4	94.6	11 15
03	32	9 12.4	166.4	08 05
04	20	10 00.4	196.6	07 25
05	08	10 48.4	229.4	06 45
06	26	12 06.4	287.7	124 02 30
12 07	29	13 09.4	339.8	123 59 10
112.16 =			$\frac{2355.4}{21}$	Mean of Obs ^d Double Alt ^s 124 09 43.1
Cos I	46° 00' 30"		9.84170	Index Error 1 - 45.0
Cos δ	+ 17 50 50		9.97858	Cor ^d Mean Double Alt ^s 124 08 58.1
Cosec z	28 09 40		0.32622	Altitude 62 04 29.0
rate			60	Refraction - 28.6
log 112.16			2.04984	alt ^d Sun's U.L. 62 04 00.4
Red. Mer ^d	157."3		2.19694	Semidiameter - 15 51.9
				parallax in alt + 4.0
Bar ^m	29.754			Cor ^d alt O ^s Center 61 48 12.5
Mer ^d alt	83° 0			Reduction to Meridian 2 37.3
Mer ^d alt ^d	83.0			Mer ^d alt O ^s Center 61 50 49.8
				Declination 17 50 49.8
Mean Result	21 Obs ^s	46° 00' 00.0		44 00 00.0

Refraction

9.9964

9.9986

9.9711

1.4906

1.4567

Refⁿ - 28."6

$\frac{E - VV}{21} = 1' 46''$

1864

May 10th

Reduction of Observations of Stars for Time

	β Gemmorum			Arcturus		
Obs Times	8 ^h 10 ^m 27 ^s	8 ^h 14 ^m 13 ^s	8 ^h 20 ^m 19 ^s	8 ^h 26 ^m 08 ^s		
"	12 00	15 58	21 42	27 02		
"	13 09	17 01	24 03	28 21		
Mean Obs ^d time	8 11 52.3	8 15 44.0	8 22 51	8 27 10.3		
Obs Double alt ^s	83° 22' 10"	82° 01' 05"	99° 28' 50"	101° 16' 10"		
"	82 43 15	81 23 20	99 53 55	101 32 30	Bar 29.632	
"	82 19 55	81 01 40	100 36 45	101 57 35	Alt Ther 60.5	
Mean Double alt ^s	82 48 27.0	81 28 42	100 15 31.2	101 35 25	Dist ^r Ther 60.0	
Index Error	- 45	- 45	- 45.0	- 45		
Cor ^d Double alt ^s	82 47 42	81 27 57	100 14 46.2	101 34 40	Refraction	
Altitudes	41 23 51	40 43 58.5	50 07 23.1	50 47 20	β 9.9946	
Refraction	- 1 03 3	- 1 04.8	- 46.6	- 45.5	t 9.9866	
Cor ^d alt ^s A	41 22 48	40 42 53.7	50 06 36.5	50 46 34.5	e 9.9993	
polar dist Δ	61 39 02	61 39 02	70 06 39	70 06 39	Const 9.9805	
Latitude L	46 00 30	46 00 30	46 00 30	46 00 30	1.6882	
Sum S	149 02 20	148 22 25.7	166 13 45.6	166 53 45	1.6687	
1/2 S	74 31 10	74 11 12.8	83 06 52.8	83 26 52	Ref - 46.6	
(1/2 S - A)	33 08 22	33 28 19	33 00 16	32 40 18	9.9805	
sec L	0.15829	0.15829	0.15829	0.15829	1.6778	
Coec Δ	5549	5549	2671	2671	1.6583	
Cos 1/2 S	9.73773	9.74157	9.07877	9.05732	Ref ⁿ 45.5	
Sin (1/2 S - A)	9.42636	9.43537	9.73616	9.73225	9.9805	
Sin 1/2 p	9 37 787	9.39072	8.99993	8.97457	1.8207	
Sin 1/2 p	9.68893	9.69536	9.49996	9.48729	1.8012	
hour angle = p	3 53 58.7	3 57 48.3	2 27 28.0	2 23 04.8	Ref ⁿ 63.3	
∠ R.	7 37 00.8	7 37 00.8	14 09 30.3	14 09 30.3	9.9805	
AR of Merid	11 30 59.5	11 34 49.1	11 42 02.3	11 46 25.5	1.8309	
Sid. Mean Noon	3 15 27.1	3 15 27.1	3 15 27.1	3 15 27.1	1.8114	
Sid. Interval	8 15 32.4	8 19 22.0	8 26 35.2	8 30 58.4	Ref ⁿ 64.8	
Retardation	1 21.2	1 21.8	1 23.0	1 23.7	2.189	
Mean Time	8 14 11.2	8 18 00.2	8 25 12.2	8 29 34.7	2 16.2	
Obs ^d Time	8 11 52.3	8 15 44.0	8 22 51.0	8 27 10.3	2 21.2	
Chro ^t slow	2 18.9	2 16.2	2 21.2	2 24.4	2 24.4	

Chro^t slow at 8^h 3 2^m 20^s 2

Reduction of Circum Meridian & Virginis for Latitude

1864

May 10th

Obs. Times	hour angle	K	Obs. Double Alt
9 ^h 44 ^m 35 ^s	- 13 ^m 59 ^s	383.8	66° 57' 50"
46 07	12 27	304.3	AR 13 ^h 18 ^m 04.9 67 00 50
47 23	11 11	245.5	ad. M. R. 3 15 27.1 01 55
49 37	8 57	157.3	AR. Mer. 10 02 37.8 04 40
50 23	8 06	128.8	Retardation 1 38.7 05 20
51 21	7 13	102.3	M. Y. Cal ⁿ 10 00 59.1 05 40
52 43	5 51	67.2	Chord. slow 2 25.0 06 20
53 40	4 54	47.1	Chord. time Cal ⁿ 9. 58 34.1 07 30
54 31	4 03	32.2	07 20
56. 05	2 29	12.1	Bar. ⁿ 29.630 07 25
57 46	- 0 48	1.3	Ther Alt ^d 62.0 08 40
9 59 00	+ 0 26	0.4	Ther Dep. ^d 62.0 09 00
10 00 52	2 18	10.4	Refraction 08 20
03 16	4 42	43.4	9.9946 07 25
04 21	5 47	65.7	9.9884 06 20
06 41	8 07	129.3	9.9994 05 35
07 54	9 20	171.0	1.9441 04 35
09 02	10 28	215.1	1.9265 04 05
11 21	12 47	320.8	Ref ⁿ 84" 4 67 00 20
10 12 20	+ 13 46	372.0	66 57 50
	Mean	140.5	Mean Obs. Double alt. 67 04 51.0
			Index Error - 45.0
Cos δ - 10° 27' 19"		9.99273	Cor ^d M. D. alt. 67 04 06.0
Cos I ₁ 46 00 30		9.84170	Altitude 33 32 03.0
Cosec Z 56 27 49		0.07197	Refraction - 1 24.4
Rate x red to M. Y.		309	Cor ^d Altitude 33 30 38.6
log 140.5		2.14768	Red ⁿ to Mer. 1 55.5
Red to Mer. 115" 5		2.06427	Mer. altitude 33 32 34.1
			Declination 10 27 18.9
			Colatitude 43 59 53.0
			Mean Result of 20 Obs. 46 00 07.0

1864

Reduction of Observations of Paris

May 10

	Obs ^d times	Obs ^d times	Obs ^d times	Obs ^d times	
	10 ² 19 ^m 17 ^s	10 ² 25 ^m 48 ^s	10 ² 33 ^m 11 ^s	10 ² 37 ^m 20 ^s	AR 13 ⁷ 09 ^m 02.7
	21 33	28 05	35 31	39 45	s.d. m. 3 15 27.1
	23 35	30 17	37 04	41 09	Retard 9 53 35.6
Mean Obs ^d times	10 21 28.3	10 28 03.3	10 35 15.3	10 39 24.7	Retardation 1 37.2
Chro. Cor ⁿ	+ 2 26.0	2 26.2	2 26.3	2 26.3	M. 7. Cul ^m 9 57 58.4
Cor ^d Obs ^d times	10 23 54.3	10 30 29.5	10 37 41.6	10 41 51.0	
M. 7. * Cul ^m	9 51 58.4	9 51 58.4	9 51 58.4	9 51 58.4	
horiz angle = p	31 55.9	38 31.1	45 43.2	49 52.6	δ 88° 35' 02"
					Δ 1 24 58
Azimuth	7° 46' 16".4	9° 31' 33".6	11° 16' 50".9	12° 17' 00".7	84 58
Equivalents	13 47.3	7 46.3	10 46.8	13 02.1	Δ in sec ^s 50 98.0
in arc	13.5	1.5	3.0	9.0	log Δ 3.707400.
p in arc	8 00 17.2	9 39 21.4	11 27 40.7	12 30 11.8	
Cos p	9.995749	9.993804	9.991253	9.989576	
log Δ	3.707400	3.707400	3.707400	3.707400	
Δ Cos p	3.703149	3.701204	3.698653	3.696976	
in sec ^s	50 48".2	50 25.8	49 95.3	49 77.1	
1 st term	84 08.2	83 45.8	83 15.3	82 57.1	Ref ⁿ
					9.9947
Δ ²	7.4148	7.4148	7.4148	7.4148	9.9995
tang A	9.9943	9.9943	9.9943	9.9943	9.9906
sin ² p	8 28 76	8 44 85	8 59 64	8 67 09	9.9848
log Δ	4.3845	4.3845	4.3845	4.3845	1.7717
2 nd term	0.0812 - 1.2	0.2421 + 1.7	0.3900 + 2.4	0.4645 + 2.9	1.7565
					ref ⁿ - 57".1
Obs ^d Double alt ^s	89° 16' 40"	89° 17' 10"	89° 17' 20"	89° 18' 10"	
	17 00 17 00	00 15	17 40 18 20	50 50	
Mean Double alt	89 16 53.3	89 17 08.3	89 17 46.7	89 18 36.7	Bar 29.63
Index Error	-45.0	-45.0	-45.0	-45.0	The Alt ^d 60.5
Cor ^d M. D. alt	89 16 08.3	89 16 23.3	89 17 01.7	89 17 51.7	The Det ^d 60.
Altitude	44 38 04.1	44 38 11.6	44 38 30.8	44 38 55.8	
Refraction	57.1	57.1	57.1	57.1	
Cor ^d alt.	44 37 07.0	44 37 14.5	44 37 33.7	44 37 58.7	
1 st term	1 24 08.2	1 23 45.8	1 23 15.3	1 22 57.1	
2 nd	+ 1.2	+ 1.7	2.4	+ 2.9	
Latitude	46 01 16.4	46 01 02.0	46 00 51.5	46 00 58.7	

Mean Result of 12 Observations 46° 01' 02".2

1864

Reduction of Observations of α Bootis for Latitude

May 10th

Obs'd Times	hour angle	K	obs'd Double alt
10 ^h 44 ^m 48 ^s - 5 01	49.4 * ^s AR	14 ^h 09 ^m 30 ^s .3	127° 45' 05"
45 49 4 00	31.4 Sid M. h	3 15 27.1	47 20
46 56 2 53	16.3 AR Mer ^d	10 54 03.2	48 20
48 58 - 0 57	1.4 Retardation	1 47.1	48 20
50 13 + 0 24	0 3 M. T. Cul ^h	10 52 16.1	49 15
51 57 2 08	8.9 Chro. slow	2 27.0	49 00
53 19 3 30	24.0 Chro. time Cul ^h	10 49 49.1	48 20
56 22 6 33	84.2		45 35
58 00 8 11	131.5		42 35
11 00 28 + 10 39	222.7		127 38 40
Means	57.01	Mean Double alt. ^d	127 46 15.0

Cos δ	19° 53' 21"	9.97330	Mean Double alt	127° 46' 15" 0
Cos L	46 00 30	9.84170	Index Error	- 45.0
Cosec γ	26 07 09	0.35639	Cor ^d obs'd D. alt	127 45 30 0
Red to M. T.		237	altitude	63 52 45 0
Rate		72	Refraction	- 27.4
log 57.01		1.75595	Cor. alt	63 52 17.6
Mer ^d Red 85.2		1.93043	Red to Mer ^d	+ 1 25.2
			Mer ^d alt.	63 53 42.8
Bar ^m 29.632			Declination	19 53 21.0
Mer ⁿ Alt ^d 60.5	Ther Det ^d 60.		Colat	44 00 21 8
Mean Result of 10 Obs				45 59 38 .2

Reduction of Observations Sun's V.L. Latitude

1864
May 11

Obs. Time	Hour Angle	K		Obs. Double Alt.
11 41 16	- 12 ^m 10 ^s	290.6	Chro. slow 2 44.0	124° 29' 40"
42 13	11 13	247.0	Eqs. of time 3 50.0	31 30
42 59	10 27	214.4	Chro. time Cul ⁿ 11 53 26.0	32 40
44 04	9 22	172.2	∫ + 18 06 06.7	35 50
44 56	8 30	141.8	hourly change 37".87	37 45
46 03	7 23	107.0		38 20
46 59	6 27	81.7	Refraction	40 00
48 52	4 44	44.0	Bar ^m 29.700 9.9956	41 55
49 31	3 55	30.1	Mer. Alt. 82.0 9.9986	42 25
50 30	2 56	16.9	Mer. Dist. 82.0 9.9720	43 15
51 16	2 10	9.2	1.4863	43 30
52 26	1 00	2.0	Ref. 28".3 1.4525	44 40
53 22	- 0 04	0.0		44 40
53 58	+ 0 32	0.6		44 25
54 39	1 13	2.9	Cos I 46° 00' 30" 9.84170	44 30
55 34	2 08	8.9	Cos ∫ 18 06 07 9.97796	44 30
56 43	- 3 17	21.2	Cosec ∫ 27 54 23 0.32973	44 10
57 23	3 57	30.6	rate 36	44 15
11 59 03	5 37	61.9	log 118.2 2.07232	43 30
12 00 16	6 50	91.7	red. to Mer. 166".8 2.22207	41 20
01 33	8 07	129.3		40 20
02 44	9 18	169.8	Mean Double Alt. 124° 39' 18".1	38 55
03 30	10 04	198.9	Index Error - 41.0	36 50
05 29	12 03	285.0	Cor. Mean Double Alt. 124 38 37.1	33 00
06 31	13 05	336.0	Altitude 62 19 18.5	30 55
12 07 18	+ 13 52	377.4	Refraction - 28.3	29 00
	9 42	118.12	Parallax in Alt. + 3.7	
E - W = 0 ^m 23 ^s Δδ + 0.2			Cor. alt. 0 ^s V.I. 62 18 53.9	
			Semidiameter - 15 51.7	
			Cor. alt. 0 ^s Center 62 03 02.2	
			Red. to Mer. + 2 46.8	
			Mer. alt. 62 05 49.0	
			Declination 18 06 06.9	
			Colatitude 43 59 42.1	
Mean Result of 26 Obs.			46 00 17.9	

1864

Reduction of Observation of Sun's I.I. for Time

May 12th

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} S \sin(\frac{1}{2} S - A) \sec I \csc \Delta \text{ Obs. D. Alt.}$$

					91° 16' 05"	9 ^h 05 ^m 46 ^s
Obs. Double Alt	Obs. times				92 03 50	9 08 17
88° 54' 30"	8 ^h 58 ^m 22 ^s				92 27 35	9 09 32
89 49 10	9 01 03				92 42 50	9 10 24
90 19 00	9 02 49				93 04 10	9 11 30
Means	89 40 53.3	9 00 44.7			92 18 54	9 09 05.8
Index Error	- 52.0				- 52	
Cor. Double Alt	89 40 01.3	Bar. 29.716			92 18 02	
Altitude	44 50 00.6	Ther. Att. 81.5			46 09 01	
Refn.	- 55.1	Ther. Det. 75.0			- 52.6	
Cor. Alt I.I.	44 49 05.5				46 08 08	
Semidiam	+ 15 51	Refraction			+ 15 51	
Cor. Alt 0 ^s center	45 04 56	log β	9.9957		46 23 59	
Par in alt	+ 06		9.9986		+ 06	
Cor. Alt 0 ^s c.	45 05 02		9.9779		46 24 05	
polar dist	71 40 36		9.9722		71 40 35	
Latitude	46 00 30		1.7686		46 00 30	
Sum	162 46 08		1.7408		164 05 10	
1/2 S	81 23 04	Refn. - 54".7			82 02 35	
(1/2 S - A)	36 18 02				35 38 30	
Sec I.	0 15 829		9.9722		0.15829	
Cosec Δ	0 02260		1.7485		0 02260	
Cos 1/2 S	9.17551		1.7207		9.14122	
Sin(1/2 S - A)	9.77234	Refn. 52".6			9.76546	
Sin ² 1/2 p	9.12874				9.08757	
Sin 1/2 p	9.56437				9.54378	
hour angle p	9 07 53.3				9 16 13.0	
Eqs. of time	3 51.1				3 51.1	
Mean Time	9 04 02.2				9 12 21.9	
Obs. time	9 00 44.7				9 09 05.8	
Chron. slow	3 17.5				3 16.1	

Chron. slow at 9^h 2^m 16^s 5

1864

Reduction of Observations of Sun's U.I. for Latitude

May 12th

Obs ^d Times	hour	Angle	K			Obs ^d Double alt ^s
11 ^m 45 ^m 44 ^s	-6 ^m	52 ^s	92.6	Obs ^d slow	3 ^m 33.0	125° 10' 15"
46 15	6	21	79.2	Eqs ⁿ of time	3 51.2	11 55
47 22	5	14	53.8	Obs ^d time Culu	11 ^m 52 36	12 05
48 32	4	04	32.5	S	18° 21' 06.6"	14 45
49 27	3	09	19.5	Δ S per hour	37.1	14 20
50 25	2	11	9.4			14 25
51 32	1	04	2.2	Bar 29.664	Refraction	14 50
52 14	-0	22	0.3	Ther Alt 87.0	9.9951	15 30
52 51	+0	15	0.1	Ther Det 87.0	9.9984	15 30
53 33	0	57	1.8		9.9677	15 15
54 15	1	39	5.3		1.4809	15 20
55 40	3	04	18.5	Refn - 27.7	1.4421	15 20
56 37	4	01	31.7			14 30
57 28	4	52	46.5	1 ^m 16 ^s = +0.8		13 35
58 13	5	37	61.9			12 00
11 59 09	6	33	84.2			11 40
12 00 35	7	59	125.1			9 55
12 01 26	8	50	153.2			9 05
12 02 11	+9	35	180.3			125 7 40
E-W =	1 ^m 16 ^s		52.53		Mean of Obs ^d Double Alt ^s	125 13 02.7
¹⁹	Δ S for 1 ^m 16 ^s		+ 0.8		Index Error	- 48.3
					Cor ^d Mean Double Alt	125 12 14.4
Cos I	46 00	30	9.84170	Altitude		62 36 07.2
Cos S	18 21	07	9.97733	Refn		- 27.7
Cosec Z	27 39	23	0.33366	Parallax in Alt ^d		+ 3.9
rate			45	Cor ^d Alt 0 ^s U.I.		62 35 43.4
log 52.53			1.72041	Semidiameter		- 15 51.5
Red to Mer ^d 74.7			1.87355	Cor ^d Alt 0 ^s Center		62 19 51.9
				Red to Mer ^d		+ 1 14.7
				Mer ^d alt ^d		62 21 06.6
				Declination		18 21 07.4
				Colatitude		43 59 59.2
				Mean Result from 19 Obs ^s		46 00 00.8

1864
May 12th

Reduction of Observations of α Bootis for Time

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin (\frac{1}{2} s - A) \sec I \operatorname{cosec} \Delta$$

Obs'd times

8 ^h 25 ^m 51 ^s	alt	52° 22' 52".5	hour angle = p =	2 ^h 12 ^m 22.7
27 02	Ref ⁿ	- 42.3	* ^s AR	14 09 30.3
28 32	Cor ^d alt	52 22 10.2	AR. Mer ^d	11 57 07.6
29 20	polar Dist	70 06 39	Sid Mer. Noon	3 23 20.2
30 25	Latitude	46 00 30	Sid Interval	8 33 47.4

Mean Obs'd times

8 28 14	Sum	168 29 19	Retardation	- 1 24.2
Obs'd Double alt ^s	$\frac{1}{2} s$	84 14 39	Mean Time	8 32 23.2
104° 01' 10"	$(\frac{1}{2} s - A)$	31 52 29	Obs'd Time	8 28 14.0
104 25 15	sec I	0.15829	Chro. slow	4 09.2
104 53 05	Cosec Δ	0.02671		
105 07 05	cos $\frac{1}{2} s$	9.00142	Bar ^m	29.580
105 26 30	sin $(\frac{1}{2} s - A)$	9.72269	Alt ^d Mer ⁿ	73° 0
Mean Obs'd D. alt	$\sin^2 \frac{1}{2} p$	8.90911	Mer Dist	73.0
Index Error	sin $\frac{1}{2} p$	9.45455		
Cor ^d Double alt				
104 45 45				

Reduction of Observations of Saturn Latitude

May 12
Bar 29.560
Mer alt 69.5
Mer Dist 69.5

9 ^h 09 ^m 46 ^s	9 ^m 56 ^s	193.7	AR	12 ^h 48 ^m 44.6	83° 19' 20"
11 38	8 04	127.8	Sid time Mer ⁿ	3 23 20.2	20 35
13 26	6 16	77.1	AR Mer ^d	9 25 24.4	22 25
16 01	3 41	26.6	Retardation	1 32.6	24 10
17 12	2 30	12.3	Mean Time	9 23 51.8	24 50
18 14	1 28	4.2	Chro. slow	4 10.0	25 05
19 36	0 06	0.0	Chro. time Cul ^m	9 19 41.8	25 10
21 57	2 15	9.9			25 20
23 45	4 03	32.2	M.O.D. alt	83° 23' 25".0	24 50
25 14	5 32	60.1	Index Error	- 52.0	23 25
25 55	6 13	75.9	Cor ^d O.D. alt	83 22 33.0	23 10
Ref ⁿ 61".5	9 26 47	7 05	98.5 alt ^d	41 41 16.5	83 22 40
		59.86	Refraction	1 01.5	
cos δ	9.99964	cos ^d alt	411 40 15.0		
cos I	9.84170	Par in alt	0.7		
cosec γ	0.12678	red to mer ^d .	+ 56.0		
rate %	277	(Declination	2 18 38.7		
K 59.86	1.77714	Colatitude	43 59 50.4		
Red. to Mer ^d 55".98	1.74804	Latitude	46 00 09.6		
		Mean Result of 12 Obs ^{ns}			

1864
May 12th

Reduction of Observations of α Virginis for Latitude

h ^m s	h ^m s	K	* R	h ^m s	h ^m s	h ^m s	h ^m s
9 45 17	3 39	26.2	13	18 04.9	Bar	29.560	67° 08' 10"
46 40	2 16	10.1	Sid time M.N.	3 23 20.2	The Alt	69.5	6 08 20
49 51	0 55	1.6	AP Merid	9 54 44.7	The Det	69.5	08 20
51 11	2 15	9.9	Retardation	1 37.4	Refraction		07 45
53 10	4 14	35.2	Mean Time Cul ^m	9 53 07.3	9.9727		07 35
55 04	6 08	73.9	Chas slow	4 11.0	1.9438		06 30
9 57 41	8 45	150.3	Chas time Cul ^m	9 48 56.3	1.9165		67 03 15
Mean		43.88			Mean of Obs ^d D. Alt ^o		67 07 07.9
					Index Error		- 52.6
Cos E	46 00 30		9.94170	Cor Double Alt			67 06 15.3
Cos D	- 10 27 19		9.99273	Altitude			33 33 07.6
Cosec Z	56 27 49		0.07906	Refraction			- 1 22.5
Red to M.T. & rate			277	Red ⁿ to Merid			+ 0 36.2
log	43.88		1.64227	D			10 27 18.9
Red to Merid	36.2		1.55854	CoLatitude			43 59 40.2
Mean Result from 7 Observations							46 00 19.8

May 12th Reduction of Observations of Polaris for Latitude.

Obs Times	Obs Times	Obs Times	h ^m s	h ^m s	h ^m s	h ^m s	h ^m s
10 05 58	10 07 45.7	10 10 46	10 13 05.0	10 22 49	10 25 31.5	AR	13 09 03.7
10 07 50		12 42		24 14		Sid M.N.	3 23 20.2
10 09 29	4 11.4	15 47	4 11.4	25 49	4 11.5	S. Interval	9 45 43.5
10 07 45.7	10 11 57.1		10 17 16.4	29 14		Retardation	1 36.0
Mean time Cul ^m	9 44 07.5		9 44 07.5			M.T. Cul ^m	9 44 07.5
h ^m angle	27 49.6		33 08.9			D	88° 35' 01.5
	6 46 06.5		8 16 21.3			Δ	1 24 58.5
	12 170		2 00.3				84 58.5
	9.0		13 5			Δ in seconds	50 985
p in arc	6 58 32.5		8 18 35.1			log Δ	3.707442
cos p	9.996773		9.995416				3.707442
log Δ	3 70 7442		3.707442				3.698743
	3 70 4215		3.702868				3.698743
89° 14' 50"	50 60.8	89° 16' 20"	50 45.1	89° 17' 25"	49 97.4	Mean Result of 10 Obsns	
89 16 25		16 35	89 16 31.7	17 22			
89 16 20	89° 15' 51.7	16 40	89 15 39.1	18 00	89° 17' 52.5		
Index Error	52.6		52.6	18 40	52.6		
Cor Double Alt	89 14 59.1		44 37 49.6		89 16 59.9		
Altitude	44 37 29.5		57.2		44 38 30.0		
Refr ⁿ	57.2		57.2		57.2		
Cor alt.	44 36 32.3		44 36 52.4		44 37 32.8		
1 st term	1 24 20.8		1 24 05.1		1 23 17.4		
2 nd terms	10		1.3		+ 24		
Latitude	46 00 54.1		46 00 58.8		46 00 52.6		46° 00' 54.9

1864 Reduction of Observations of Arcturus Latitude

May 12th

Obs ^d times	sun angle	K	Obs ^d Double alt ^s	Mean Obs ^d Double alt
10 ^h 34 ^m 19 ^s	5 ^m 53 ^s	68.0	127° 46' 15"	127° 45' 49.4"
35 58	4 14	35.2	46 10	Index Error - 52.6
37 48	2 24	11.3	47 35	Cor ^d M. Double alt ^d 127 44 56.8
39 26	0 46	1.2	48 40	altitude 63 52 28.4
41 26	1 14	3.0	47 35	Ref ⁿ - 26.9
42 45	2 33	12.8	47 20	Red to Mean + 1 16.2
44 52	4 40	42.8	46 45	Mer ^d alt 63 53 17.7
47 33	7 21	106.1	43 05	Declination 19 53 21.3
10 49 45	9 33	179.0	127 39 00	Colatitude 43 59 56.4
		57.04	127 45 49.4	Mean of 9 obs ^d 46° 00' 03.6

Refraction	* R	14 ^m 09	30.3	Cos L	46 00 30	9.84170
9.9727	S. D. M. H.	3 23	20.2	Cos δ	19 53 21	9.97329
1.4577	Int ^l	10 46	10.1	Cosec z	26 07 09	0.35639
1.4304	Retardation	1 45	8	rate Red M. 7		277
-26.9	* Cal ⁿ	10 44	24.3	log	51.04	1.70791
	Chord Error	4 12	0	Red to Mer ^d	76.2	1.88206
	Chord time Cal ⁿ	10 40	12.3			

May 13

Reduction of Observations of Sirius I.I. for Time

Obs ^d times	sun angle	K	Obs ^d Double alt ^s	Mean Obs ^d Double alt	Refraction
9 ^h 05 ^m 49 ^s	9 ^m 07 ^s 38.7		93° 22' 25"	93° 22' 25"	0.15829
06 31	92 00 50		93 22 25	93 22 25	0.15829
08 39	92 14 00		93 44 20	93 44 20	0.2321
09 36	92 54 45		93 55 00	93 55 00	0.2321
9 07 38.7	93 12 20		93 12 20	93 12 20	0.2321
	92 35 29.0		93 40 35	93 40 35	0.2321
	92 34 59.0		93 40 05	93 40 05	0.2321
9 ^h 10 ^m 11 ^s	46 17 29.5		46 50 02.5	46 50 02.5	0.452
9 11 16	46 16 43.2		46 49 17.3	46 49 17.3	0.452
9 11 55	46 15 51.4		46 15 51.4	46 15 51.4	0.452
9 11 07.3	46 32 35		47 05 09	47 05 09	0.452
polar dist	71 25 52		71 25 50	71 25 50	0.452
Latitude	46 00 30		46 00 30	46 00 30	0.452
sun	163 58 57		164 31 29	164 31 29	0.452
1/2 S	81 59 28		82 15 44	82 15 44	0.452
(1/2 S - A)	35 26 53		35 10 35	35 10 35	0.452

1864

Reduction of Observations of Sun's H.I. Latitude

May 13

Obs'd times	hour	angle	K		Obs'd Double alt	
11 ^h 49 ^m 23 ^s	-2 ^m	14 ^s	9.8	Mean D. Alt	125° 42' 12".5	125° 43' 50" Refraction
50 05	1	32	4.6	Index Error	- 30.0	44 55 9.9923
51 05	-0	32	0.6	Cor D. Alt	125 41 42.5	45 50 9.9698
54 17	+2	40	14.0	Altitude	62 50 51.2	44 50 9.9985
54 47	3	10	19.7	Refraction	- 27.4	44 00 1.4765
55 23	3	46	27.9	Par in alt	+ 3.9	43 10 1.4371
55 52	4	15	35.5	Cor Alt 0.01	62 50 27.7	43 10 Ref -27.4
56 30	4	53	46.8	Semidiam	- 15 51.3	42 00
56 57	5	20	55.8	Alt O'Center	62 34 36.4	41 05 Par 29.474
57 34	5	57	69.5	Red to Merid.	1 10.8	40 40 True Alt 84.5
58 06	6	29	82.5	Merid Alt	62 35 47.2	40 00
58 36	6	59	95.7	Declination	18 35 50.0	39 40
59 03	7	26	108.5	Colat.	43 59 57.2	39 00
11 59 29	+7	52	121.5			125 38 45
E - W = 3 ^m 53 ^s				49.46	46° 00' 02".8	mean result
14				cos δ 18° 35' 50"	9.97671	of 14 Observations
				cos L 46 00 30	9.84170	
				cos γ 27 24 40	0.33672	
				log rate & log 49.46	1.69475	
				Red to Merid 70".8	1.84988	

May 13th Reduction of Observations of Saturn. Latitude

Obs'd times	hour	angle	K		Obs'd Double alt	
9 ^h 12 ^m 56 ^s	- 1	58	7.6	δ 2° 17' 41".6	MR 12 ^h 48 ^m 33.7	
9 15 53	+ 0	59	1.9		sid. m. noon 3 27 16.7	
9 16 58	+ 2	04	8.4		sid interval 9 21 17.0	
					Retardation - 1 31.9	
Obs'd D. Alt	83° 25' 10"	83° 27' 10"	83° 25' 00"	H.I. Cal ⁿ 9	19 45.1	
Index Error	- 30	- 30	- 30			
Cor. D. alt	83 24 40	83 26 40	83 24 30	Obs'd. Cor.	4 50.6	
Altitude	41 42 20	41 43 20	41 42 15	Ch. time Cal ⁿ 9	14 54.5	
Ref + par. in alt	- 1 00	1 00	1 00			
Cor altitude	41 41 20	41 42 20	41 41 15			
Declination	2 17 42	2 17 42	2 17 42			Mean of 3 Obs ^s
Red to Merid.	+ 7	2	8			46° 00' 34".0
Colatitude	43 59 09	44 00 04	43 59 05			cloudy & windy
Latitude	46 00 51	45 59 56	46 00 55			

1864
May 13th

Reduction of Observations of a Venus Latitude

obs ^d time	hor angle	K							
9 ^h 36 ^m 48 ^s + 7 ^m 32 ^s	111.4	x.825	91.9	NR	13 ^h 18 ^m 04.9				
9 38 58	5 22	56.5	..	46.6	S.D.M.N	3 27 16.7			
9 40 36 + 3 44	27.4	..	22.6	S.I.	9 50 48.2				
					Retar ⁿ	1 36.8			
Obs ^d Double Alt. ^d	67° 05' 50"	67° 07' 25"	67° 07' 20"		9 49 11.4				
Index Error	- 30	- 30	- 30						
Cor ^d . D. alt. ^d	67 05 20	67 06 55	67 06 50	Obs ^d	4 51.4				
Altitude	33 32 40	33 33 27.5	33 33 25	9	44 20.0				
Refn	1 24	1 24.0	1 24						
Cor alt	33 31 16	33 32 03.5	33 32 01						
Red to Merid.	1 32	46.6	23						
Declination	10 27 19	10 27 19.0	10 27 19						
Calculated	44 00 07	44 00 09	43 59 43						
Mean of 3 from Obs	46° 00' 00.3								

Polaris.

9 ^h 28 ^m 19 ^s
4 51
9 33 08
9 40 12
7 04
1° 46' 17"
Cos 9.999792
3.707463
3 70 72 55
50 96.3
84 56.3
89 15 00
30
89 14 30
44 37 15
57
+ 1 24.56
46° 01' 14"

May 14th

Reduction of Observations of Sun D.I.

obs ^d D. alt	Obs ^d times	obs ^d D. alt							
92° 43' 40"	2 ^h 38 ^m 59 ^s	90° 58' 55"	2.8 by + 2.8 = 5.6						
92 36 10	39 54	90 43 05	5.6 x 35.45 = 198.5						
92 12 45	40 34	90 20 25	+ 18 48 33.1						
91 47 00	41 56	90 06 30	+ 3 18.5						
91 27 25	42 57	89 57 00	18 51 57.6						
91 12 00	2 43 45	90 25 11.0	obs ^d times						
Mean Obs ^d D. Alt	91 59 50.2	41 20.8	2 ^h 44 ^m 29 ^s						
Index Error	- 29	- 29.0	45 18						
Cor ^d . M. D. alt	91 59 21	90 24 42.0	46 31						
altitude	45 59 40.5	45 12 21.0	47 13						
Refraction	- 52.3	Ref - 53.8	47 40						
Par ^t . in alt.	+ 6.0	par in alt + 6.0	2 46 14.2						
Semidiam	- 15 51.1	Sem - 15 51.1							
Cor ^d . Alt @ ^s Center	45 43 03.1	44 55 42.1							
polar dist Δ	71 08 10.	71 08 07.1							
Latitude L.	46 00 30	46 00 30							
Sun S	162 51 43	162 04 19							
1/2 S	81 25 51.5	81 02 09.5							
1/2 (S - A)	35 42 48.0	2 51 43.4							
	Obs ^d time 2 41 20.8	2 46 14.2							
Chr ^a . slow	5 27.1	5 29.2							

Refraction.

9.9936
9.9754
9.9988
9.9678
1.7510
1.7188
Ref - 52.3
9.9678
1.7630
1.7308
Ref - 53.8
2 55 35.2
3 51.8
2 51 43.4
2 46 14.2
5 29.2

1864

Reduction of Observations of Sun's U.L. Latitude

May 14th

Obs	Times	hour	angle	K	Obs ^d Double Alt	Eq ⁿ of Time	
11 ^h	41 ^m 55 ^s	-	8 50	153.2	126° 04' 55"	Chro. slow	3 ^m 51.8
42	30		8 15	133.6	06 05	Chro. time transit	5 22.8
43	13		7 32	111.4	07 25	D + 18° 50' 11.2	
43	59		6 46	89.9	08 40		
44	49		5 56	69.1	09 55	Refraction	
45	33		5 12	53.1	10 45	9. 99 35	Bar ^m 29.560
46	27		4 18	36.3	11 30	9. 99 88	Ther. alt 78.
47	21		3 24	22.7	12 25	9. 97 54	
48	06		2 39	13.8	12 55	1. 47 21	
49	23		1 22	3.7	13 45	1. 43 98	= 27.5
49	59		0 46	1.2	13 35	Cos L 46 00 30	9. 84170
50	32	-	0 13	0.1	13 45	Cos D 18 50 11	9. 97609
51	10	+ 0	25	0.3	13 50	Correc z 27 10 19	0 34058
51	48		1 03	2.2	13 20	rate	60
52	48		2 03	8.0	13 50	log 76.157	1. 88701
53	28		2 43	14.5	13 10	Red to Merid 109.8	2. 04068
54	23		3 38	25.9	12 55		
54	55		4 10	34.1	11 25	Mean Double Alt	126° 10' 07.0
55	34		4 49	45.5	11 25	Index Error	- 29.0
56	16		5 31	59.8	10 40	Cor Double Alt	126 09 38.0
56	53		6 08	73.9	10 25	Altitude	63 04 49.0
57	29		6 44	89.0	09 55	Refr ⁿ	- 27.5
58	15		7 30	110.4	08 20	Par in alt	+ 3.8
59	05		8 20	136.3	08 10	Semidiam	15 51.1
11	59 53		9 08	164.4	06 25	Cor. Alt. O ^s Center	62 48 34.2
12	00 04		9 59	195.7	05 50	Red to Merid	1 49.8
12	01 30		10 45	226.9	04 00	Merid Alt O ^s Center	62 50 24.0
12	02 12	+ 11	27	257.4	126 03 55	Declination	18 50 11.2
				76.157		Colatitude	44 00 12.8
				Mean	126 10 07.0	Latitude	45 59 47.2

$\frac{E - W}{28} = 1^m 24^s$

Mean of 28 obsns.

Reduction of Observations of Arcturus Time

1864

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin(\frac{1}{2} s - A) \operatorname{Cosec} \Delta \sec I.$$

May 14 th	Obs. Double Alt ^s	Obs. Double alt ^s	Obs. times
8 ^h 07 ^m 08 ^s	101° 21' 10"	103° 13' 20"	8 ^h 13 ^m 24 ^s
09 08	56 40	103 41 05	8 14 55
10 47	102 27 10	104 07 20	8 16 24
12 12	102 51 15	104 34 10	8 17 55
8 09 48.7	102 09 04	103 53 59	8 15 39.5 Mean Obs. times
Index Error	- 33	33	
Cor Obs ^d D. Alt	102 08 31	103 53 26	
Altitude	51 04 15.5	51 56 43	Refraction 9.9918
Ref ⁿ	- 44.9	- 43.5	9.9875
Cor Alt	51 03 30.6	51 55 59.5	9.9994
Polar Dist	70 06 38	70 06 38	9.9787
Latitude	46 00 30	46 00 30	1.6736
Sum	167 10 39	168 03 07	1.6523
$\frac{1}{2} s$	83 35 19.5	84 01 34	Ref ⁿ -44.9
$(\frac{1}{2} s - A)$	32 31 49	32 05 34	
sec I.	0.15829	0.15829	9.9787
Cosec Δ	0.02671	0.02671	1.6599
cos $\frac{1}{2} s$	9.04792	9.01730	1.6386
sin $(\frac{1}{2} s - A)$	9.73057	9.72533	-43.5 Ref ⁿ
$\sin^2 \frac{1}{2} p$	8 96349	8 92763	
sin $\frac{1}{2} p$	9.48174	9.46381	Sid M. N. W. 3 ^h 30 ^m 45 ^s .73
Hour angle	2 21 12.3	2 15 19.0	Diff ⁿ Long ^t 27.56
* ^s R	14 09 30.3	14 09 30.3	Sid. M. Noon Comp. 3 31 13.29
AR Mer ^d	11 48 18.0	11 54 11.3	
Sid M. Noon	3 31 13.3	3 31 13.3	
Sid. interval	8 17 04.7	8 22 58.0	Chord ^r slow at 8 ^h 3 5 ^m 55 ^s .3
Retardation	- 1 21.4	1 22.4	
Mean Time	8 15 43.3	8 21 35.6	
Obs ^d time	8 09 48.7	8 15 39.5	
Chord ^r slow	5 54.6	5 56.1	

1864
May 14

Reduction of Observations of Saturn Latitude

Obs ^d times	hour angle	K	Obs ^d D. alt		
8 ^h 57 ^m 12 ^s	- 12 32	308.4	83° 19' 00"	Chord slow	5 ^m 54 ^s 5
8 58 20	11 24	255.1	21 05	AR wash ^t	12 ^h 48 24.8
9 01 13	8 31	142.4	24 10	Diff for Long ^t	- 1 2
02 16	7 28	109.5	25 00	AR	12 48 23.1
03 29	6 15	76.7	26 45	sid M. noon	3 31 13.3
04 32	5 12	53.1	27 00	AR of merid	9 17 09.8
05 45	3 59	31.1	28 30	Retardation	- 1 31.3
06 56	2 48	15.4	28 20	M. Time Cul ⁿ	9 15 38.5
09 08	- 0 36	0.7	29 30	Chord Error	- 5 54.5
10 14	+ 0 30	0.5	29 00	Chord time Cul ⁿ	9 09 44.0
11 08	1 24	3 8	29 00		
12 22	2 38	13.6	29 00	Mean Obs ^d D. alt	83° 25' 20.5
13 52	4 08	33.5	28 35	Index Error	- 3 2.5
15 37	5 53	68.0	27 10	Co ⁿ ? Double alt	83 24 48.0
17 29	7 45	117.9	25 30	Altitude	41 42 24.0
18 15	8 31	142.4	24 40	Refraction	- 1 02.2
19 27	9 43	185.4	23 05	Co ⁿ ? alt	41 41 21.8
20 36	10 52	231.8	22 15	Declination	2 16 46.4
21 39	11 55	278.8	20 25	Red ⁿ to Merid.	+ 1 52.2
9 22 45	+ 13 01	332.6	83 18 50	per in alt	+ 0.7
		120.03	83 25 20.5	Colat.	44 00 01.1

Mean result of 20 Obs^{ns} 45 59 58.9

Cos L	46° 00' 30"	9.84171
Cos δ	2 16 46	9.99966
Cos γ	48 17 16	0.12677
Red. to M. Y. + rate		227
log K	120.03	2.07929
Red to Merid	112.2	2.04990

Refⁿ
9.9787
1.8160
1.7947
Refⁿ
- 62.2

1864 Reduction of Observations of a Virginis for Latitude

May 14th hour angle R Obs Double Alt^s

9 ^h 30 ^m 12 ^s	-9 ^m 10 ^s	165.0	67° 03' 30"	*R 13 ^h 18 ^m 04.9	cos 46° 00' 30"	9.84171	67° 03' 54"	
32 13	7 09	100.4	05 20	S.N. 2. 3	31 13.3	cos 10 27 19	9.99275	32.5
35 49	-3 33	24.7	07 05	S. 1. 9	46 57.6	cos 56 27 49	0.07906	67 03 21.5
39 36	+0 14	0.1	08 20	Retard ⁿ	1 36.1	rate &c	227	33 31 40.7
42 22	3 00	17.7	07 00	tan Alt ^g	45 15.5	log k 136.34	2.13462	-1 23.2
44 54	5 32	60.1	05 20	Obs slow	5 53.2	Red to true 112.3	2.05041	33 30 17.5
46 38	7 16	103.7	04 55	9	39 22.3	9.9787	10 27 18.9	
48 49	9 27	175.3	02 25	8:10	27 18.9	1.9416	1 52.3	
51 40	12 18	297.0	67 00 00	Ref ⁿ	83".2	1.9203	43 59 28.7	
9 53 59	+14 37	419.4	66 55 05					
		136.34						Mean Result of 10 Obs 46° 00' 31".3

May 14th Reduction of Observations of Polaris Latitude

9 ^h 59 ^m 06 ^s	10 ^h 04 ^m 55 ^s	10 ^h 12 ^m 41 ^s	A.R.S.P. 13 ^h 08 ^m 64.8
10 02 13	06 07	14 39	did m. n 3 31 13.3
10 03 36	09 03	17 47	did int. 9 37 51.5
Mean Obs ^d times	10 01 38.3	10 06 41.7	10 16 31.2 Retardation 1 34.7
Obs slow	5 52.7	5 52.6	5 52.4
Cor times Obs ⁿ	10 07 31.0	10 12 34.3	10 22 23.6 Time Cul ^m 9 36 16.8
Time Cul ^m	9 36 16.8	9 36 16.8	9. 36 16.8 D 88" 35' 01." 0
hour angle	31 14.2	36 17.5	46 06.8 Δ 1 24 59.0
	7 46 16.4	9 01 28.7	11 31 53.3 84 59.0
	3 30.6	4 15.7	1 30.2
	3.0	7.5	12.0 Δ in seconds 5099.0
p in arc	7° 49' 50.0	9° 05' 51.9	11 33 35.5 log Δ 3.707485
cos p	9.995931	9.994522	9.991100
log Δ	3.707485	3.707485	3.707485 Δ ² 7.4149
Δ cos p	3.703416	3.702007	3.698585 tang A 9.9944
1 st term	50 51.5	50 35.1	49 95.6 log α 4.3845 Ref ⁿ
Obs ^d Double Alt	89° 15' 20."	89° 16' 20"	89° 17' 05"
	15 55	16 15	17 15
	16 30	16 50	17 50
			17 40 1.5 0.1927 9.9893
Mean Obs ^d D. Alt	89 15 55	89 16 28.3	89 17 27.5 9.9994
Index Error	-32.5	-32.5	-32.5
Cor Double alti	89 15 22.5	89 15 55.8	89 16 55.0 Δ tang A. α 1.7938 1.7716
Altitude	44 37 41.2	44 37 57.9	44 38 27.5 sin p 8.6043 1.7522
Ref ⁿ	-56.5	-56.5	-56.5
Cor altitude	44 36 44.7	44 37 01.4	44 37 31.0 0.3981
1 st term	1 24 11.5	1 23 55.1	1 23 15.6
2 nd term	1.2	1.6	2.5
Latitude	46 00 57.4	46 00 58.1	46 00 49.1 Mean Result of 10 Obs ⁿ 46° 00' 54".3

1864

Reduction of Circum Meridian Altitudes & Bores

May 14th

Obs ^d Times	hour	angle	K	Obs ^d Double Alt	Bar	29.456	Att ^d Ther ^m 63° 0
10 ^m 24 ^m 06 ^s	-6 ^m 54 ^s	93.5	127° 43' 50"	* ^s R	14 ^m 09 ^m 30 ^s		
25 17	5 43	64.2	44 55	Sid. M. noon	3 31 13.3		
26 57	4 03	32.2	46 00	Sid. interval	10 38 17.0		
28 39	-2 21	10.8	47 15	Retardation	-1 24.9		
31 00	0 00	0.0	49 50	Mean time Cul ⁿ	10 36 52.1		
32 45	+1 45	6.0	48 20	Chro ^d Cor ^d	-5 52.1		
35 05	4 05	32.7	47 15	Chro ^d time Cul ⁿ	10 31 00.0		
37 54	6 54	93.5	43 05	Mean Obs ^d Double Alt	127 45 30.5		
40 16	+9 16	168.6	127 39 15	Index Error	-32.5		
				Cor ^d Obs ^d D. alt	127 44 58.0		
				Altitude	63 52 29.0		
				Refraction	-27.0		
Cos I,	46" 00' 30"	9.84170		Cor ^d altitude	63 52 02.0		
Cos D	19 53 21	9.97329		Red. to Mer ^d	+1 23.1		
Cosec Z	26 07 09	0.35639		Merid alt	63 53 25.1		
rate & Red to Mer ^d .		227		Declination	19 53 21.3		
log 55.72		1.74601		Colatitude	44 00 03.8		
Red to Mer ^d .	83".1	1.91966		Mean of 9 Obs ^d	45 59 56.2		

May 15th

Reduction of Observations of Sirius I. I. for Time

Obs ^d Double Alt	Obs ^d time	Obs ^d Double Alt	Obs ^d time	Ref ⁿ
86° 45 30	8 ^h 46 ^m 07 ^s	87° 33 55"	8 ^h 48 ^m 33 ^s	9.9929
87 05 10	8 47 07	47 50	49 11	9.9831
87 21 15	8 47 56	57 35	49 45	9.9992
Mean Obs ^d D. Alt	87 03 58.3	8 47 03.3	87 46 26.7	8 49 09.7 1.7883
Index Error	-38.3		-38.4	1.7635
Cor ^d Double Alt	87 03 20	0.15829	87 45 48	0.15829 58.0
Altitude	43 31 40	0 02444	43 52 54	2444
Refraction	-58	9.22336	-57	9.21537 9.9752
Parallax in alt ^d	+6	9.77536	+6	9.77354 1.7830
Semidiameter	+15 51	9.18145	+15 51	9.17164 1.7582
Cor ^d alt O ^d Center	43 46 39	9.59072	44 07 54	9.58582 57.3
Latitude I	46 00 30	8 56 32.7	46 00 30	8 58 41.5 Bar ⁿ
Polar Dist Δ	70 57 33	3 57.5	70 57 33	3 51.5 29.512
Sum	160 44 42	8 52 41.2	161 05 56	8 54 50.0 Mer ^d Alt
1/2 S	80 22 21	8 47 03.3	80 32 58	8 49 09.7 69.0
(1/2 S - A)	36 35 42	slow 5 37.9	36 25 04	slow 5 40.3

1864 Reduction of Circum Meridian Altitudes of Sun's I.I.

Obs ^d Time	hour angle	K	Obs ^d Double Alt. ^s	Eg ⁿ of time	Ch ⁿ slow	Ch ⁿ time O ^s transit	
May 15 th			125° 33' 10"			3 51 ^s	
11 ^m 44 00 ^s	6 22	79.6	34 40			5 47	
45 25	4 57	48.1	35 10			11 50 22	
46 10	4 12	34.6	36 00				
47 04	3 18	21.4	36 55	Cos I	46° 00' 30"		9.84171
48 12	2 10	9.2	37 35	Cos D	19 04 14		9.97549
49 13	1 09	2.6	37 55	Cosec z	26 56 16		0.34385
50 10	0 12	0.1	37 30	rate			90
51 13	0 51	1.4	37 25	log K	39.841		1.60033
52 01	1 39	5.3	36 45	Red to Mer ^d	57.85		1.76227
53 06	2 44	14.7	36 25				
54 12	3 50	28.8	36 00	Mean of Obs ^d Double Alt. ^s	125° 35' 41.2"		
54 52	4 30	39.8	35 35	Index Error			38.3
55 41	5 19	55.5	35 00	Cor ^d Obs ^d D. Alt. ^s	125 35 02.9		
56 08	5 46	65.3	34 15	Altitude.	62 47 31.4		
56 39	6 17	77.5	33 20	Refraction			- 27.8
57 13	6 51	92.1	125 33 00	Parallax in Alt.			+ 3.9
57 33	7 11	101.3		Cor ^d alt O ^s I.I.	62 47 07.5		
		39.841	125 35 41.2	Semidiameter	+ 15 50.9		
				Cor ^d Alt. O ^s Center	63 02 58.4		
				Refraction			+ 57.8
				Red. to Mer ^d			
Par ^a	29.439	9.9909		Mer ^d alt. ^s	63 03 56.2		
Mer. Alt. ^s	69.5	9.9989		Declination	19 04 13.7		
Mer. Dist ^s	69.	9.9762		Colatitude	43 59 42.5		
		1.4774		Mean Result 17 Obs ^s	46 00 17.5		
		1.4434					
		Ref ⁿ - 27.8					

1864

Reduction of Observations of Sun's V.L. for June.

May 15th

Obs. times	Obs. times	Obs. times
2 ^h 46 ^m 14 ^s	2 ^h 48 ^m 37 ^s	2 ^h 50 ^m 09 ^s
47 22	49 10	51 09
48 06	49 39	53 23

Bar. 29.387
Ther. Alt. 82.0

Mean Obs. times 2 47 14.0 2 49 08.7 2 52 18.0

Obs. Double Alt	90° 37' 20"	89° 50' 50"	89° 10' 40"
	90 16 00	40 25	02 20
	90 01 10	31 00	88 17 55
Mean Double Alt	90 18 10.0	89 40 45	88 39 36.2
Index Error	- 38.3	- 38.3	- 38.3
Cor. Double Alt	90 17 31.7	89 40 06.7	88 38 57.9
Altitude	45 08 45.8	44 50 03.4	44 19 28.9
Refraction	- 53.1	- 53.7	- 54.6
Par. in alt.	+ 6.0	+ 6.0	+ 6.0
Semidiam	- 15 51.0	- 15 51.0	- 15 51.0

Refraction

9.9910
9.9720
9.9986
9.9616
1.7639
1.7255
Ref. - 53.1

Cor. alt. O's Center	44 52 08.	44 33 24	44 02 49
pol. dist Δ	70 54 05	70 54 04	70 54 02
Latitude L	46 00 30	46 00 30	46 00 30
Sunn S	161 46 43	161 27 58	160 57 21
1/2 S	80 53 21.5	80 43 59	80 28 40.5
(1/2 S - A)	36 01 13.	36 10 35	36 25 51
Sec L	0.15829	0.15829	0.15829
Cosec Δ	0.02458	2459	2459
Cos 1/2 S	9.19960	9.20692	9.21862
Sin (1/2 S - A)	9.76943	9.77105	9.77368
Sin 1/2 p	9.15190	9.16085	9.17518
Sin 1/2 p	9.57595	9.58042	9.58759
hour angle	2 57 01	2 58 56.8	3 02 05.2
Eq. of time	- 3 50.9	- 3 50.9	- 3 50.9
Mean Time	2 53 10.1	2 55 05.9	2 58 14.3
Obs. time	2 47 14.0	2 49 08.7	2 52 18.0
Cor. slow.	5 56.1	5 57.2	5 56.3

Chord slow 2^h 55^m 5^m 56^s .53

1864 Reduction of Observations of α Virginis for Latitude

May 17th

Obs ^d Times	hour angle	K	Obs ^d Double alt		
9 ^h 04 ^m 29 ^s	-18 ^m 01 ^s	637.0	66° 50' 10"	* ^s AR	13 ^h 18 ^m 04 ^s .9
06 37	15 53	495.2	53 30	sid Time M.K.	3 43 03.0
07 59	14 31	413.6	56 05	sid int part M.K.	9 35 01.9
09 32	12 58	330.0	66 59 00	Retardation	- 1 34.2
11 19	11 11	245.5	67 00 30	Mean Time Cul ^u	9 33 27.7
12 53	9 37	181.6	02 20	Chro. slow	- 10 58.2
14 00	8 30	141.8	03 05	Chro. time * Cul ^u	9 22 29.5
16 20	6 10	74.7	05 15		
20 14	- 2 16	10.1	06 50	Cos I 46° 00' 30"	9.84171
22 46	+ 0 16	0.1	07 45	Cos δ 10 27 19	9.99273
27 19	4 49	45.5	06 20	Correc _z 56 27 49	0.07912
28 25	5 55	68.7	05 30	rate $\sqrt{2}$ M.K.	300
29 20	6 50	91.7	04 45	log K 279.88	2.44698
30 37	8 07	129.3	03 50	Red to Mer? 231."0	2.36354
32 39	10 09	202.2	01 40		
33 42	11 12	246.3	67 00 30		
35 12	12 42	316.6	66 59 00	mean Obs ^d Double Alt ^s	66° 59' 43."3
36 35	14 05	389.3	57 10	altitude	33 29 51.6
38 43	16 13	516.1	53 00	Refraction	- 1 23.9
40 10	17 40	612.5	50 45	Cor ^d altitude	33 28 27.7
9 41 47	19 17	729.7	66 47 10	Red to Mer ^d	+ 3 51.0
	Mean	279.88		Mer ^d alt ^d	33 32 18.7
				Declination	- 10 27 18.7
				Colatitude	43 59 37.4
				Latitude	46 00 22.6
Bar 29 5.50	Refraction			Mean Result of 21 Obs ^u	
Ther alt ^d 65.0	9.9793				
	1.9447				
Ref ⁿ - 83."9	1.9240				

1864

Reduction of Observations of Polaris for Latitude

	Obs ^d Times	Obs ^d Times	Obs ^d Times	Obs ^d Times	Obs ^d Times	Obs ^d Times
May 17 th	9 ^h 44 ^m 55 ^s	9 ^h 53 ^m 12 ^s	9 ^h 57 ^m 06 ^s	10 ^h 01 ^m 56 ^s	10 ^h 06 ^m 24 ^s	10 ^h 10 ^m 35 ^s
	48 55	54 11	59 20	03 09	08 37	12 33
	52 10	55 50	00 13	05 17	09 25	14 56
Mean Obs ^d Times	9 48 40.0	9 54 24.3	9 58 39.0	10 03 27.3	10 08 08.7	10 12 41.3
Chr ^t . slow	+ 10 55.7	+ 10 55.9	+ 10 56.0	+ 10 56.2	+ 10 56.4	+ 10 56.6
Cor ^d time Obs ⁿ	9 59 35.7	10 05 20.2	10 09 35.0	10 14 23.5	10 19 05.1	10 23 37.9
M. Y. Cal ⁿ	9 24 30.9	9 24 30.9	9 24 30.9	9 24 30.9	9 24 30.9	9 24 30.9
hour angle p	35 04.8	40 49.3	45 04.1	49 52.6	54 34.2	59 07.0
Sidereal	8° 46' 26".2	10° 01' 38".6	11° 16' 50".9	12° 17' 0".7	13° 32' 13".1	14° 47' 25".4
Equivalents	1 00.2	12 17.0	1 00.2	13 02.1	8 31.4	1 45.3
in arc	12.0	4.5	1.5	9.0	3.0	
p in arc	8 47 38.4	10 14 00.1	11 17 52.6	12 30 11.8	13 40 47.5	14 49 10.7
Cor p	9.994865	9.993036	9.991501	9.989576	9.987502	9.985308
log Δ	3.707544	3.707544	3.707544	3.707544	3.707544	3.707544
Δ cos p	3.702409	3.700580	3.699045	3.697120	3.695046	3.692852
1 st term	50 39".7	50 18".5	50 00.9	49 78.8	49 55.0	49 30.1
Δ ² tang A α	1.7945	1.7945	1.7945	1.7945	1.7945	1.7945
sin ² p	8.3685	8.4994	8.5841	8.6706	8.7478	8.8156
2 nd term	+ 1.5	+ 2.0	+ 2.4	+ 2.9	+ 3.5	+ 4.1
Obs ^d Double Alt	89° 16' 00"	89° 16' 30"	89° 17' 20"	89° 17' 50"	89 18 35.0	89 19 05
	15	40	25	18 00	45.0	10
	20	45	30	18 20	50.0	55
Mean Double Alt ^s	89 16 12.0	89 16 38.3	89 17 25.0	89 18 03.3	89 18 43.3	89 19 23.3
Altitude	44 38 06.0	44 38 19.1	44 38 42.5	44 39 01.6	44 39 21.6	44 39 41.6
Refraction	- 56.4	- 56.4	- 56.3	- 56.3	- 56.3	- 56.3
Cor ^d Alt ^s	44 37 09.6	44 37 22.7	44 37 46.2	44 38 05.3	44 38 25.3	44 38 45.3
1 st term	+1 23 59.7	+1 23 38.5	+1 23 20.9	+1 22 58.8	+1 22 35.0	+1 22 10.1
2 nd term	+ 1.5	+ 2.0	+ 2.4	+ 2.9	+ 3.5	+ 4.1
Latitude	46 01 10.8	46 01 03.2	46 01 09.5	46 01 07.0	46 01 03.8	46 00 59.5
Mean Result of			R 13 ^h 09 ^m 06.6	S 88 35 0.3	Refraction	
21 Obs ^s			Sid ⁿ 3 43 03.0	1 24 59.7	9.9934	
			Ret ⁿ 9 24 03.6	84 59.7	9.9866	
			1 32.7		9.9993	
			Cal ⁿ + 9 24 30.9	Δ 5099.7	1.7711	
					1.7504 = 56.3	

May 17
Obs. Times

Reduction of β Leonis for Time.

	Obs. times	Obs. times	Obs. times	
10 ^h 15 ^m 45 ^s	10 ^h 31 ^m 09 ^s	10 ^h 37 ^m 04 ^s	10 ^h 41 ^m 33 ^s	AR 11 ^h 42 ^m 09 ^s .6
17 13	33 16	38 09	43 13	S.M.N. 3 43 03.0
20 08	34 08	39 10	44 18	D + 15 19 43
10 17 22.0	mean of Obs. times 10 32 51.0	10 38 07.7	10 43 01.3	Bar 29.550
+ 10 56.8				Alt. Ther 65.0
10 28 18.8	Obs. D. Alt. 88° 00' 00"	86 08 20	84 43 55	Det. Ther 65.0
9 24 30.9	87 20 00	85 48 45	84 13 30	
1 03 47.9	87 03 20	85 30 00	83 53 10	Refraction
	Mean Obs. D. Alt. 87 27 47	85 49 02	84 16 52	9.9934
15° 02' 27.8	Index Error. - 50	- 50	- 50	9.9866
45 30 4	Cor. Mean D. Alt 87 26 57	85 48 12	84 16 02	9.9993
11 46.9	Altitude 43 43 28.5	42 54 06	42 08 01	9.9793
13 5	Refraction - 58.0	- 1 00	- 1 01	1.7854
15 59 58.6	Altitude Cor. 43 42 30.5	42 53 06	42 07 00	1.7647
9.982842	polar dist Δ 74 40 17	74 40 17	74 40 17	Ref. - 58.2
3.707544	Latitude L 46 00 30	46 00 30	46 00 30	
3.690386	Sum 164 23 17	163 33 53	162 47 47	9.9793
49 02.2	1/2 S 82 11 38.5	81 46 56	81 23 53	1.7979
7.4157	(1/2 S - A) 38 29 08	38 53 50	39 16 53	1.7772
9.9949	Sec I. 0.15829	0.15829	0.15829	Ref. - 60.0
4.3845	Cos Δ 1573	1573	1573	
8.8806	Cos 1/2 S 9.13297	9.15514	9.17483	9.9793
0.6757	Sin(1/2 S - A) 9.79401	9.79791	9.80149	1.8095
+ 4.7	Sin ² 1/2 p 9.10100	9.12707	9.15034	1.7885
89 20 00.0	Sin 1/2 p 9.55050	9.56353	9.57517	Ref. - 61.5
10.0	hour Angle = p 2 46 27.2	2 51 46.5	2 56 40.8	
40.0	* ^s R 11 42 09.6	11 42 09.6	11 42 09.6	
89 20 16.7	AR. Mer. 14 28 36.8	14 33 56.1	14 38 50.4	
44 40 08.4	Sid. M. Noon 3 43 03.0	3 43 03.0	3 43 03.0	
- 56.3	Sid. time past M.N. 10 45 33.8	10 50 53.1	10 55 47.4	
44 39 12.1	Retardation - 1 45.7	- 1 46.6	- 1 47.4	
41 21 42.2	Mean Time 10 43 48.1	10 49 06.5	10 54 00.0	
4.9	Obs. time 10 32 51.0	10 38 07.7	10 43 01.3	
46 00 58.9	Chron. slow 10 57.1	10 58.8	10 58.7	

Chron. slow at 10^h.8 10^m 58^s.2

Recapitulation of Results of Latitude
uncorrected for Eccentricity of Sextant.

Date 1864	Object	No Obs ⁿ	Latitude
May 7 th	Polaris	10	46° 01' 21".6
8	Sun	14	46 00 18.0
9	α Virginis	7	45 59 54.0
9	α Bootis	6	45 59 17.3
9	Polaris	12	46 01 02.1
10	Sun	21	46 00 00.0
10	α Virginis	20	46 00 07.0
10	Polaris	12	46 01 02.2
10	α Bootis	10	45 59 38.2
11	Sun	26	46 00 17.9
12	Sun	19	46 00 00.8
12	Saturn	12	46 00 09.6
12	α Virginis	7	46 00 19.8
12	Polaris	10	46 00 54.9
12	α Bootis	9	46 00 03.6
13	Sun	14	46 00 02.8
13	Saturn	3	46 00 34.0
13	Polaris	1	46 01 14.0
13	α Virginis	3	46 00 00.3
14	Sun	28	45 59 47.2
14	Saturn	20	45 59 58.9
14	α Virginis	10	46 00 31.3
14	Polaris	10	46 00 54.3
14	α Bootis	9	45 59 56.2
15	Sun	17	46 00 17.5
17	α Virginis	21	46 00 22.6
17	Polaris.	21	46 01 04.7

Latitude by Polaris

Date	Latitude	alt. ^o	Cor ^e	No Obs ⁿ	Correct Latitude
May 7.	46 01 21.6	44° 41'	-24.2	10	46° 00' 57".4
9.	46 01 02.1	38	"	12	46 00 37.9
10.	46 01 02.2	38	"	12	46 00 38.0
12.	46 00 54.9	38	"	10	46 00 30.7
14.	46 00 54.3	38	"	10	46 00 30.1
17.	46 01 04.7	38	"	21	46 00 40.5
13	46 01 14.0	44 37	"	1	46 00 49.8
Mean	corrected result of 76 Observations				46 00 39.3.

Latitude by Sun

May 8	46° 00' 18".0	61° 01'	+34".7	14	46° 00' 52".7
10	46 00 00.0	62 04	35.4	21	46 00 35.4
11	46 00 17.9	62 19	35.6	26	46 00 53.5
12	46 00 00.8	62 36	35.8	19	46 00 36.6
13	46 00 02.8	62 51	36.0	14	46 00 38.8
14	45 59 47.2	63 05	36.2	28	46 00 23.4
15	46 00 17.5	62 47	+36.0	17	46 00 53.5
Mean	corrected Result of 139 Observations.				46 00 40.8

Latitude by a Virginis.

May 9	45° 59' 54".0	33° 34'	+17".2	7	46° 00' 11".2
10	46 00 07.0	33 32	17.2	20	46 00 24.2
12	46 00 19.8	33 33	17.2	7	46 00 37.0
13	46 00 00.3	33 33	17.2	3	46 00 17.5
14	46 00 31.3	33 31	17.2	10	46 00 48.5
17.	46 00 22.6	33 30	+17.2	21	46 00 39.8
Mean	corrected Result of 68 Observations				46 00 32.3

Latitude by Saturn

Date.	Latitude	alt. ^d	Cor. ⁿ e.	N ^o Obs ⁿ	Corrected Latitude
May 12	46° 00' 09".6	41° 41'	+ 22.3	12	46° 00' 31".9
13	46 00 34.0	41 42	+ 22.3	3	46 00 56.3
14	45 59 58.9	41 42	+ 22.3	20	46 00 21.2
Mean Result corrected of 35 observations					46 00 27.9

Latitude by α Bootis.

May 9	45° 59' 17".3	63° 54'	+ 36.7	6	45° 59' 54".0
10	45 59 38.2	63 53	36.7	10	46 00 14.9
12	46 00 03.6	63 52	36.7	9	46 00 40.3
14	45 59 56.2	63 52	+ 36.7	9	46 00 32.9
Mean corrected Result of 34 observations					46 00 22.7

Final Results

Object	Weight	Altitude	Cor. ⁿ exact ^d	Correct Latitude
Sun	139	+62° 24'	+ 35.7	46° 00' 40".9
Polaris	76	-44 38	- 24.2	46 00 39.3
α Virgins	68	+ 33 32	+ 17.2	46 00 32.3
Saturn	35	+ 41 42	+ 22.3	46 00 27.9
α Bootis	34	+ 63 53	+ 36.7	46 00 22.7
Mean corrected Result from 352 observations				46 00 35.9

The difference of latitude between astronomical stations first and second being by measurement 116 chs + 131 chs - 26 ch = 221 ch of 33 feet = 7293 feet or 1' 12".0. which applied to the most probable result obtained from 580 observations for station first Cottonwood Cr. 45° 59' 24".85" we get as the most probable result for station second, on Columbia River.

46° 00' 36".86

$$103 \text{ chs} \times 33 = 3399 \text{ Log } 3.531351$$

$$\frac{3600}{364635} \text{ " } 3.556302$$

$$\frac{3600}{364635} \text{ " } 4.438142$$

$$1.525795 = 33.56$$

the location of Initial Monument measured from astronomical station.

Mean Altitude of Station above
Mean Sea level.

Barometric readings taken at Astronomical Station
Second, Columbia River to determine the approx-
imate elevation of the station above mean sea
level.

Barometer	Ther. Alt. ^g	Ther. Det. ^d	Barometer	Ther. Alt. ^g	Ther. Det. ^d
29.506	69.5	69.5	29.528	75.0	75.0
.500	61.5	61.5	539	74.0	74.0
460	78.0	78.0	559	70.0	70.0
449	73.5	73.5	474	84.0	84.0
622	75.0	75.0	425	89.0	89.0
630	70.0	70.0	580	75.0	75.0
649	74.0	74.0	560	78.0	78.0
754	83.0	83.0	460	64.5	64.5
610	75.0	75.0	456	63.0	63.0
625	65.0	65.0	512	69.0	69.0
632	60.5	60.5	374	77.0	77.0
700	82.0	82.0	439	69.5	69.5
716	81.5	81.5	387	82.0	82.0
664	87.0	87.0	550	65.0	65.0
580	73.0	73.0	540	71.0	71.0
29.560	69.5	69.5	29.558	73.0	73.0

Mean of 32 Observations 29.549 73.9 74.

The reading of Barometer at level of sea and
reduced to temperature of 32° Fah.ⁿ 30.060 & Ther 64°
assumed sea level altitude 30.030. 27661.5

Reading at station reduced to 32° Fah.ⁿ 29.460 27135.1
526.4

$$\frac{526.4}{900.} (64^{\circ} + 74^{\circ} - 64^{\circ}) = 74^{\circ} \times 0.585 = 43.3$$

Approximate elevation of Station above Mean sea level = 569.7 feet

Reduction of Observations made at Station Third
near Snake River. Situated at the forks of the most
Easterly tributary of Grand Ronde River near its mouth
2nd Computation.

	Obs ^d times			Obs ^d times			Obs ^d times			Obs ^d times						
	^h	^m	^s	^h	^m	^s	^h	^m	^s	^h	^m	^s	^h	^m	^s	
1864	9	18	27	9	21	41	9	29	42	9	35	45				Refractions
August 25 th	9	20	17		22	58	9	32	35	9	38	16				9.9823
	9	21	41		24	46	9	34	00	9	40	06				9.9910
Mean of Obs ^d times	9	20	08.3	9	23	08.3	9	32	05.7	9	38	02.3				9.9996
																9.9729
	53°	30'	50"	52°	23'	40"	103°	25'	55"	103°	53'	30"				2.0692
	52	51	45	51	55	15		39	35	104	04	50				2.0421
	52	23	40	51	18	25		44	50	104	13	00				Ref ⁿ - 1 40.2
Mean Obs ^d S. Alt	52	55	25	51	52	33	103	36	46.7	104	03	46.7				
Index Error			+ 37.5			+ 37.5						+ 37.5				9.9729
Cor Double Alt	52	56	02.5	51	53	10.5	103	37	24.2	104	04	24.2				2.0786
Altitude	26	28	01.2	25	56	35.2	51	48	42.1	52	02	12.1				2.0515
Refraction			- 1 50.2			- 1 52.6			- 43.1			- 42.8				- 112.6
Cor ^d Alt A	26	26	11.0	25	54	42.6	51	47	59	52	01	29				
polar Dist Δ	70	06	30	70	06	30	81	28	56	81	28	56				9.9729
Assumed Lat.	46	00	35	46	00	35	46	00	35	46	00	35				1.6620
Sum	142	33	16	142	01	47.6	179	17	30	179	31	00				1.6349
1/2 S	71	16	38	71	00	53.8	89	38	45	89	45	30				Ref ⁿ - 43.1
(1/2 S - A)	44	50	27	45	06	11.2	37	50	46	37	44	01				
Sec I			0.15831			0.15831			0.15831			0.15831				9.9729
Cosec Δ			0.02671			0.02671			0.00482			0.00482				1.6585
Cos 1/2 S			9.50649			9.51230			7.79108			7.62509				1.6314
sin(1/2 S - A)			9.84828			9.85026			9.78785			9.78674				Ref ⁿ - 42.8
sin ² 1/2 p			9.53979			9.54758			7.74206			7.57496				
sin 1/2 p			9.76989			9.77379			8.87103			8.78748				
hour angle p	4	48	31.0	4	51	32.0		0	34	05.5		0	28	07.0		
* ^s AR	14	09	29.2	14	09	29.2		19	44	12.5		19	44	12.5		
sid. time Obs ⁿ	18	58	00.2	19	01	01.2		19	10	07.0		19	16	05.5		
sid. M. Noon	10	17	17.2	10	17	17.2		10	17	17.2		10	17	17.2		
sid. interval	8	40	43.0	8	43	44.0		8	52	49.8		8	58	48.3		
Retardation			- 1 25.3			- 1 25.8			- 1 27.3			- 1 28.2				
mean time	8	39	17.7	8	42	18.2		8	51	22.5		8	57	20.1		
Obs ^d time	9	20	08.3	9	23	08.3		9	32	05.7		9	38	02.3		
Chro ^d fast			40 50.6			40 50.1			40 43.2			40 42.2				
																Chro ^d fast at 9.5 40 ^m 47.8

1864

Reduction of Observations of Polaris for Latitude

August 25 th	Obs ^d times	Obs ^d times	Obs ^d times	Obs ^d times	Obs ^d times	
	2 ^h 32 ^m 51 ^s	2 ^h 43 ^m 59 ^s	2 ^h 55 ^m 17 ^s	3 ^h 02 ^m 56 ^s	3 ^h 15 ^m 26 ^s	
	34 40	46 57	56 46	06 54	17 22	AR 1 ^h 10 ^m 28 ^s .1
	36 33	47 57	58 20	09 08	20 01	S.M. 2 10 17 17.2
	38 17	50 28	59 59	10 00	21 35	14 53 10.9
	41 03	52 55	3 01 38	13 09	23 52	2. 26.3
					26 34	
Mean Obs ^d time	2 36 40.8	2 48 27.2	2 58 24.0	3 08 25.4	3 20 40.8	* Pol 14 ^h 50 ^m 44.6
Chr ^d Cor ⁿ	- 41 46.2	- 41 47.7	- 41 49.3	- 41 50.5	- 41 52.0	
Cor ^d Obs ^d time	1 54 54.6	2 06 39.5	2 16 34.7	2 26 34.9	2 38 48.8	δ 88° 35' 05.6
M. J. X ^s Cul ⁿ	2 50 44.6	2 50 44.6	2 50 44.6	2 50 44.6	2 50 44.6	1 24 54.4
Hour angle	55 50.0	44 05.1	34 09.9	24 09.7	11 55.8	84 54.4
Sidereal	13° 47' 15.5	11° 01' 48.4	8° 31' 23.8	6° 00' 59.1	2° 45' 27.1	5094.4
Equivalents	12 32.0	1 15 2	2 15 4	2 15 4	15 47.3	3. 707093
		1.5	13.5	10.5	12.0	
p	13 59 47.5	11 03 05.1	8 33 52.7	6 03 25.0	2 59 26.4	
Cos p	9.986910	9.991871	9.995129	9.997568	9.999408	Refraction
log Δ	3.707093	3.707093	3.707093	3.707093	3.707093	9.9729
Δ Cos p	3.694003	3.698964	3.702222	3.704661	3.706501	1. 7295
1 st term	- 49 45.1	500.0.0	5037.6	5066.0	5087.5	1. 7024
Δ	3.70709		3.70709		3.70709	Ref ⁿ - 50.4
sin p	9.38357		9.17290		8.71744	
Δ sin p	3.09066		2.87999		2.42453	
log a	4.38454		4.38454		4.38454	9.9729
tang A	0.03640		0.03675		0.03690	
2 nd term	0.60226		0.18127		9.26991	1. 7292
	+ 4.0	+ 2.8	+ 1.5	+ 0.9	+ 0.2	Ref ⁿ 1. 7021
Obs ^d Double Alt ^s	94° 47' 15"	94° 49' 40"	94° 51' 10"	94° 52' 20"	94° 52' 45"	Ref ⁿ - 50.4
	47 39	49 40	51 15	52 00	52 30	
	48 20	50 00	51 30	52 00	52 40	
	48 20	50 10	52 00	52 10	52 55	
	49 00	50 35	52 15	52 10	53 00	
					53 10	
Mean Obs ^d D. alt ^s	94 48 05	94 50 01	94 51 38	94 52 08	94 52 50	Mean Result
Index Error	+ 37.5	+ 37.5	+ 37.5	+ 37.5	+ 37.5	26 Obs ^d
Cor ^d Double alt	94 48 42.5	94 50 38.5	94 52 15.5	94 52 45.5	94 53 27.5	
Altitude	47 24 21.2	47 25 19.2	47 26 07.7	47 26 22.7	47 26 43.7	46° 01' 11.33
Refraction	- 50.4	- 50.4	- 50.4	- 50.4	- 50.4	
Cor ^d Altitude A	47 23 30.8	47 24 28.8	47 25 17.3	47 25 32.3	47 25 53.3	
1 st term	-1 22 23.1	-1 23 20.0	-1 23 57.6	-1 24 26.0	1 24 47.5	
2 nd term	+ 4.0	+ 2.8	+ 1.5	+ 0.9	+ 0.2	
Latitude	46 01 11.7	46 01 11.6	46 01 21.2	46 01 07.2	46 01 06.0	

same

1864

Reduction of Observations of Sun's L.I. Time

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin (\frac{1}{2} s - A) \operatorname{cosec} \Delta \sec I.$$

August 26th

	Obs ^d Double Alt ^s	Obs ^d times	Obs ^d Double Alt ^s	Obs ^d times
	69° 25' 55"	9 ^h 27 ^m 14 ^s	71° 13' 45"	9 ^h 33 ^m 00 ^s
	69 37 20	27 50	71 25 05	33 35
	69 56 45	28 52	71 37 25	34 14
	70 22 30	30 15	71 51 25	34 58
	70 33 20	30 51	72 00 40	35 30
	70 49 00	31 40	72 14 50	36 16
Mean Obs ^d Alt ^s	70 07 28.3	9 29 27.0	71 43 51.7	9 34 35.5
Index Error	+ 37.5		+ 37.5	
Cor ^d D. Alt	70 08 05.8		71 44 29.2	
altitude	35 04 02.9	Ref ⁿ	35 52 14.6	Ref ⁿ
Refraction	- 1 18.0	9.9729	- 1 15.8	9.9729
Cor ^d alt O ^s L.I.	35 02 44.9	1.9192	35 50 59.	1.9065
Par in alt	+ 7.0	1.8921	+ 7	1.8794
Meridian	+ 15 52.5	Ref ⁿ = - 78.0	+ 15 52.	75.8
Cor ^d Alt O ^s Center	35 18 04.0		36 06 58	
polar Dist ^s Δ	79 48 45	Assumed Long ^t	79 48 50	Bar ^m 28.916
Latitude	46 00 35	2 ^h 39 ^m 34 ^s	46 00 35	Ther ^m Alt 77.5
Sum s	161 08 04		161 56 23	Ther ^m Det ^d 77.5
1/2 s	80 34 02	δ = +10° 11' 14"	80 58 12	
(1/2 s - A)	45 15 18		44 51 14	
Sec I	0.15831		0.15831	
Cosec Δ	691		691	
Cos 1/2 s	9.21455		9.19576	
Sin (1/2 s - A)	9.85141		9.84838	
Sin ² 1/2 p	9.23118		9.20935	
Sin 1/2 p	9.61559		9.60467	
hour angle p	8 ^h 45 ^m 01.7		8 ^h 50 ^m 10.4	
Eqs ⁿ of time	+ 1 27.5		1 27.5	
Mean Time	8 46 29.2		8 51 37.9	
Obs ^d time	9 29 27.0		9 34 35.5	
Chr ^m fast	- 42 57.8		- 42 57.6	

1864 Reduction of Observations of Sun's I.I. Latitude

August 26th

$$\text{Red. to Merid}^d = K \left\{ \frac{\cos I \cos \delta}{\cos A} \right\} \text{ in } \tan A \left\{ \frac{\cos I \cos \delta}{\cos A} \right\}^2$$

$$K = \frac{2 \sin^2 \frac{1}{2} p}{\sin 1''} \quad m = \frac{2 \sin^4 \frac{1}{2} p}{\sin 1''}$$

Obs. No.	Time	hour	angle	K	m	obs'd Double alt ^d		
12 ^k	26 ^m 07 ^s	18 ^m	18 ^s	657.2	1.05	107° 20' 25"	Chr. ^d fact	0 ² 43 ^m 00.3 ^s
	26 46	17	39	611.4	.91	22 05	Eqt. of time	1 25.1
	27 32	16	53	559.4	.76	23 50	Chr. time Cul ⁿ	12 44 25.4
	28 09	16	16	519.3	.66	25 35		
	28 53	15	32	473.6	.55	26 55	cos δ	10° 08' 14" 9.993166
	29 51	14	34	416.5	.42	29 55	cos I	46 00 35 9.841695
	30 43	13	42	368.4	.34	31 00	Co sec γ	35 52 21 0.232115
	31 28	12	57	329.2	.26	31 50	log rate	9.998067
	32 37	11	48	273.3	.18	34 40	log A'	0.065043
	33 22	11	03	239.7	.14	36 10	K 243.49	2.386481
	34 14	10	11	203.6	.10	37 45	282".83	2.451524
	34 58	9	27	175.3	.08	38 50	Bar 28.888	Ther Alt 88.5
	35 33	8	52	154.4	.06	39 35	A ² 0.1301	Ref ⁿ
	37 03	7	22	106.6	.03	40 35	m 9.3979	1.6308
	38 09	6	16	77.1	.01	42 00	tan A 0.1408	9.9836
	39 48	4	37	41.8	.01	43 40	.47 9.6688	9.9983
	40 37	3	48	28.3	.00	44 35	Ref ⁿ - 37".9	9.9660 1.5787
	41 42	2	43	14.5	.00	45 25		
	42 19	2	06	8.7	.00	46 00	M.O.D.A 107° 35' 42".4	
	42 48	1	37	5.1	.00	45 20	Index Error	+ 37.5
	43 27	0	58	1.8	.00	45 00	Cor. ^d D. alt ^d 107 36 19.9	
	44 26	0	01	0.0	.00	44 50	Altitude 53 48 09.9	
	45 54	1	29	4.3	.00	44 40	Ref ⁿ	- 37.9
	46 43	2	18	10.4	.00	44 25		
	47 12	2	47	15.2	.00	43 40	par in alt	+ 14.9
	47 50	3	25	22.9	.00	43 30	Semidiam	+ 15 52.6
	48 30	4	05	32.7	.00	43 20		
	49 12	4	47	44.9	.01	42 50	Cor. ^d alt	54 03 29.5
	50 50	6	25	80.8	.01	41 50	Red. to Merid.	+ 4 42.8
	52 11	7	46	118.4	.04	40 45	" " "	- .5
	52 47	8	22	137.4	.05	39 35		
	53 25	9	00	159.0	.06	39 10	Mer. ^d alt	52 08 11.8
	54 17	9	52	191.1	.09	37 20		
	55 02	10	37	221.3	.12	36 30	Declination	10 08 14.4
	57 06	12	41	315.8	.24	32 50	Colat.	43 59 57.4
	57 38	13	13	342.9	.29	31 30		
	58 14	13	49	374.7	.34	30 25	Latitude	46 00 02.6
	58 39	14	14	397.6	.38	29 00		
12	59 29	15	04	445.6	.48	27 20	Mean Result	46 Obs ⁿ
1	00 16	15	51	493.1	.59	25 45		
1	00 57	16	32	536.5	.70	24 30		
1	02 05	17	40	612.5	.91	20 55		
1	02 35	18	10	647.4	1.02	19 35		
				243.49	0.25	107 19		

Reduction of Observations for Time

1864
August 26th

α Bootis

α Aquila

	Obs ^d Times	Obs ^d times	Obs ^d times	Obs ^d times	
	8 ^h 30 ^m 37 ^s	8 ^h 35 ^m 11 ^s	8 ^h 42 ^m 15 ^s	8 ^h 45 ^m 02 ^s	
	32 29	36 12	43 09	47 56	Ref ⁿ
	34 08	37 24	44 10	48 42	9.9729
Mean Obs ^d times	8 32 24.7	8 36 15.7	8 43 11.3	8 47 13.3	1.9274
					1.9003
Obs ^d Double Alt	69° 43' 40"	68° 08' 15"	97° 00' 35"	97° 29' 25"	ref ⁿ -79.5
" " "	69 05 50	67 48 10	97 09 05	98 00 00	
" " "	68 31 50	67 23 00	97 20 10	98 09 40	9.9729
Mean Obs ^d Double Alt	69 07 06.7	67 46 28.3	97 09 56.7	97 53 01.7	1.9383
Index Error	+ 37.5	+ 37.5	+ 37.5	+ 37.5	1.9112
Cor ^d M. D. Alt ^d	69 07 44.2	67 47 05.8	97 10 34.2	97 53 39.2	ref ⁿ -81.5
Altitude	34 33 52.1	33 53 32.9	48 35 17.1	48 56 49.6	
Refraction	- 1 19.5	- 1 21.5	- 48.4	- 47.8	9.9729
Cor ^d Altitude	34 32 32.6	33 52 11.4	48 34 29.	48 56 02	1 7118
Polar dist	70 06 30	70 06 30	81 28 56	81 28 56	1.6847
Latitude	46 00 35	46 00 35	46 00 35	46 00 35	ref ⁿ -48.4
Sum = s	150 39 38	149 59 16	176 04 00	176 25 33	
1/2 s	75 19 49	74 59 38	88 02 00	88 12 46	9.9729
(1/2 s - A)	40 47 16	41 07 27	39 27 31	39 16 45	1.7063
Sec L.	0.15831	0.15831	0.15831	0.15831	1.6792
Cosec Δ	0.02671	0.02671	0.00482	0.00482	- 47.8
Cos 1/2 s	9.40355	9.41317	8.53553	8.49402	
Sin (1/2 s - A)	9.81509	9.81802	9.80313	9.80148	
Sin ² 1/2 p	9.40366	9.41621	8.50779	8.45863	
Sin 1/2 p	9.70183	9.70810	9.25089	9.22931	
hour angle = p	4 01 45.0	4 05 38.7	1 22 07.0	1 18 05.7	
X ^s R	14 09 29.2	14 09 29.2	19 44 12.5	19 44 12.5	
sid. Time Obs ^d	18 11 14.2	18 15 07.9	18 22 05.5	18 26 06.8	
sid. M. Noon	10 21 13.8	10 21 13.8	10 21 13.8	10 21 13.8	
sid. interval	7 50 00.4	7 53 54.1	8 00 51.7	8 04 53.0	
Retardation	- 1 17.0	- 1 17.6	- 1 18.8	- 1 19.4	
Mean Time	7 48 43.4	7 52 36.5	7 59 32.9	8 03 33.6	
Obs ^d time	8 32 24.7	8 36 15.7	8 43 11.3	8 47 13.3	
Ch ^d . fact	43 41.3	43 39.2	43 38.4	43 39.7	

Ch^d. fact 8^h 43^m 39^s.7

1864
August 26

Reduction of Observations of Aquila Latitude

Obs. times	hour	angles	H	Obs. D. alt.			
9 ^h 43 ^m 14 ^s	-	22 ^m 04 ^s	955.3	104° 26' 55"	* ^s R	19 ^m 44 ^s 12 ^s .5	
46	02	19 16	728.4	37 10	Sid time M. R.	10 21 13.8	
47	31	17 47	620.6	39 45	Internal Sid.	9 22 58.7	
48	47	16 31	535.4	44 20	Retardation	- 1 32.2	
50	15	15 03	444.6	49 10	M. Time Cul ^m	9 21 26.5	
51	08	14 10	393.9	50 10	Chr. fast	+ 43 51.5	
52	12	13 06	336.9	51 50	Chr. time Cul ^m	10 05 18.0	
54	20	10 58	236.1	55 55			
55	55	9 23	172.9	57 40	Cos I	46° 00' 35"	9.841695
57	29	7 49	120.0	104 58 35	Cos D	8 31 04	9.995183
58	36	6 42	88.1	105 00 00	Cosec Z	37 29 31	0.215633
9 59	55	5 23	56.9	01 145	Red for Sid M. Y.		2371
10 01	23	3 55	30.1	02 55	Red. for rate		9.998067
02	37	2 41	14.1	03 05	log K	340.42	2.532015
04	11	- 1 07	2.4	03 20	Red to Mer. 384".56		2.584964
05	43	+ 0 25	0.3	03 20			
06	44	1 26	4.0	03 50	Ref ^m		
08	58	3 40	26.4	03 25		1.6523	
10	05	4 47	44.9	02 05		9.9833	
11	45	6 27	81.7	105 01 30		9.9720	
13	31	8 13	132.6	104 59 00		9.9986	
14	55	9 37	181.6	57 05		1.6062	Ref ^m 40".4
16	38	11 20	252.2	54 25	Mean Obs. D. Alt.	104° 51' 14".9	
18	03	12 45	319.1	51 25	Index Error	+ 37.5	
19	07	13 49	374.7	50 10	Cor. Mean D. Alt.	104 51 52.4	
20	45	15 27	468.5	46 25	Altitude	52 25 56.2	
22	35	17 17	586.2	42 20	Refraction	- 40.4	
23	32	18 14	652.4	39 55	Cor. alt.	52 25 15.8	
25	07	19 49	770.6	35 00	Red. to Mer.	+ 6 24.6	
26	50	21 32	909.8	30 30	Mer. alt.	52 31 40.4	
10 28	01	+22 43	1012.4	104 25 40	Declination	8 31 04.1	
					Colatitude	44 00 36.3	
					Mean Result	31 Obs. 45 59 23.7	

Star dim & unsteady.

1864

Reduction of Observations of β Ceti

August 26th

Obs'd time	Obs'd time	Obs'd time	Obs'd time	Obs'd time	Obs'd time	Obs'd time
^h ^m ^s	^h ^m ^s	^h ^m ^s	^h ^m ^s	^h ^m ^s	^h ^m ^s	^h ^m ^s
2 54 22	2 57 14	2 59 45	3 02 02	3 03 53	3 05 47.0	3 12 48
44 34.7	44 35	44 35.2	44 35.6	44 35.8	44 36.	44 36.9
2 09 47.3	2 12 39.0	2 15 09.8	2 17 26.4	2 19 17.2	2 21 11.0	2 28 11.1
2 13 15.3	2 13 15.3	2 13 15.3	2 13 15.3	2 13 15.3	2 13 15.3	2 13 15.3
3 28.0	26.5	1 54.5	4 11.1	6 01.9	7 55.7	14 55.8
23.6	0.7	7.1	34.4	71.5	1 23.4	4 37.5
36.6	1.1	11.0	53 3	110.8	191.3	678.1
50 35 25	50 37 20	50 36 20	50 35 30	50 34 25	50 33 40	50 14 00
+ 37.5	+ 37.5	+ 37.5	+ 37.5	+ 37.5	+ 37.5	+ 37.5
50 36 02.5	50 37 57.5	50 36 57.5	50 36 07.5	50 35 02.5	50 34 17.5	50 14 37.5
25 18 01.2	25 18 58.7	25 18 28.7	25 18 03.7	25 17 31.2	25 17 08.7	25 07 18.7
1 50.4	1 50.3	1 50.3	1 50.4	1 50.4	1 50.5	1 50.4
25 16 10.8	25 17 08.4	25 16 38.4	25 16 13.3	25 15 40.8	25 15 18.2	25 05 28.3
36.6	1.1	11.1	53.3	1 50.8	3 11.3	11 18.1
18 43 34.1	18 43 34.1	18 43 34.1	18 43 34.1	18 43 34.1	18 43 34.1	18 43 34.1
44 00 21.5	44 00 43.6	44 00 23.6	44 00 40.7	44 01 45.7	44 02 03.6	44 00 20.5

Observations indifferent Mean Result 45° 59' 30"

Reduction of Observations of Polaris Latitude

August 26th

Obs'd time	Obs'd Double Alt	Obs'd time	Obs'd Double Alt	Obs'd times	Obs'd Double Alt
3 18 05	94° 52' 20"	3 32 16	94° 53' 30"	3 44 36	94° 53' 00"
20 38	52 40	34 47	53 40	46 58	52 40
23 42	52 30	36 54	53 30	49 03	52 40
25 17	53 00	40 18	53 20	51 10	52 00
30 13	53 20	43 23	53 10	54 08	51 50
3 23 35	94 52 46	3 37 31.6	94 53 26	3 49 11.0	94 52 26
44 47.1	+ 37.5	44 48.9	+ 37.5	44 50.4	37.5
2 38 47.9	94 53 23.5	2 52 42.7	94 54 03.5	3 04 20.6	94 53 03.5
2 46 49.3	47 26 41.7	2 46 49.3	47 27 01.7	2 46 49.3	47 26 31.7
8 01.4	- 50.4	5 53.4	- 50.4	17 31.3	50.4
	47 25 51.3		47 26 11.3	AR 1 10 28.8	47 25 41.3
2 00 19.7	1 24 51.1	1 15 12.3	1 24 52.5	10 21 13.8	1 24 39.3
15.0		13 17.2			
6.0		6.0			
2 00 40.8 = p	46 01 00.2	p = 1 28 35.5	46 01 18.8	14 49 15.0	46 01 02.0
				2 25.7	
				14 46 49.3	
9.999732	3.70708	9.999856	4 15 41.9	84 54.2	9.998723
3.707076	8.88414	3.707076	7 46.3	88° 35' 05.8	3.707076
3.706808	2.59122	3.706932	4.5	Δ 1 24 54.2	
5091.1	4.38454	5092.5	4 23 32.7	84 54.2	3.705799
	20.03680				
	60.378				
Mean Result	15 Obs ^{ns}	46° 01' 07.0		5094.2	5079.3

1864 Reduction Observations of Sun's V.I. for Latitude
 August 28th made at the Termination of Monument on the Snake Riv

12 ^h	obs ^d	times	h ^m	angle	K	n	
12	20	47	-29	07	1662.3	6.70	106° 22' 10"
22	00	27	54		1526.5	5.65	27 45 Equ ⁿ of time 00 50.4
22	41	27	13		1452.8	5.11	31 20 Chord ^t fact 49 03.6
23	16	26	38		1391.2	4.70	33 15 Chord ^t time 0 ^s Cul ^m 12 49 54.0
24	04	25	50		1349.0	4.15	36 30
24	45	25	09		1240.6	3.73	39 45 $\delta = + 9^{\circ} 25' 53.2$
25	22	24	32		1180.7	3.38	41 15 $\Delta \delta$ 53.0
26	22	23	32		1086.4	2.87	41 30
26	47	23	07		1048.3	2.66	46 10 $\frac{E-W}{n} = \frac{585.56^s - 635.31^s}{81}$
27	17	22	37		1003.5	2.43	47 20 = $\frac{51-35^s}{81} = 38^s$
27	53	22	01		951.0	2.20	49 45 $47168.7 \div 81 = 582.33$
28	27	21	27		902.8	1.97	51 00
29	32	20	22		813.9	1.61	53 45 I 46' 00' 00" 9.841771
30	03	19	51		773.1	1.44	55 40 $\delta + 9 25 53$ 9.994089
30	31	19	23		737.3	1.32	106 57 25 z 36 34 07 0.224910
31	19	18	35		677.7	1.10	107 00 00 rate 9.998067
32	04	17	50		624.1	0.95	02 00 log A' 0.058837
32	36	17	18		587.4	0.83	03 00 log 582.33 2.765189
33	10	16	44		549.5	.73	04 30 Am ₀ 666.8 2.824006
34	21	15	33		474.6	.55	07 10 11' 06.8
35	13	14	41		423.2	.43	08 30
36	22	13	32		359.5	.31	11 30 log A' 0.0588
37	24	12	30		306.7	.23	13 50 " A' 0.0588
38	32	11	22		253.6	.15	16 00 Cot z 0.1297
39	14	10	40		223.4	.12	17 10 log n ₀ 145 0.1614
39	50	10	04		198.9	.09	17 50 B _n 2.56 0.4087
40	24	9	30		177.2	.08	18 30
41	06	8	48		152.0	.06	19 25
42	07	7	47		118.9	.04	20 50
43	10	6	44		89.0	.02	22 15
43	43	6	11		75.1	.01	22 40
44	11	5	43		64.2	.01	23 05
44	42	5	12		53.1	.01	23 55
45	17	4	37		41.8	.01	23 50
45	57	3	57		30.6	.01	24 30
12	46	36	-3	18	21.4		107 25 40

Reduction of Observations of Sun's U.L. for Latitude

1864 August 28th made at ^{terminating} base of Monument on Boundary line betⁿ O. and W. T. Snaken

Obs ^d times	hour	angle	k	m	Obs ^d Double Alt					
12 ^h 47 ^m 00 ^s	-	2 ^m 54 ^s	16.5		107° 25' 25"	Mean Obs ^d D. Alt	107° 03' 39.7			
48 42	1	12	2.8		25 25	Index Error	- 18.3			
49 23	-	0 31	0.5		27 10	Cor ^d Double Alt	107 03 21.4			
50 29	+	0 35	0.7		25 40	Altitude	53 31 40.7			
51 07	1	13	2.9		26 30	Ref ^m + par. in Alt.	- 33.7			
52 10	2	16	10.1		25 50	Cor ^d Alt U.L	53 31 07.0			
52 51	2	57	17.1		24 55	Secundium	- 15 53.0			
53 53	3	59	31.2	0.01	24 10	Cor ^d Alt 0 ^s Center	53 15 14.0			
54 37	4	43	43.7	0.01	23 55	Red to Mer ^d	11 04.2			
55 23	5	29	59.0	.01	23 40	Mer ^d alt	53 26 18.2			
56 02	6	08	73.9	.01	22 55	Declination	9 25 53.2			
57 18	7	24	107.5	.03	21 55	$\Delta \delta$ for 38 ^s	+ .6			
57 55	8	01	126.2	.04	21 00	Calatitude	44 00 25.6			
58 22	8	28	140.7	.05	20 30		45 59 34.4			
58 58	9	04	161.4	.06	107 19 30	Mean Result of 81 Obs ^s				
12 59 40	9	46	187.3	.09	107 19 10					
1 00 13	10	19	208.9	.11	18 00	Red to Mer ^d =	$K \left\{ r \frac{\cos L \cos \delta}{\cos A} \right\}$			
00 40	10	46	227.6	.13	17 05		$- m \tan A \left\{ r \frac{\cos L \cos \delta}{\cos A} \right\}^2$			
01 17	11	23	254.4	.15	16 20					
01 50	11	56	279.5	.19	15 35	$K = \frac{2 \sin^2 \frac{1}{2} p}{\sin 1''}$	$m = \frac{2 \sin^4 \frac{1}{2} p}{\sin 1''}$			
02 38	12	44	318.3	.24	14 00					
03 18	13	24	352.5	.30	13 00					
04 07	14	13	396.7	.38	10 30	Obs ^d times	hour	angle		
04 35	14	41	423.2	.43	09 05	1 ^h 12 ^m 58 ^s + 23 ^m 04 ^s	1043.8	2.63	106° 45' 35"	
05 00	15	06	447.5	.48	08 15	13 33	23 39	1097.2	2.93	43 55
05 41	15	47	488.9	.58	07 50	14 17	24 23	1166.3	3.30	41 10
06 09	16	15	518.3	.66	06 35	15 00	25 06	1235.7	3.70	38 45
06 58	17	04	571.6	.79	04 10	16 35	26 41	1396.4	4.73	33 45
07 27	17	33	604.5	.89	02 55	17 00	27 06	1440.3	5.03	30 20
08 04	18	10	647.7	1.02	01 30	17 34	27 40	1501.1	5.46	28 45
08 35	18	41	685.0	1.13	107 00 55	17 59	28 05	1546.6	5.80	27 15
09 40	19	46	766.7	1.42	106 57 30	18 29	28 35	1602.1	6.23	25 05
10 09	20	15	804.6	1.57	55 00 1	19 38	+ 29 44	1733.4	7.28	106 20 00
10 50	20	56	859.8	1.80	53 05					
1 12 20	+22	26	987.3	2.36	106 48 05					

1864 Reduction of Observations made at the base of Mount
 August 29th on Boundary Line between Oregon & Washington Territory.

Obs. times	hour	angle	R	m	Obs. Double Alt.	Sun's U.L.
12 ^h 22 ^m 53 ^s	-	29 ^m 53 ^s	1750.9	7.43	105° 36' 25"	
24	16	28 30	1592.7	6.13	42 10	Eqn of time 0 ^m 10 ^s 32.6
24	44	28 02	1541.1	5.76	44 55	Chr's fast 52 13.4
25	13	27 33	1488.5	5.37	46 50	Chr's time O'time 12 52 46.0
26	19	26 27	1372.1	4.56	51 00	
27	04	25 42	1295.5	4.07	53 25	$\delta = +9^{\circ} 04' 27.9$
27	45	25 01	1227.5	3.65	56 45	$\Delta \delta = 53.73$
28	15	24 31	1179.1	3.37	105 58 50	
29	00	23 46	1108.1	2.98	106 01 20	$\frac{E - W}{n} = \frac{491.21^s - 673.33^s}{75}$
32	39	20 07	794.0	1.52	13 00	
33	22	19 24	738.5	1.32	14 35	$182.12' \div 75 = 2^m 26^s$
34	35	18 11	648.9	1.02	18 10	$\Delta \delta \text{ for } 2^m 26^s = 2.2$
35	15	17 31	602.2	.88	19 40	
35	50	16 56	562.7	.76	21 30	2 nd term. Coefficient
36	42	16 04	506.7	.62	23 30	$126.30 \div 75 = 1.7$
37	31	15 15	456.5	.50	24 45	
38	30	14 16	399.5	.39	27 10	Refraction
39	31	13 15	344.6	.29	29 20	9.9823
40	25	12 21	299.4	.22	30 35	9.9987
41	06	11 40	267.2	.17	31 50	9.9737
42	52	9 54	192.4	.09	34 40	ref. ^m log 1.6417
43	33	9 13	166.8	.07	36 25	- 39".5 1.5964 Ref. ^u
44	05	8 41	148.0	.05	36 40	
44	38	8 08	129.9	.04	37 15	
45	06	7 40	115.4	.03	37 40	
45	43	7 03	97.6	.02	38 50	
46	58	5 48	66.0	.01	39 30	
47	39	5 07	51.4	.01	39 55	
48	23	4 23	37.7	.01	40 40	
48	59	3 47	28.1		41 05	
49	58	2 48	15.4		41 35	
50	36	2 10	9.2		41 55	
51	15	1 31	4.5		42 25	
52	03 -	0 43	1.0		42 20	
52	53 +	0 07	0.0		42 50	
12	55	37 +	15.9	106	42 00	

August 29th Reduction of Obs^{ns} Sun's U.L. Made at Base of Monument on Boundary Line

12	56	10 ^s	3 ^m	24 ^s	k	22.7 ^m	106°	41'	25"
	56	53	4	07		33.3		41	25
	57	43	4	57		48.1	0.01	40	35
	58	17	5	31		59.8	0.01	40	20
	58	48	6	02		71.5	0.01	39	55
12	59	33	6	47		90.3	0.02	39	00
1	00	17	7	31		110.9	0.03	38	35
	01	07	8	21		136.9	0.05	37	05
	01	50	9	04		161.4	0.06	36	10
	02	26	9	40		183.5	0.08	35	45
	03	15	10	29		215.8	0.11	34	30
	03	59	11	13		247.0	0.15	33	20
	04	53	12	07		288.2	0.20	31	45
	05	21	12	35		310.8	0.23	30	35
	05	55	13	09		339.4	0.28	29	40
	06	43	13	57		382.0	0.36	27	55
	08	48	16	02		504.6	0.62	22	50
	09	31	16	45		550.6	0.73	21	25
	10	17	17	31		602.2	0.88	19	30
	11	08	18	22		662.0	1.07	17	20
	11	45	18	59		707.1	1.22	16	15
	12	16	19	30		746.2	1.35	14	10
	12	51	20	05		791.4	1.51	12	35
	13	32	20	46		846.1	1.73	10	30
	14	09	21	23		897.2	1.95	09	10
	14	40	21	54		940.9	2.15	07	10
	15	12	22	26		987.3	2.36	05	05
	15	41	22	55		1030.3	2.57	04	10
	16	11	23	25		1075.7	2.81	02	35
	16	47	24	01		1131.4	3.11	106	00
	17	36	24	50		1209.6	3.35	105	57
	18	23	25	37		1287.1	4.02	54	00
	18	57	26	11		1344.6	4.38	52	00
	19	32	26	46		1405.2	4.79	49	55
	20	10	27	24		1472.3	5.26	47	20
	20	43	27	57		1532.0	5.69	44	50
	21	35	28	49		1628.3	6.43	41	30
	22	28	29	42		1729.5	7.25	38	00
1	23	07	30	21		1805.9	7.91	105	34

L	46°	00' 00"	cos	9.841771
S	9	04 28	cos	9.994551
Z	36	55 32	cos	0.221281
			rate	9.998067
			log A'	0.055670
			log K 624 59	2.795595
			AK 710" 01	2.851265
			11' 50" 01	
			Log A'	0.0557
			" "	0.0556
			Cot Z	0.1241
			log m 1.7	0.2304
			Bm 2.9	0.4668
			Mean Double Alt	106° 18' 57.9
			Index Error	- 25.0
			Cor? D. Alt?	106 18 32.9
			Altitude	53 09 16.5
			Ref ⁿ + par ⁿ in alt?	- 34.5
			alt 0's U.L.	53 08 42.0
			Semidiam	- 15 53.2
			Cor? alt? 0's center	52 52 48.8
			Red. to Mer?	+ 11 47.1
			Change in ΔS	+ 2.2
			Mer? alt?	53 04 38.1
			Declination	9 04 27.9
			Colatitude	44 00 10.2
			Latitude	45 59 49.8
			Mean Result	75 Obs ^{ns}

1864 Reduction of Observations Circum Meridian Altitudes of a Aquile
 August 29th made at Third Station

Obs. times	hour angles	K	Obs. Double Alt ^s	Refraction
9 ^h 41 ^m 09 ^s - 21 ^m 54 ^s		940.9	104° 30' 00"	Bar ⁿ 28.800 9.9823
42 43	20 20	811.3	104 34 10	Ther ⁿ Alt. 66° 9.9866
43 55	19 08	718.4	104 37 10	Ther ⁿ Det. [?] 66. 9.9993
45 20	17 43	616.0	104 40 40	1.6521
47 49	15 14	455.5	104 46 50	Ref ⁿ - 41".7 1.6203
49 07	13 56	381.1	104 50 00	
52 11	10 52	231.8	104 54 40	Cos L 46° 00' 35". 9.841695
53 24	9 39	182.8	104 56 10	Cos S + 8 31 04 9.995183
55 42	7 21	106.1	105 00 10	Coscc z 37 29 31 0.215633
9 58 29	4 34	40.9	105 02 15	Red. to Mer. ^d 0.002371
10 00 45	2 18	10.4	105 02 30	rate 9.998067
02 25 - 0 38		0.8	105 03 50	log K 297.52 2.473516
03 43 + 0 40		0.9	105 03 25	Red. to Mer. ^d 336".1 2.526465
07 12	4 09	33.8	105 03 30	
10 46	7 43	116.9	104 59 55	Mean Obs. Double Alt 104° 52' 42".9
12 10	9 07	163.2	104 58 00	Index Error - 25.0
13 14	10 11	203.6	104 55 25	Cor. Obs. Double Alt 104 52 17.9
14 49	11 46	271.8	104 53 20	Altitude 52 26 08.9
10 16 43 + 13 40		366.6	104 49 45	Refraction - 41.7
Mean		297.52	104 52 42.9	Cor. alt. ^d 52 25 27.2
* ^s R	19 ^h 44 ^m 12.5			Red. to Mer. ^d + 5 36.1
Sid. Mean Noon	10 33 03.4			Merid. alt. 52 31 03.3
Sid. interval	9 11 09.1			(Declination) 8 31 04.3
Retardation	- 1 30.3			CoLatitude 43 59 59.0
Mean time Cul ⁿ	9 09 38.8			Mean Result of 19 Obs. ^s 46 00 01.0
Chro ⁿ fast	53 24.4			
Chro ⁿ time Cul ⁿ	10 03 03.2			

Reduction of Observations of a Lyra for Time

$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin(\frac{1}{2} s - A) \operatorname{Cosec} \Delta \sec I.$

1864
August 29th

Obs. times	Obs. Double alt ^d	Obs. Double alt	Obs. times
10 ^h 49 ^m 21 ^s	134° 16' 10"	129° 32' 10"	11 ^h 02 ^m 57 ^s
50 01	134 04 20	128 41 40	11 05 33
52 54	133 03 00	127 56 50	11 07 37
56 15	131 52 55	127 29 25	11 08 54
10 56 55	131 37 35		
10 53 05.2	132 58 48.0	128 25 01	11 06 15.2
Index Error	- 25.0	- 25.	
Cor. Double alt ^d	132 58 23.0	128 24 36	Bar ^m 28.800
Altitude	66 29 11.5	64 12 18	Ther. alt ^d 66.
Refraction	- 24.0	- 26	
Cor. alt ^d	66 28 47.	64 11 52	Refraction
polar dist	51 20 04	51 20 04	
Latitude	46 00 35	46 00 35	9.9682
Sum	163 49 26	161 32 31	1.4051
$\frac{1}{2} s$	81 54 43	80 46 15	1.3733
$(\frac{1}{2} s - A)$	15 25 56	16 34 23	Ref ^m - 23.7
sec I	0.15831	0.15831	
Cosec Δ	0.10745	0.10745	Red. M. from Washington
cos $\frac{1}{2} s$	9.14829	9.20518	10 ^h 32 ^m 37 ^s .2
sin $(\frac{1}{2} s - A)$	9.42504	9.45520	Change for long? + 26.2
sin ² $\frac{1}{2} p$	8.83909	8.92614	10 33 03.4
sin $\frac{1}{2} p$	9.41954	9.46307	
hour angle p	2 01 52.0	2 15 04.8	
* ^s N.	18 32 22.8	18 32 22.8	
Sid Time Obs ⁿ	20 34 14.8	20 47 27.6	
Sid. Mean Noon	10 33 03.4	10 33 03.4	
Sid. interval	10 01 11.4	10 14 24.2	
Retardation	1 38.5	1 40.6	
Mean Time	9 59 32.9	10 12 43.6	
Obs. time	10 53 05.2	11 06 15.2	
Chro. fast	- 53 32.3	- 53 31.6	

Recapitulation of Results for Latitude.

obtained from observations made at 3rd astronomical station

Date 1864	Object	Latitude	Altitude	Cor ^e	Cor ^d	Latitude	No ^s Obs ^s	Weight
Aug ^t 25 th	Polaris	46° 01' 11".3	-47° 25'	-25".9		46° 00' 45.4	26	26
26.	Sun	46 00 02.6	+53.47	+30.0		46 00 32.6	43	43
"	α Aquilæ	45 59 23.7	+52 25	+29.1		45 59 52.8	31	15.5
"	β Ceti	45 59 30.0	+25 16	+12.3		45 59 42.3	5	2.5
"	Polaris	46 01 07.0	-47 26	-25.9		46 00 41.1	15	15.5
29	α Aquilæ	46 00 01.0	+52.25	+29.1		46 00 30.1	19	19
Mean of 139 observations corrected							46 00 29.9	121

Observed on Boundary Line

Aug ^t 28.	Sun	45 59 34.4	+53.31	29.8		46 00 04.2	81	60
29.	Sun	45 59 49.8	+53.09	29.5		46 00 19.3	75	50

Reduced these observations to astronomical station 47.60 chains north.

47.60 chains = 3141.6 feet log 3.497151

$\frac{3600}{364635}$
3.556302

364635 ar. Comp 4.438142

47.60 Chains at 46th parallel = 31".02 1.491595

Final Results.

Object	No ^s Obs ^s	Latitude	Weight
Polaris	26	46° 00' 45".4	26
Sun	43	46 00 32.6	43
α Aquilæ	31	45 59 52.8	15.5
β Ceti	5	45 59 42.3	2.5
Polaris	15	46 00 41.1	15
Sun	81	46 00 35.2	60
Sun	75	46 00 50.3	50
α Aquilæ	19	46 00 01.0	19

Elevation above sea level		
Bar	29.000	85.0 Ther ^o Extr.
	28.916	88.0
	28.888	88.5 same as
	28.850	85.5
	28.890	82.0 Ther ^o alt.
	28.862	83.0
	28.800	66.0 Instrument
	28.750	65.0
	28.760	62.7 in the open
	28.730	67.8
	28.765	78.0 air but shaded
	28.820	70.0
Mean 12 readings	28.831	76.8 from Sun
Mean reading at sea red ^d to 32° 5'	30.060	= 2766.5
" " " Camp "	28.740	26488.7
		1172.8
		100.1

$\frac{1173}{900} (64 + 76.8 - 64)$

Mean result of 295 observations gives for Latitude of station 3rd

46° 00' 35.68

The Boundary was south by measurement 47.60 chains = 31".0

Astronomical Observations for Time & Longitude

Camp on Russell Creek N.T. Dec^r 22nd 1863

$$\sin^2 \frac{1}{2} p = \cos \frac{1}{2} s \sin(\frac{1}{2} s - A) \operatorname{cosec} \Delta \sec I.$$

Obs ^d Time	Obs ^d Double Alt ^s	Obs ^d Double Alt ^s	Obs ^d Time
5 ^h 25 ^m 26 ^s	73° 37' 30"		
29 01	72 41 00		
32 50	71 46 10	68° 52' 00"	5 ^h 41 ^m 25 ^s
36 47	70 28 00	68 32 30	42 42
37 52	70 08 10	68 03 55	44 16
5 39 59	69 27 16		
5 35 17.8	70 54 07.2	68 29 28.3	5 42 47.7
Altitude	35 27 03.6	34 14 44.1	
Ref ⁿ	- 1 20.6	- 1 25.0	
Cor alt	35 25 43	34 13 19.1	Polaris. Culmination
pol ^r dist	51 20 19	51 20 19	
Latitude	46 01 25	46 01 25	AR 1 ^h 09 ^m 54 ^s 4
Sum	132 47 27	131 35 03	Sid M. n 18 03 28.6
$\frac{1}{2} s$	66 23 43	65 47 31	Sid interval 7 06 25.8
$(\frac{1}{2} s - A)$	30 58 00	31 34 12	Retardation 1 09.9
Sec I _r	0.15840	0.15840	M. J. Cul ⁿ 7 05 15.9
Cosec Δ	0.10743	0.10743	Chr ^d fast 2 56.0
Cos $\frac{1}{2} s$	9.60252	9.61284	Chr ^d time * ^s Cul ⁿ 7 08 12.9
$\sin(\frac{1}{2} s - A)$	9.71142	9.71895	
$\sin^2 \frac{1}{2} p$	9.57977	9.59762	
$\sin \frac{1}{2} p$	9.78988	9.79881	
hour angle = p	5 04 26.5	5 11 57.0	
* ^s AR	18 32 18.8	18 32 18.8	
Sid. time Obs ⁿ	23 36 45.3	23 44 15.8	
Sid. time at N. n.	18 03 28.6	18 03 28.6	
Sid. interval	5 33 16.7	5 40 47.2	
Retardation	54.6	55.8	
Mean Time	5 32 22.1	5 39 51.4	
Obs ^d time	5 35 17.8	5 42 47.7	
Chr ^d fast	2 55.7	2 56.3	

Note - These and the following observations were made along the line of the Boundary for the determination of the time and true Meridian.

Double Altitudes of α Canis Minoris for Time
Camp Winter Quarters on Cottonwood Creek

1864
February 4th

	Obs ^d Double alt	Obs ^d Double alt	Obs ^d Time
δ^1 08 ^m 58 ^s	67° 30' 50"	68 36 10	δ^2 12 ^m 40 ^s
8 10 17	67 54 00	69 04 50	8 14 16
8 11 37	68 16 05	68	
8 10 17.3	67 53 38	68 50 30	8 13 28
Altitude	33 56 49	34 25 15	
Refraction	- 1 26	- 1 25	
Cor ^d Alt	33 55 23	34 23 50	
polar Dist	84 25 58	84 25 58	
Latitude	46 00 22	46 00 22	
Sum	164 21 43	164 50 10	
$\frac{1}{2} S$	82 10 51.5	82 25 05	
($\frac{1}{2} S - A$)	48 15 28	48 01 15	
Sec I	0.15827	0.15827	
Cosec Δ	205	205	AR 1 ^m 09 ^m 17 ^s .5
Cos $\frac{1}{2} S$	9.13369	9.12039	sid Mer Noon 20 56 56.9
sin ($\frac{1}{2} S - A$)	9.87282	9.87122	interval 4 12 20.6
sin ² $\frac{1}{2} p$	9.16683	9.15193	+ 6
sin $\frac{1}{2} p$	9.58341	9.57596	10 12 20.6
hour angle p	3 00 15.0	2 57 01.2	Retardation 1 40.3
\times^s AR	7 32 12.0	7 32 12.0	M. T. W. Elong ⁿ 10 10 40.3
sid time Obs ⁿ	4 31 57.0	4 35 10.8	Chas ^t fast 36 31
sid M. Noon	20 56 56.9	20 56 56.9	Alt time $\frac{1}{2}$ N. Elong ⁿ 10 47 11
sid interval	7 35 00.1	7 38 13.9	
Retardation	1 14.5	1 15.1	
Mean Time Obs ⁿ	7 33 45.6	7 36 58.8	
Obs ^d time	8 10 17.3	8 13 28.0	
Chas ^t fast	36 31.7	36 29.2	

To find Time of the
greatest Western Elongation
of Polaris

Reduction of Observations of a Coma Minoris for Time
 Camp Winter Quarters on Cottonwood Creek

1864
 February 23^d

Obs Times	Obs Double Alt
6 ^h 41 ^m 43 ^s	73° 51' 20"
6 43 45	74 29 55
6 44 46	74 46 20
6 46 45	75 19 00
6 49 30	76 06 10
6 45 13.8	74 54 33
Altitude	37 27 16
Refraction	- 1 16
Cor Alt	37 26 00
Polar Dist	84 25 59
Latitude	46 00 22
Sun	167 52 21
1/2 S	83 56 10
(1/2 S - A)	46 30 10
Sec I.	0. 158 28
Cosec Δ	205
Cos 1/2 S	9. 023 82
Sin (1/2 S - A)	9. 860 58
Sin 1/2 p	9. 044 73
Sin 1/2 p	9. 522 36
hour Angle p	2 35 34.5
* ^s AR	7 32 13.2
sid. interval	4 56 38.8
sid ^d M. Noon	22 11 51.4
sid interval	6 44 47.4
Retardation	1 06.3
Mean Time	6 43 41.1
Obs ^d Time	6 45 13.8
Chro ^d fact	1 32.7

Polaris V.C. 1^h 09^m 03^s.7
 Sid time Mean Noon 22 11 51.4
 Sid. interval fact. M. N 2 57 12.3
 6
 Sid. time Greatest Elongation 8 57 12.3
 Retardation 1 28.0
 Mean Time Greatest Elong. 8 55 44.3
 Chro^d fact 1 32.7
 Chro^d time g^t elongation 8 57 19.0

Reduction of Double Altitudes & Azimuth for Time

1864

$\alpha = 1^h 59^m 31.6$ $\delta = 22^\circ 49' 8''$

February 24th

Obs ^d Double alt	80° 00' 00"
79 20 05	
78 39 40	
78 10 10	
77 28 55	

Obs ^d Times	7. 25 43 ^s
27 37	
29 35	
30 46	
7 32 52	
7 29 18.6	

Mean Obs ^d Double Alt	78 43 45
Altitude	39 21 52.5
Refraction	- 1 11.0
Cor ^d Alt	39 20 41
Pol ^r dist	67 10 52
Latitude	46 00 22
Sun	152 31 55
1/2 S	76 15 57
(1/2 S - A)	36 55 16

Polaris	1 ^h 09 ^m 03.1
Sid time N. N	22 15 47.9
Sid interval	2 53 15.2
	6
Sid time of Elongation	8 53 15.2

Sec I	0.15828
Cosec Δ	35 40
Cos 1/2 S	9. 37552
Sin (1/2 S - A)	9. 77867
Sin 1/2 P	9. 34787
Sin 1/2 p	9. 67393
hour Angle = p	3 45 18.3
* ^s AL	1 59 31.6
Sid. time Obs ^d	5 44 49.9
Sid. N. N	22 15 47.9
Sid. interval	7 29 02.0
Retardation	1 13.6
Mean Time	7 27 48.4
Obs ^d Times	7 29 18.6
Chord ^d fact	1 30.2

Retardation	1 27.3
Mean Time of greatest Elongation	8 51 52 47.9
Chord ^d fact	1 30.2
Chord ^d time of ^t elongation	8 53 18.1

Reductions of Double Altitudes & Circus Minoris for June
 Camp Winter Quarters Cotton Wood Creek

1864
 February
 28th

Obs ^d Double alt	Obs ^d time	
79° 59' 55"	6 ^h 49 ^m 06 ^s	α γ^h 32 ^m 13.2
80 12 10	6 49 53	δ + 5 34.1
80 27 00	6 50 47	
80 48 00	6 52 07	
81 12 05	6 53 46	
81 22 10	6 54 27	

Mean Obs^d I. Alt 80 40 13 Mean Obs^d Times

Index Error	—	53	
Cor Double alt	80	39	20
Altitude	40	19	40
Refraction	—	1	08
Cor. Altitude	40	18	32
Latitude	46	00	22
polar Dist	84	25	59
Sum	170	44	53

Polaris T.C	1 ^h	09 ^m	01.0
sid. M. Moon	22	31	34.8
sid Time	2	37	26.2
sid. Time of "longest"	8	37	26.2
Retardation	—	1	24.7

$\frac{1}{2} S$	85	22	26
sec I	45	03	54
cos A	0.	15828	
cos $\frac{1}{2} S$	8.	90663	
sin($\frac{1}{2} S - A$)	9.	84998	
sin $\frac{1}{2} p$	8.	91694	
sin $\frac{1}{2} p$	9.	45847	
hour angle p	2	13	36.8
* A.C.	7	32	13.2
sid time Obs ^d	5	18	36.4
sid Mean Moon	22	31	34.8
sid. interval	6	47	01.6
Retardation	—	1	06.7
Mean Time	6	45	54.9
Obs ^d time	6	51	41.0
Chro ^d fact.	5	46.1	

Mean Time Greatest Elong ⁿ	8	36	01.5
Chro ^d fact	5	51	
Chro ^d time greatest Elong ⁿ	8	41	52

X

Reduction of Double Altitudes of a Circle Meridian. June
Camp Winter Quarters Cotton Wood Co.

1864

February 29. Obs^d (Double Alt) Obs^d times α $7^h 32^m 13.2$

77° 50' 05"	6 ^h 37 ^m 49 ^s	8	+ 5 34 01
78 09 50	6 39 03		
78 30 20	6 40 17		
78 57 30	6 42 02		
79 28 00	6 44 04		
Mean Obs ^d Double Alt ^s	78 35 09	6 40 39.0	Mean of Obs ^d times

Index Error - 1 40

Cor^d (Double Alt

78 33 29

Cor^d Altitude

39 15 33 Refⁿ - 1 11"

polar dist.

84 25 59 Polaris δ 09^m 09.5

Latitude

46 00 22 Sid M. Noon 22 35 31.4

Sun

169 41 54 Sid Time p.m.n. 2 33 29.1

$\frac{1}{2}$ S

84 50 57 6

($\frac{1}{2}$ S - A)

45 35 24 Sid. Time G. Elongⁿ 8 33 29.1

Acc I

0.15828 Retardation - 1 24.1

Correc Δ

205 M. Y. Greatest Elongⁿ 8 32 05.0

Cos $\frac{1}{2}$ S

8.95317 Chro^d fast 7 00

Sin ($\frac{1}{2}$ S - A)

9.85391 Chro^d time greatest Elongⁿ 8 39 05.

Sin² $\frac{1}{2}$ p

8.96741

Sin $\frac{1}{2}$ p

9.48370
2 21 52

* AR

7 32 13.2

Sid time

5 10 21.2

Sid M. N

22 35 31.4

Sid interval

6 34 49.8

Retardation

1 04.6

Mean Time

6 33 45.2

Obs^d Time

6 40 39.0

Chro^d fast

6 53.8

Reduction of Observations of α Arctis for Time

Camp Winter Quarters Cotton Wood Creek

1864

March 1st

Obs of Double Alt	Obs times	
79° 50' 00"	7 ^h 09 ^m 35 ^s	AP 1 ^h 59 ^m 31 ^s .5
79 05 55	7 11 51	Q Dec ⁿ + 22° 49' 07"
78 46 05	7 12 44	
78 03 10	7 14 41	
77 31 55	7 16 13	

Mean Double Alt^s 78 39 25 7 13 01 Mean of Obs^d Times

Index Error - 1 25

Cor Double Alt^s 78 38 00

Altitude 39 19 00

Refraction - 1 11

Cor^d Alt^d 39 17 49

polar Dist 67 10 53

Latitude 46 00 22

Sum 152 29 04

1/2 S 76 14 32

(1/2 S - A) 36 56 43

Sec I 0. 15828

Cosce Δ 3539

Cos 1/2 S 9. 37624

Sin(1/2 S - A) 9. 77891

Sin² 1/2 p 9. 34882

Sin 1/2 p 9. 67441

Mean Angle p 3 45 34.9

* A.R. 1 59 31.5

Sid time Obs^d 5 45 06.4

Sid M. Noon 22 39 27.9

Sid interval 7 05 38.5

Retardation - 1 09.7

Mean Time 7 04 28.8

Obs^d time 7 13 01.0

Chro^d fact 8 32.2

Polaris U.C. 1^h 09^m 00^s.0

Sid. Mean Noon 22 39 27.9

Sid time past M.N. 2 29 32.1

6

Sid. time greatest Elongⁿ 8 29 32.1

Retardation - 1 23.4

Mean Time greatest Elongⁿ 8 28 08.7

Chro^d fact 8 36.3

Chro^d time greatest Elongⁿ 8 36 45.0

Reduction of Observations of a Leonis for Time

1864

Obs'd Double Alt. Obs'd times Camp Winter Quarters Cottonwood Creek

March 12 th	69° 41' 00"	7 ^h 17 ^m 58 ^s	
	70 04 30	7 19 03	AR. 10 ^h 01 ^m 10.2
	70 22 40	7 19 55	(Dist + 12° 37' 32")
	70 41 15	7 20 57	
	71 01 05	7 21 52	
Mean Obs'd D. Alt.	70 22 06	7 19 57.0	Mean of Obs'd times
Index Error	-1 40		
Cor Double Alt	70 20 26		
Altitude	35 10 13		
Refraction	-1 22		
Cor d Alt	35 08 51	Polaris V.C.	1 ^h 08 ^m 55.1
Polar Dist	77 22 28	Sid Mean noon	23 22 50.0
Latitude	46 00 22	Sid interval post M. U.	7 46 05.1
Sun	158 31 41		6
1/2 S	79 15 50	Sid time g ^t Elongation	7 46 05.1
(1/2 S - A)	44 06 59	Retardation	-1 16.3
Sec I	0. 158 28	M. J. greatest Elongation	7 44 48.8
Coec Δ	10 6 3	Chord fact	10 18.2
Cos 1/2 S	9. 27 0 18	Chord time greatest Elong. ^h	7 55 07.0
Sin(1/2 S - A)	9. 84 2 69		
Sin ² 1/2 S	9. 28 1 78		
Sin 1/2 S	9. 64 0 89		
True Angle = β	3 27 30.8		
* A.R.	10 01 10.2		
Sid A.P. M ²	6 33 39.4		
Sid M. U.	23 22 50.0		
Sid interval	7 10 49.4		
Retardation	-1 10.6		
Mean Time	7 09 38.8		
Obs'd Time	7 19 57.0		
Chord fact	10 18.2		

1864

Reductions of Observations of α Aurigae for Time
Camp on Cotton Wood Creek.

March 14th

$R 5^h 06^m 40.8$

$Q Dec^h 45^{\circ} 57' 25''$

Obs. Double alt	Obs. Times
113° 27' 30"	8 ^h 38 ^m 34 ^s
112 48 40	8 40 20
112 21 50	8 41 38
112 02 10	8 42 40
111 42 05	8 43 52

Mean double Alt 112 28 27 8 41 24.8 Mean of Obs. Times.

Index Error - 1 40

Cor. (D. Alt 112 26 47

Altitude 56 13 23

Refraction - 39

Cor. (Alt. 56 12 44

polar Dist. 44 08 35

Latitude 46 00 22

Sun 146 21 41

$\frac{1}{2} S$ 73 10 50

($\frac{1}{2} S - A$) 16 58 06

Sec I 0.15828

Coscc Δ 0.15710

Cos $\frac{1}{2} S$ 9.46142

Sin ($\frac{1}{2} S - A$) 9.46515

Sin² $\frac{1}{2} p$ 9.24195

Sin $\frac{1}{2} p$ 9.62097

hour Angle p 3 17 34.0

$\chi^s R$ 5 06 40.8

Sid time Obsⁿ 8 24 14.8

Sid Me. Noon 23 30 43.1

Sid vernal 8 53 31.7

Retardation - 1 27.3

Mean Time 8 52 04.4

Obs. Time 8 41 24.8

Chord slow 10 39.6

Polaris U.C. 1^h 08^m 54^s.7

Sid time Mean Noon 23 30 43.1

Sid. time past M. N. 7 38 11.6

6

Sid. time greatest Elongⁿ 7 38 11.6

Retardation - 1 15.1

Mean Time greatest Elongⁿ 7 36 56.5

Chord. slow 10 39.6

Chord. time greatest Elongation 7 26 16.9

Reduction of Observations for Time & Bores.
Camp on Columbia River.

1864
May 22nd

Obs ^d Double Alts	Obs ^d Times	A.R.
117° 18' 00"	8 ^h 30 ^m 27 ^s	14 ^h 09 ^m 30 ^s .3
117 39 30	8 32 04	Dec ⁿ 19° 53' 21"
117 55 40	8 33 14	
118 07 50	8 34 13	
118 11 40	8 35 14	
118 44 20	8 37 04	
119 04 30	8 38 38	
Mean Obs ^d D. Alt	118 08 47	8 34 25 Mean of Obs ^d Times
Altitude	59 04 23.5	
Index Error & Ref ⁿ	- 1 25.5	
Cor Alt	59 02 58.0	Polaris S. P. 13 ^h 09 ^m 10 ^s .4
pdca dist	70 06 39	Sid. Mean Noon 4 02 45.8
Latitude	46 00 30	Sid. time past M. N. 9 06 24.6
Sum	175 10 07	Retardation - 1 29.5
1/2 S	87 35 03	Mean Time Cul ⁿ 9 04 55.1
(1/2 S - A)	28 32 05	Chro ^d . slow 7 14.5
Sec I	0.15829	Chro ^d . Time Cul ⁿ 8 57 40.6
Cosec Δ	0.05549	
Cos 1/2 S	8.62482	
Sin(1/2 S - A)	9.67915	
Sum ² 1/2 p	8.51775	
Sum 1/2 p	9.25887	
True Angle p	1 23 39.3	
* ^s A.R.	14 09 30.3	
Red A.R. Mer ^d	12 45 51.0	
Sid M. Noon	4 02 45.8	
Sid interval	8 43 05.2	
Retardation	1 25.7	
Mean Time	8 41 39.5	
Obs ^d Time	8 34 25.0	
Chro ^d slow	7 14.5	

Reduction of Observations for Time June 27th 1864
 Double Altitudes of a Lyra Mill Creek N.J.

Obs^d Time Obs^d Double Alt^s
 8^h 38^m 31^s R. 113° 26' 30" Refect.

40	06	114	01	20
40	59	114	21	05
41	39	114	33	20
42	28	114	50	00
43	12	115	05	40
8	44	115	24	00

Mean Obs^d Time 8 42 04.3 114 42 34.

" " Double Alt 114 42 34

Index Error 00

Cor. D. Alt 114 42 34

Altitude 57 21 17.

Refraction - 37

Cor Alt A 57 20 40

Polar Dist 51 20 19

Latitude 46 00 15

Sum 154 41 14

1/2 S 77 20 37

(1/2 S - A) 19 59 57

Sec L 0.15827

Cosec Δ 0.10743

Cos 1/2 S 9.34065

Sin (1/2 S - A) 9.53405

Sin² 1/2 p 9.14040

Sin 1/2 p 9.57020

Hour angle p 2 54 34

*^s AR 18 32 23.3

Sid. Time Obs 15 37 49.3

Sid M. Non 6 24 41.3

Sid interval 9 13 08.0

Retardation 1 31.

Mean Time 9 11 37.

Obs^d time 8 42 04

Chrd slow 29 33

Reduction of Observations of Saturn June 28th
for Time. Ridge East & North of Mill Creek N.Y.

Obs ^d Double Alt	Obs ^d Times
53 05 10"	8 ^h 53 02 ^s
52 48 50	8 54 00
52 34 15	8 54 58
52 13 40	8 56 04
51 43 55	8 57 49
Mean Double A	52 29 10
Index Error	- 50
Cor Double Alt	52 28 20
Altitude	26 14 10
Refraction	- 1 57
Cor Alt	26 12 13
Lat.	46 0 15
Polar Dist	92 15 00
Sunn	16 4 27 28
$\frac{1}{2} S$	82 13 44
$(\frac{1}{2} S - A)$	56 01 31
Sec L	0.15827
Cosec A	33
cos $\frac{1}{2} S$	9.13103
sin $(\frac{1}{2} S - A)$	9.91870
sin ² $\frac{1}{2} p$	9.20833
sin $\frac{1}{2} p$	9.60416
hour angle p	3 09 36.
A.R.	12 46 18
Sid. Time Obs ⁿ	15 55 54
Sid M. G.	6 28 38
Sid. interval	9 27 16
Retardation	1 33
Mean Time	9 25 43
Obs ^d time	8 55 11
Chas ^d slow	30 32

Mean Obs^d times

Reduction of Observations of Arcturus July 25

Camp in Blue Mt^s near 60th mile.

Obs^d Double Alt Obs^d Times

95° 35' 20" 8^h 34^m 34^s

95 09 25 35 57

94 53 50 36 45

94 38 00 37 31

94 18 05 38 34

93 48 50 8 40 05

Mean Double Alt 94 43 55 8 37 14.3 Mean Obs^d Times

Alt. 47 21 57.5

Refraction - 27.5

Alt 47 21 30

Index Error - 26

Cor alt 47 21 04

polar Dist 70 06 30

Latitude 46 00 10

Sum 163 27 44

$\frac{1}{2} S$ 81 43 52

$(\frac{1}{2} S - A)$ 34 22 48

sec L 0.15825

Cosec Δ 0.02672

cos $\frac{1}{2} S$ 9.15781

sin $(\frac{1}{2} S - A)$ 9.75180

sin² $\frac{1}{2} p$ 9.09458

sin $\frac{1}{2} p$ 9.54729

hour angle p 2 45 10.5

*^s R. 14 09 29.7

sid. time Obs^d 16 54 30.2

sid. M. U. 8 15 04.8

sid. interval 8 39 25.4

Retardation 1 25.2

Mean Time 8 38 00.2

Obs^d time 8 37 14.3

Chro^l slow. 45.9

Reduction of Observations of Arcturus August 11/64
 Camp in Blue Mts 78th mile.

Obs ^d double alt	Obs ^d Time		
85° 29' 50"	8 ^h 55 ^m 10 ^s	AR	14 ^h 09 ^m 29 ^s .4
85 11 20	56 06	57	19° 53' 30"
84 52 00	57 04		
84 32 30	58 03		
83 52 40	9 00 07		

Mean Obs^d altitude 84 47 40.0 8 57 18.0 Mean Obs^d Time

Refraction - 1 03

Cor Alt 42 22 47

Latitude 46 00 00

Polar dist 70 06 30

Sin 158 29 17

1/2 S 79 14 38.5

(1/2 S - A) 36 51 51

Sec L 0. 15823

Cosec Δ 26 72

Cor 1/2 S 9. 27097

sin (1/2 S - A) 9. 77810

sin 1/2 p 9. 23402

sin 1/2 p 9. 61701

True angle p 3 15 39.5

* AR 14 09 29.4

Sid time Obs^d 17 25 08.9

Sid M. noon 9 18 10.0

Sid interval 8 06 58.9

Retardation 1 19.7

Mean Time 8 05 39.2

Obs^d Time 8 57 18.0

Chas^t fast 51 38.8

Mean Time Greatest E. Elongation of Polaris

A.R. 1^h 10^m 16^s.8

Sid. M. noon 9 18 10.0

Sid. interval. 15 52 06.8

Deduct 6 00 00.0

Sid interval E E 9 52 06.8

Retardation - 1 37.0

Mean time greatest E. Elongⁿ 9 50 29.8

Chas^t fast 51 38.8

Chas^t time G. E. Elongation 10 42 08.6

Field Notes of Survey of Oregon & Washington
Boundary from the Columbia to Snake Rivers.

November 17th

1863

Established Astronomical Camp on Northwest branch of Cottonwood Creek foot of the Blue Mountains, and began observations for the determination of the 46th parallel of latitude.

December 12th

Completed the series of observations and determined the position of Camp to be $45^{\circ} 59' 26.5''$ dependent upon the results from the reduction and discussion of 228 observations of circum-meridian & circum-polar stars for latitude; 150 independent altitudes for time, of stars near the Prime Vertical and 80 observations of suns semidiameter &c; for instrumental corrections; also the necessary observations for Refraction and elevation above sea level. (December 14th Compared two pole chain of thirty three feet length, consisting of 50 links, with standard chains the latter being used only for comparisons.

Measured north from Camp of observation 116 chains of 33 feet each. Ran west on tangent to parallel several miles until interrupted by heavy snows and intense cold. Thermometer for many days marking 10° & 15° below zero. ^{Fah}

March 2nd

1864

The weather having moderated began to mark off the tangent to 46th parallel (at the intersection of north and south line between Ranges 36 and 37 East of Willamette meridian) and the approximate Boundary line dependent upon the above written results; prolonging this tangent on the 6th of May I reached the Columbia River. Length of tangent 35 miles equal to a southern departure from the 46th parallel at Columbia River of 12.90 chains. consequently ran due north 12.90 chains equal to 283.8 yards and set a temporary stake near the east bank of the Columbia River as the 46th parallel from the determination of astronomical station on Cottonwood Creek, Oregon.

1864

2nd Astronomical Station.May 7th

Encamped on East bank of Columbia River at the foot of "Cathedral Rock" about 400 feet high & almost perpendicular, with a steep stone slide: near road to Wallula distant about 6 miles. also $\frac{1}{3}$ mile S.S.W. of mouth of big Cañon coursing East.

May 20th

The position of this station is dependent upon the results of 352 observations for Latitude, 107 Altitudes for June, 67 measurements of Sun's Semi-diameter for instrumental corrections and 26 readings for Refraction and elevation above sea level.

Magnetic Declination $20^{\circ} 20'$ East. The compass needle was rather sluggish and non-sensitive and although this determination does not merit full confidence, it is correct for all practical purposes.

May 23rd

Final result for latitude of this station $46^{\circ} 00' 33''.6$ The Boundary would therefore be south $33''.6$ seconds equal to 51.5 chains which distance was measured and temporarily marked as the 46th parallel according to the observations at station Second

The difference between the two determinations of the 46th parallel as resulting from the Cottonwood series, station 1.st (prolonged to Columbia River) and the Columbia River series, station 2.nd was four seconds. Combining both series the most probable determination is obtained by equations of condition. (vide pages 6 to 10.)

The initial point of the Boundary being thus determined, is dependent upon the results of 580 observations for latitude and over 250 altitudes for June, all necessary measurements and examinations being made to correct instrumental errors and personal equations. The objects were so selected that, any imperfection in measurement or unknown error in instrument if not entirely eliminated would produce at most a minimum effect.