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ASTRONOMICAL REPORT.

GEOGRAPHICAL AND GEOLOGICAL EXPLORATIONS AND SURVEYS WEST OF THE 100TH MERIDIAN.

1874.

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George M. Wheeler,

First Lieut. Corps of Engineers,

U. S. Army.

REPORT

UPON

THE DETERMINATION

OF THE

ASTRONOMICAL CO-ORDINATES

OF

THE PRIMARY STATIONS AT CHEYENNE, WYOMING TERRITORY, AND COLORADO SPRINGS, COLORADO TERRITORY,

MADE DURING

The Years 1872 and 1873,

GEOGRAPHICAL AND GEOLOGICAL EXPLORATIONS AND SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN.

U. S. Engineer dept.

FIRST LIEUTENANT GEORGE M. WHEELER,
CORPS OF ENGINEERS, IN CHARGE.

Dr. F. KAMPF and J. H. CLARK,
CIVILIAN ASTRONOMICAL ASSISTANTS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1874.

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OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., February 13, 1874.

SIR: Lieut. George M. Wheeler, Corps of Engineers, has sent to this office a report embodying the results from the astronomical observations made at Cheyenne, Wyoming Territory, and Colorado Springs, Colorado Territory.

As this report contains information of value to officers engaged upon explorations, surveys, and reconnaissances in the western country, I have respectfully to recommend that it be printed at the Government Printing-Office, and that five hundred copies be furnished on requisition from this office.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier-General and Chief of Engineers.

Hon. W. W. BELKNAP,
Secretary of War.

Approved by the Secretary of War, February 14, 1874.
H. T. CROSBY, *Chief Clerk.*

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL AND GEOLOGICAL EXPLORATIONS AND SURVEYS
WEST OF THE 100TH MERIDIAN,
Washington, D. C., February 9, 1874.

SIR: I have the honor to forward herewith a report embodying the results from the astronomical observations made at Cheyenne, Wyoming Territory, and Colorado Springs, Colorado Territory. They are typical stations for the years 1872 and 1873, although not selected because of probable errors that are a minimum.

Attention is invited to the methods employed and the order of sequence in reporting the results.

Uniformity of plan seems to be a matter of so great importance in the prosecution of astronomical work in the western interior that the one now in use is submitted for consideration as a step at least in this direction.

Minor features of the methods are still to be perfected; yet the errors of star-places, from observation, and those known as instrumental, have now become reduced to such small and nearly equable values, that it seems desirable that some general and uniform plan should be adopted for the report at least, if not for the manner of conducting the observations.

The present one is submitted with extreme diffidence, and will probably demand certain changes in the light of future experience.

At Colorado Springs a heavy stone monument and observing-pier, with meridian-marks, have been established.

The same has been done at the greater number of the other points occupied as main field-stations in the years 1871, 1872, and 1873.

These meridian-lines may serve various purposes in checking future surveys in adjacent areas.

Very respectfully, your obedient servant,

GEO. M. WHEELER,
Lieutenant of Engineers, in Charge.

Brig. Gen. A. A. HUMPHREYS,
Chief of Engineers, United States Army.

NOTE.—The results from the observations made during the field-seasons of 1871, 1872, and 1873, at the remaining primary stations, twenty-two in number, will appear in Volume II of the Reports of the Survey, as proposed in the Annual Report of the Chief of Engineers for 1873, Appendix EE.

ORDER OF SEQUENCE

FOR AN

ASTRONOMICAL REPORT

AT

MAIN OR PRIMARY FIELD-STATIONS.

Longitude by Telegraph; Latitude by Zenith Telescope, (Talcott's method.)

1. Geographical position of station.
2. Physical-geography details; especially all physical peculiarities.
3. Meteorological conditions, both general and special; the latter while observations were made.
4. Description of observatory; including *personnel* of party, name of telegraph-operator, and name of telegraph-company whose wire has been employed.
5. Description of instruments used.
6. Points with which connections were made; nights of observation, and observers; also name of computer or computers.
7. Tabulation of stars used, and number of observations.
8. Instrumental values; circumstances of telegraphic communication, *i. e.*, length of circuit, number of batteries, repeaters, &c.
9. Uniform tables of time-reductions at receiving-station.
10. Uniform tables of time-reductions at sending-station.
11. Grouping of series of exchange-signals, including means of single and serial results.
12. Personal equation.
13. Probable error by least squares.
14. Resulting longitude.
15. Reduction of the latitude-observations properly grouped, with discussion of results.
16. Resulting astronomical co-ordinates.

ABBREVIATIONS AND SIGNS.

---

a, b, c, = azimuth, level, and collimation corrections.
A, B, C, = azimuth, level, and collimation factors.
T = observed time reduced to the mean of wires and corrected for rate.
T′ = observed time corrected for instrumental errors.
AR. = apparent right ascension of star.
Δ_0 T = resulting error of the chronometer after the mean of the wires is corrected for rate and level.
Δ T_0 = adopted mean error of chronometer.
δ T = Δ T_0 − Δ_0 T.
Δ T = error of the chronometer.
v = difference between mean final correction of chronometer and Δ T.

REPORT

ON

ASTRONOMICAL OPERATIONS,

CONDUCTED DURING

THE FIELD-SEASON OF 1872,

AT THE

MAIN OR PRIMARY FIELD-STATION, CHEYENNE, WYOMING TERRITORY,

AND

DEDUCTION OF RESULTS.

BY

DR. F. KAMPF AND J. H. CLARK,
CIVILIAN ASTRONOMICAL ASSISTANTS,

United States Engineer Office,
Geographical and Geological Explorations
and Surveys West of the 100th Meridian,
Washington, D. C., January 1, 1874.

CHEYENNE, WYOMING TERRITORY.

(1.) Geographical Position of Station.

The station at Cheyenne, the latitude of which is N. 41° 7′ 46″.62, and its longitude 28^m $19^s.44$ east of the Mormon observatory at Salt Lake, is situated in the western part of the town, in lot 11, block 413, and is northwest from the junction of the branch-road leading to the depot of Fort D. A. Russell with the main stem of the Union Pacific Railroad.

The town of Cheyenne, on the north side of the railroad, is the capital of Wyoming Territory; and besides the Union Pacific Railroad with its branch to Fort Russell, has a railroad-connection with Denver, Colorado. These facilities make it a flourishing place, and it possesses already, in addition to its public buildings, quite a number of substantial business-houses and attractive private residences.

A fine hotel, engine-houses, workshops, and other similar improvements, are among the sources of prosperity which spring directly from the railroad-company.

Besides the traffic with Fort Russell, it is the depot for Red Cloud's agency, Fort Laramie, and the settlements on the North Platte.

The surrounding region affords unlimited pasturage, and cattle are said not only to subsist but grow fat on it during the whole year.

Agriculturally there is but little promise outside of what may be accomplished by irrigation.

(2.) Physical-Geography Details.

The site of Cheyenne is nearly or quite level; northward, however, there is a gradual swell of the land, and within a few miles it cuts off the extensive view one is accustomed to on the great plains. Eastward and southward there is the usual rolling and slightly-broken prairie; but in the southwest, Long's Peak, already white this September with snow, some seventy miles distant, looms up boldly above the horizon. West and northwest, low mountains, many of which mark the rim of the Laramie Plains, are just visible. Crow Creek, a moderate stream coming down from the foot-hills of this rim, forms a valley immediately west and south of the town, working its way apparently through mountain-drift, as the direct eruptive force of the Rocky Mountain system seems not to have reached so far east in this latitude.

(3.) Meteorological Conditions.

The determination of this station occupied the first three weeks in the month of October, 1872. There were no rains, nor any clouds, and, with the exception of two or three windy nights, the elements presented no obstacle whatever to a continued series of observations. In the early morning it would become cold enough to form

ice, making it sufficiently uncomfortable to restrain the ardor of an observer from extending his observations into the small hours of the night. From the experience of this season, and that of many others which I have undergone in former years in astronomical work, both on the plains and in the mountains, I am of the opinion that the best time of the year (so far as the weather is concerned) for astronomical observations in the Territories and the far Western States occurs in September and October. They are the months that fall between the rainy season of the summer and the stormy weather of the winter.

The following table shows the direction of the wind, and the estimated force, from 7 a. m. to 7 p. m. and from 7 p. m. to 7 a. m. The weather was clear all the time. Such an atmosphere, at an elevation of 6,000 feet, could not be otherwise than favorable for astronomical work.

Date.	General direction of wind.		Estimated force of wind.		Remarks.
	7 a. m. to 7 p. m.	7 p. m. to 7 a. m.	7 a. m. to 7 p. m.	7 p. m. to 7 a. m.	
1872.					
October 5	NW.	N.	1	1	
6	SW.	0	1	0	
7	NW.	0	1	0	
8	NE.	0	1	0	
9	SE.	0	1	0	
10	SE.	0	1	0	
11	N.	0	1	0	
12	N.	0	1	0	
13	0	0	0	0	
14	NW.	NW.	1	1	Aurora borealis in the north at 11.30 p. m.
15	NW.	0	2	0	
16	NW.	0	1	0	
17	SW.	0	1	0	Aurora borealis in the north at 9 p. m.
18	0	0	0	0	
19	W.	0	1	0	
20	W.	N.	1	2	

(4.) Description of Observatory.

A large wall-tent drawn over a framework formed the observatory. The opening for the meridian-line was furnished with a flap and curtains; the former served to protect the instrument from the weather when not in use, and the latter to keep off the wind and dust while observing. Here, and at other stations previously occupied, the opening for the meridian-line in the observatory was entirely unobstructed. Subsequently it was found to be an improvement to retain the ridge-pole (which commonly interferes but little with the completeness of the observations) as a support against the violent winds so prevalent in the country in which our operations are conducted. The tent was furnished with all the appliances of a field and temporary observatory, such as stools, stands, tables, and the like, and nothing was wanting as to equipment for first-class field-work. The Western Union Telegraph Company furnished the line and other facilities for this station. Mr. Bates, one of the operators employed at the Cheyenne office, was assigned to do the telegraphing; and when business did not per-

mit him to leave, which sometimes happened, Mr. Henderson, who was off duty at this hour, was obliging enough to supply his place gratuitously. Mr. F. R. Simonton was my assistant here, and kept, in conjunction with C. Herbert, an hourly meteorological record, besides his other duties as assistant.

(5.) Description of Instruments Used.

(*a.*) *Transit.*

The transit used was the meridian-zenith-instrument No. 28, made by Würdemann, a description of which is given in Dr. Kampf's report, and it was mounted on a large block of wood. The instrumental values are, for one division of the micrometer-screw, 0″.6216; of the striding-level A, 1″.21; and of the zenith-level, 1″.10.

(*b.*) *Chronograph.*

The record of the observations for time, as well as the exchange of signals, with one exception (the night of the 14th), was made by means of the chronograph, of the form contrived by Professor Harkness, United States Naval Observatory. It consists of clock-work driven by a weight, and can be adjusted to run some two hours. The regulation of the movement is effected by a steel spring, with movable balances, striking on a fly-wheel. A cylinder is attached, covered with paper, and is made to revolve once a minute. Along this cylinder a screw carries a pen, which, being in the same circuit with the chronometer, records its breaks. The chronometric breaks are made every second, except the sixtieth, which is omitted, to mark the minute. Removing the paper from the cylinder, both the minutes and the seconds will be found, if the instrument is working properly, recorded in parallel lines, and the culminations of the stars observed, distinctly marked by arbitrary breaks, and easily read off.

(*c.*) *Chronometer.*

The chronometer in use here was the Negus break-circuit No. 1499. It had a gaining-rate, +0.054, hourly average, at a mean temperature of 50°. The break-arrangement got out of order once, but it was readily repaired, and ran the rest of the season without giving any trouble.

(*d.*) *Battery.*

A local circuit of sufficient force was produced by two cups of zinc and copper, a form known, I believe, among electricians as the Hill battery. It is simple, works a week or more without renewal, and the only possible objection to it for the purpose to which we apply it is that the sulphate is a little slow to act, particularly in cold weather.

(6.) Connections.

The observatory was west of the telegraph-office, and the main connection was effected by a loop into one of the main overland wires and put in communication with Salt Lake by a switch at Ogden. The local connections, including the chronometer, the chronograph, and the observing-keys, were made by means of a switch-board, which also received the main circuit. The various wires being put in their proper

posts on this board, and the circuit closed, it required only the simple movement of sliding a switch-button to cut off or put on either circuit, and thus send the chronometric break, or receive that of the connected station on the chronographic sheet, as desired. The nights of the 1st, 3d, 8th, 9th, 10th, 11th, and 12th were occupied on latitude, in which time 257 results were obtained. The 5th, 14th, 16th, 18th, 19th, and 21st were successively put in on longitude. There were several other evenings when efforts were made in this direction, but failed from causes beyond my control. Mr. Austin did the observing at Salt Lake, while the observations at Cheyenne were made by myself, and also the longitude reductions for both stations. Prof. W. A. Rogers, of Harvard College Observatory, computed the latitude-observations, and they were subsequently revised, partially recomputed, and formulated by Dr. Kampf.

(7.) Tabulation of Stars Used.

Tabulation of Stars used for Determination of Time at Cheyenne, Wyoming Territory, and Salt Lake City, Utah Territory.

Name of Star.	Mean Right Ascension, 1872.0.	Declination.	October—						October—					
			5.	14.	16.	18.	19.	21.	5.	14.	16.	18.	19.	21.
	h. m. s.	° ′ ″												
τ Aquilæ	19 57 53.20	+ 6 55.1							*	*				
θ Aquilæ	20 4 41.98	− 1 12.0								*				
a^2 Capricorni	10 57.04	− 12 56.4	*											
κ Cephei	13 9.32	+ 77 19.5							*	*				
π Capricorni	19 59.54	− 18 37.7	*						*	*	*			
ε Delphini	27 5.82	+ 10 52.2	*						*	*	*		*	
Groombridge 3241	30 32.52	+ 72 5.9	*		*					*	*	*	*	
a Cygni	37 4.10	+ 44 49.4			*				*	*	*	*	*	
μ Aquarii	45 44.86	− 9 27.7	*		*				*	*	*	*	*	
ν Cygni	52 24.08	+ 40 40.5	*		*									
12-Year Catalogue 1879	53 19.06	+ 80 4.2							*	*	*	*	*	
σ^2 Ursæ Majoris, L. C.	59 5.92	+ 67 39.1				*	*							
61 Cygni	21 1 9.67	+ 38 7.3	*						*	*	*	*	*	*
ζ Cygni	7 29.33	+ 29 42..				*	*		*	*	*	*	*	*
a Cephei	15 31.39	+ 62 2.6	*			*	*				*	*	*	*
1 Pegasi	16 10.09	+ 19 15.5												
1 Draconis, L. C.	18 38.59	+ 81 53.3				*	*							
β Aquarii	24 49.16	− 6 8.0	*				*				*	*		*
β Cephei	26 59.96	+ 69 59.9				*	*				*		*	*
ξ Aquarii	30 56.16	− 8 25.6				*	*				*	*	*	*
ε Pegasi	37 53.98	+ 9 17.4	*			*	*				*	*	*	*
11 Cephei	40 2.36	+ 70 43.3	*			*	*							*
μ Capricorni	46 18.94	− 14 9.2				*	*	*					*	
79 Draconis	51 16.44	+ 73 5.8	*			*	*	*						
a Aquarii	59 12.53	− 0 56.4	*					*						*
32 Ursæ Majoris, L. C.	22 8 42.70	+ 65 44.7						*						
θ Aquarii	10 4.68	− 8 25.2	*	*						*				
π Aquarii	18 44.37	+ 0 43.7		*	*		*	*		*				
9 Draconis, L. C.	24 9.11	+ 76 22.3		*	*		*	*		*				

Tabulation of Stars used for Determination of Time, &c.—Continued.

Name of Star.	Mean Right Ascension, 1872.0.	Declination.	October—						October—					
			5.	14.	16.	18.	19.	21.	5.	14.	16.	18.	19.	21.
	h. m. s.													
η Aquarii	22 28 46.69	− 0 46.6			*			*						
226 Cephei	30 1.09	+ 75 34.0		*									*	
ζ Pegasi	35 4.65	+ 10 9.8		*	*		*	*		*			*	
ν Cephei	45 7.64	+ 65 31.6		*									*	
λ Aquarii	45 56.08	− 8 15.6											*	
α Piscis Australis . . .	50 34.39	− 30 18.0		*										
α Pegasi	58 23.15	+ 14 31.0		*				*					*	*
o Cephei	13 22.74	+ 67 24.7					*	*	*	*		*	*	
θ Piscium	21 28.50	+ 5 40.6					*	*	*	*		*		
λ Draconis, L.C. . . .	23 46.64	+ 70 2.2						*						
ι Piscium	33 22.07	+ 4 56.0	*			*			*	*		*		*
γ Cephei	34 6.60	+ 76 55.1	*	*			*	*			*	*		*
Groombridge 4163 . .	48 37.77	+ 73 41.9	*	*		*			*		*			*
ω Piscium	52 44.36	+ 6 9.3		*		*	*		*		*			*
α Andromedæ	0 1 46.47	+ 28 23.0	*						*		*			*
4 Draconis, L.C. . . .	6 10.66	+ 78 19.6		*		*	*							
γ Pegasi	6 38.78	+ 14 28.3	*						*		*			*
α Cassiopeiæ	33 15.41	+ 55 50.1		*	*	*		*						
β Ceti	37 9.77	− 18 41.4				*								
21 Cassiopeiæ	37 14.03	+ 74 17.2		*	*		*	*						
32 Camelopardalis, L.C. .	48 12.72	+ 84 6.5					*	*						
ϵ Piscium	56 18.10	+ 7 12.0		*	*	*	*	*						
θ^1 Ceti	1 17 37.54	− 8 50.7		*	*		*	*						
38 Cassiopeiæ	21 44.35	+ 69 36.3		*	*		*	*						
η Piscium	24 38.13	+ 14 41.1		*	*		*	*						
o Piscium	38 38.23	+ 8 30.8		*										

(8.) Instrumental Values.

The values of the implements pertaining to zenith-instrument No. 28 are, for one division of the micrometer-screw, 0″.622; of the striding-level A, 1″.21; and of the zenith-level, 1″.10. The wire which made the circuit between the stations Salt Lake and Cheyenne, counting the distance along the railroad, is some 550 miles, and does not include any battery or repeating-office. At Cheyenne there was a repeating-office; but as the observatory, as elsewhere stated, was situated west of it, the signals did not work through any repeater; and at the time these observations were made Salt Lake itself was only a relay-office; but there was a switch at Ogden, which had always to be called to "straighten" the wire before the work of exchanging could be commenced. Powerful batteries have always been kept at both places, and lately the repeating-office at Corinne has been removed to Salt Lake, and the latter has not only become a repeating-office but also the headquarters of the western division of the main or eastern branch of the company.

(9.) Uniform Tables of Time-Reductions at Receiving-Station.

SALT LAKE OBSERVATORY, *October* 5, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
τ Aquilæ . . .	W.	20 0 5.28	− 0.04	− 0.10	− 0.07	20 0 5.07	19 57 54.80	− 2 10.27
κ Cephei . . .	.	15 19.82	− 0.62	+ 0.49	− 0.31	15 19.38	20 13 9.66	[9.72]
π Capricorni . .	.	22 12.20	− 0.13	− 0.16	− 0.07	22 11.84	20 1.58	10.26
ε Delphini . . .	.	29 18.22	− 0.20	− 0.09	− 0.07	29 17.86	27 7.54	10.32
α Cygni	E.	39 16.20	− 0.18	− 0.02	− 0.09	39 15.91	37 5.57	10.34
μ Aquarii . . .	.	47 57.56	− 0.12	− 0.14	+ 0.07	47 57.37	45 46.89	10.48
12-Year Cat. 1879.	.	55 31.14	− 1.03	+ 0.66	+ 0.40	55 31.17	53 20.37	10.80
61 Cygni	.	21 3 22.20	− 0.35	− 0.01	+ 0.07	21 3 21.91	21 1 11.63	10.28
ζ Cygni	.	9 41.76	− 0.31	− 0.04	+ 0.11	9 41.52	7 31.10	10.42
Mean, exclusive of κ Cephei, at $20^h\ 30^m$ local sidereal time								− 2 10.39

Normal Equations.

$$9\,\delta t - 3.24\,a + 0.18\,c = -2.22 \qquad a = -0.18$$
$$-3.24\,\delta t + 22.91\,a - 10.29\,c = -3.72 \qquad c = +0.07$$
$$0.18\,\delta t - 10.29\,a + 63.46\,c = +0.60 \qquad \delta t = -0.31$$

SALT LAKE OBSERVATORY, *October* 5, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
o Cephei	E.	23 15 37.08	− 0.44	+ 0.31	− 0.35	23 15 36.60	23 13 26.08	− 2 10.52
θ Piscium . . .	.	23 41.72	− 0.17	− 0.15	− 0.17	23 41.23	21 30.96	10.27
ι Piscium . . .	W.	35 35.20	− 0.36	− 0.16	+ 0.17	35 34.85	33 24.59	10.26
Groombridge 4163	.	50 52.16	− 0.60	+ 0.52	+ 0.61	50 52.69	48 42.32	10.37
ω Piscium . . .	.	54 57.66	− 0.19	− 0.15	+ 0.17	54 57.49	52 46.90	10.59
α Andromedæ . .	.	24 3 59.66	− 0.19	− 0.06	+ 0.19	24 3 59.60	24 1 49.06	10.54
γ Pegasi	.	8 52.00	− 0.16	− 0.12	+ 0.18	8 51.90	6 41.33	10.57
Mean at $23^h\ 30^m$ local sidereal time								− 2 10.44

Normal Equations.

$$7\,\delta t - 0.65\,a - 4.13\,c = -2.06 \qquad a = -0.27$$
$$-0.65\,\delta t + 6.35\,a + 2.54\,c = -1.96 \qquad c = -0.17$$
$$-4.13\,\delta t + 2.54\,a + 24.83\,c = -3.17 \qquad \delta t = -0.43$$

(9.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

SALT LAKE OBSERVATORY, *October* 14, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
τ Aquilæ	E.	20 0 17.86	− 0.08	− 0.14	− 0.10	20 0 17.54	19 57 54.66	− 2 22.88
θ Aquilæ	.	7 6.86	− 0.06	− 0.17	− 0.10	7 6.53	20 4 43.55	22.98
κ Cephei	.	15 31.66	− 0.25	+ 0.68	− 0.46	15 31.63	13 8.71	22.92
π Capricorni. . .	.	22 24.56	− 0.03	− 0.23	− 0.11	22 24.19	20 1.44	22.75
ε Delphini . . .	.	29 30.56	− 0.05	− 0.13	− 0.10	29 30.28	27 7.40	22.88
Groombridge 3241	.	32 55.78	− 0.16	+ 0.42	− 0.33	32 55.71	30 32.87	22.84
α Cygni	W.	39 28.28	− 0.09	+ 0.02	+ 0.14	39 28.35	37 5.34	23.00
μ Aquarii . . .	.	48 9.96	− 0.04	− 0.20	+ 0.10	48 9.82	45 46.76	23.06
12-Year Cat. 1879.	.	55 40.70	− 0.13	+ 0.92	+ 0.58	55 42.07	53 19.25	22.82
61 Cygni	.	21 3 34.30	+ 0.01	− 0.02	+ 0.13	21 3 34.42	21 1 11.45	22.97
ζ Cygni	.	9 54.05	− 0.03	− 0.06	+ 0.12	9 54.08	7 30.95	23.13
Mean at $20^h\ 30^m$ local sidereal time								− 2 22.93

Normal Equations.

$$11\,\delta t - 4.46\,a + 1.25\,c = +1.73 \qquad a = -0.250$$
$$-4.46\,\delta t + 26.19\,a + 5.21\,c = -7.89 \qquad c = -0.096$$
$$1.25\,\delta t + 5.21\,a + 75.02\,c = -8.35 \qquad \delta t = +0.070$$

SALT LAKE OBSERVATORY, *October* 14, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
θ Aquarii. . . .	W.	22 12 30.22	− 0.05	− 0.07	+ 0.01	22 12 30.11	22 10 6.97	− 2 23.14
π Aquarii. . . .	.	21 9.88	− 0.04	− 0.06	+ 0.01	21 9.79	18 46.61	23.18
9 Draconis, L. C. .	.	26 32.45	+ 0.04	− 0.34	− 0.04	26 32.11	24 9.00	23.11
ζ Pegasi	.	37 30.27	− 0.05	− 0.05	+ 0.01	37 30.18	35 6.88	23.30
o Cephei	E.	23 15 49.05	− 0.23	+ 0.11	− 0.03	23 15 48.90	23 13 25.87	23.03
θ Piscium . . .	.	23 54.24	− 0.08	− 0.05	− 0.01	23 54.10	21 30.92	23.18
ι Piscium . . .	.	35 57.97	− 0.08	− 0.05	− 0.01	35 57.83	33 34.57	23.26
Mean at 23^h local sidereal time								− 2 23.17

Normal Equations.

$$7\,\delta t + 5.68\,a - 5.79\,c = -1.78 \qquad a = -0.09$$
$$5.68\,\delta t + 17.39\,a - 11.98\,c = -2.72 \qquad c = +0.01$$
$$-5.79\,\delta t - 11.98\,a + 29.56\,c = +1.70 \qquad \delta t = -0.18$$

(9.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

SALT LAKE OBSERVATORY, *October* 16, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
π Capricorni . .	W.	20 22 27.72	− 0.04	+ 0.16	. .	20 22 27.84	20 20 1.41	− 2 26.43
ε Delphini . . .	.	29 33.61	− 0.09	+ 0.09	. .	29 33.61	27 7.37	26.24
Groombridge 3241	.	32 59.45	− 0.28	− 0.30	. .	32 58.87	30 32.72	26.15
a Cygni	.	39 31.84	− 0.25	− 0.02	. .	39 31.57	37 5.29	26.28
μ Aquarii. . . .	.	48 13.16	− 0.13	+ 0.14	. .	48 13.17	45 46.74	26.43
12-Year Cat., 1879	E.	55 47.17	− 0.99	− 0.66	. .	55 45.52	53 18.99	26.53
61 Cygni	.	21 3 37.78	− 0.09	+ 0.01	. .	21 3 37.70	21 1 11.41	26.29
ζ Cygni	.	9 57.05	− 0.08	+ 0.04	. .	9 57.01	7 30.92	26.06
a Cephei	.	17 59.12	+ 0.02	− 0.14	. .	17 59.00	15 32.72	26.28
β Aquarii. . . .	.	27 17.73	+ 0.01	+ 0.13	. .	27 17.87	24 51.19	26.68
β Cephei	.	29 27.95	+ 0.03	− 0.26	. .	29 27.72	27 1.34	26.38
ξ Aquarii. . . .	.	33 24.70	+ 0.01	+ 0.13	. .	33 24.84	30 58.26	26.58
ε Pegasi	.	40 22.32	+ 0.01	+ 0.09	. .	40 22.42	37 55 92	26.50
Mean at 21^h local sidereal time								− 2 26.37

Normal Equations.

$$13\,\delta t + 3.15\,a + 3.05\,c = -5.43 \qquad a = -0.18$$
$$3.15\,\delta t + 20.33\,a + 21.20\,c = -4.81 \qquad c = 0.00$$
$$3.05\,\delta t + 21.20\,a + 68.43\,c = -4.83 \qquad \delta t = -0.37$$

SALT LAKE OBSERVATORY, *October* 16, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
γ Cephei	W.	23 36 37.90	+ 0.50	− 0.39	+ 0.22	23 36 38.23	23 34 11.24	− 2 26.99
Groombridge 4163	.	51 7.68	+ 0.45	− 0.29	+ 0.18	51 8.02	48 42.09	25.93
ω Piscium . . .	.	54 13.17	+ 0.12	+ 0.09	+ 0.05	54 13.43	52 46.89	26.54
a Andromedæ . .	.	24 4 15.36	+ 0.18	+ 0.04	+ 0.06	24 4 15.64	24 1 49.05	26.59
γ Pegasi	.	9 7.67	+ 0.18	+ 0.07	+ 0.05	9 7.97	6 41.33	26.64
Mean at 24^h local sidereal time								− 2 26.54

Normal Equations.

$$5\,\delta t + 3.26\,a = -3.17 \qquad a = -0.15$$
$$3.26\,\delta t + 11.07\,a = -3.36 \qquad \delta t = -0.54$$

(9.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

SALT LAKE OBSERVATORY, *October* 18, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
Groombridge 3241	W.	20 33 3.31	− 0.31	+ 0.08	− 0.39	20 33 2.69	20 30 32.58	− 2 30.11
α Cygni	.	39 35.44	− 0.15	+ 0.01	− 0.17	39 35.13	37 5.23	29.90
μ Aquarii. . . .	.	48 17.04	− 0.06	− 0.04	− 0.12	48 16.82	45 46.70	30.12
12-Year Cat., 1879	.	55 49.47	− 0.36	+ 0.18	− 0.69	55 48.60	53 18.73	29.87
61 Cygni	.	21 3 41.48	− 0.09	0.00	− 0.15	21 3 41.24	21 1 11.37	29.87
ζ Cygni	E.	10 0.63	− 0.08	− 0.01	+ 0.14	10 0.68	7 30.88	29.80
α Cephei	.	18 2.16	− 0.07	+ 0.04	+ 0.25	18 2.38	15 32.64	29.74
β Aquarii. . . .	.	27 20.95	− 0.03	− 0.04	+ 0.12	27 21.00	24 51.17	29.83
ξ Aquarii. . . .	.	33 28.01	∓ 0.00	− 0.04	+ 0.12	33 28.09	30 58.24	29.85
ε Pegasi	.	40 25.72	∓ 0.00	− 0.03	+ 0.12	40 25.81	37 55.90	29.91
Mean at 21^h local sidereal time								− 2 29.90

Normal Equations.

$$10\,\delta t + 3.14\,a - 6.43\,c = +0.48 \qquad a = +0.05$$
$$3.14\,\delta t + 18.99\,a - 26.71\,c = -1.81 \qquad c = +0.12$$
$$-6.43\,\delta t - 26.71\,a + 59.95\,c = +5.86 \qquad \delta t = +0.11$$

SALT LAKE OBSERVATORY, *October* 18, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ϕ Aquarii. . . .	E.	23 10 13.91	− 0.07	− 0.32	+ 0.01	23 10 13.53	23 7 44.11	− 2 29.42
o Cephei	.	15 54.99	− 0.14	+ 0.50	+ 0.03	15 55.38	13 25.76	29.62
θ Piscium . . .	.	24 0.92	+ 0.01	− 0.24	+ 0.01	24 0.70	21 30.90	29.80
ι Piscium . . .	W.	35 54.53	− 0.04	− 0.25	− 0.01	35 54.23	33 24.56	29.67
γ Cephei	.	36 39.85	− 0.18	+ 1.12	− 0.05	36 40.74	34 11.14	29.60
Mean at 24^h local sidereal time								− 2 29.62

Normal Equations.

$$5\,\delta t - 1.85\,a - 0.78\,c = +2.69 \qquad a = -0.43$$
$$-1.85\,\delta t + 9.36\,a + 9.19\,c = -4.66 \qquad c = +0.013$$
$$-0.78\,\delta t + 9.19\,a + 29.27\,c = -3.93 \qquad \delta t \quad +0.38$$

(9.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

SALT LAKE OBSERVATORY, *October* 19, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ε Delphini . . .	E.	20 29 38.95	− 0.14	− 0.06	+ 0.06	20 29 38.81	20 27 7.32	− 2 31.49
Groombridge 3241	.	33 4.49	− 0.42	+ 0.20	+ 0.19	33 4.46	30 32.50	31.96
a Cygni	.	39 36.84	− 0.20	+ 0.01	+ 0.08	39 36.71	37 5.21	31.50
μ Aquarii . . .	.	48 18.51	− 0.06	− 0.09	+ 0.06	48 18.42	45 46.69	31.73
12-Year Cat., 1879	.	55 49.63	− 0.36	+ 0.44	+ 0.35	55 50.06	53 18.60	31.46
ζ Cygni	W.	21 10 2.41	− 0.05	− 0.02	− 0.07	21 10 2.27	21 7 30.86	31.41
a Cephei	.	18 3.66	− 0.12	+ 0.09	− 0.13	18 3.50	15 32.60	30.90
β Cephei	.	29 32.33	− 0.15	+ 0.17	− 0.17	29 32.18	27 1.17	31.01
ξ Aquarii. . . .	.	33 29.86	− 0.05	− 0.09	− 0.06	33 29.66	30 58.22	31.44
ε Pegasi	.	40 27.34	− 0.09	− 0.06	− 0.06	40 27.13	37 55.88	31.25
μ Capricorni. . .	.	48 52.77	− 0.06	− 0.10	− 0.06	48 52.55	46 21.16	31.39
Mean at 21^h local sidereal time								− 2 31.41

Normal Equations.

$$11\,\delta t - 4.01\,a + 3.24\,c = -3.98 \qquad a = -0.120$$
$$-4.01\,\delta t + 21.89 - 22.23\,c = -2.15 \qquad c = +0.066$$
$$+3.24\,\delta t - 22.23\,a + 35.45\,c = +3.38 \qquad \delta t = -0.41$$

SALT LAKE OBSERVATORY, *October* 19, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
226 Cephei	E.	22 32 34.43	− 0.03	+ 0.82	+ 0.20	22 32 35.42	22 30 3.77	− 2 31.65
ζ Pegasi	.	37 38.63	− 0.01	− 0.08	+ 0.06	37 38.60	35 6.83	31.77
ι Cephei	.	47 41.35	0.00	+ 0.32	+ 0.11	47 41.78	45 10.12	31.66
λ Aquarii . . .	.	48 30.22	0.00	− 0.28	+ 0.05	48 29.99	45 58.46	31.53
a Pegasi	.	23 0 57.20	0.00	− 0.16	+ 0.05	23 0 57.09	58 25.42	31.67
o Cephei	W.	15 56.85	0.00	+ 0.42	− 0.13	15 57.15	23 13 25.73	31.42
Mean at 22^h 30^m local sidereal time								− 2 31.62

Normal Equations.

$$6\,\delta t - 2.89\,a = -2.65 \qquad a = -0.359$$
$$-2.89\,\delta t + 8.63\,a = -1.36 \qquad \delta t = -0.620$$

(9.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

SALT LAKE OBSERVATORY, *October* 21, 1872.

Name of Star.	Clamp.	T	δB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
61 Cygni	W.	21 3 46.07	− 0.10	+ 0.69	+ 0.09	21 3 45.75	21 1 11.31	− 2 35.44
ζ Cygni	.	10 3.65	− 0.11	+ 2.54	+ 0.08	10 6.16	7 30.83	35.33
α Cephei	.	18 16.62	− 0.24	− 8.90	+ 0.15	18 7.63	15 32.52	35.11
β Aquarii . . .	.	27 17.99	− 0.08	+ 8.44	+ 0.07	27 26.42	24 51.13	35.29
β Cephei	E.	29 53.21	− 0.31	−16.53	− 0.20	29 36.17	27 1.05	35.12
ξ Aquarii . . .	.	33 24.95	− 0.08	+ 8.79	− 0.07	33 33.59	30 58.20	35.39
ε Pegasi	.	40 25.25	− 0.08	+ 6.13	− 0.07	40 31.23	37 55.86	35.37
11 Cephei	.	42 56.94	− 0.18	−17.46	− 0.21	42 39.09	40 3.72	35.37
α Aquarii . . .	.	22 1 42.61	− 0.07	+ 7.75	− 0.07	22 1 50.22	59 14.62	35.60
Mean at 21^h 30^m local sidereal time								− 2 35.34

Normal Equations.

$$9\,\delta t + 0.74\,a + 3.42\,c = -11.86 \qquad a = -11.560$$
$$-0.74\,\delta t + 6.80\,a + 6.20\,c = -78.82 \qquad c = -0.072$$
$$3.42\,\delta t + 6.20\,a + 29.22\,c = -74.90 \qquad \delta t = -0.370$$

SALT LAKE OBSERVATORY, *October* 21, 1872.

Name of Star.	Clamp.	T.	δB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
α Pegasi	E.	23 0 55.95	− 0.19	+ 5.28	− 0.13	23 1 0.91	22 58 25.41	− 2 35.50
ι Piscium . . .	.	35 53.36	− 0.09	+ 6.92	− 0.12	36 0.07	23 33 24.54	35.53
γ Cephei	.	37 17.52	+ 0.18	−30.49	− 0.55	36 46.66	34 11.00	35.66
Groombridge 4163	W.	51 39.62	+ 0.15	−22.75	+ 0.44	51 17.46	48 41.94	35.52
ω Piscium . . .	.	55 15.69	+ 0.03	+ 6.68	+ 0.12	55 22.52	52 46.88	35.64
α Andromedæ . .	.	24 4 21.55	+ 0.03	+ 2.81	+ 0.14	24 4 24.53	24 1 49.04	35.49
γ Pegasi	.	9 11.46	− 0.01	+ 5.39	+ 0.13	9 16.97	6 41.32	35.65
Mean 23^h 30^m local sidereal time								− 2 35.55

Normal Equations.

$$7\,\delta t + 2.23\,a + 0.29\,c = -30.02 \qquad a = -11.725$$
$$2.23\,\delta t + 11.67\,a - 4.82\,c = -138.58 \qquad c = +0.124$$
$$0.29\,\delta t - 4.82\,a + 37.58\,c = +61.02 \qquad \delta t = -0.550$$

(10.) Uniform Tables of Time-Reductions at Sending-Station.

CHEYENNE, WYOMING TERRITORY, *October* 5, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
a^2 Capricorni. . .	E.	22 2 48.80	+ 0.22	+ 65.35	+ 0.30	22 3 54.67	20 10 58.95	−1 52 55.72
π Capricorni. . .	.	11 44.94	+ 0.19	+ 71.72	+ 0.31	12 57.16	20 1.58	55.58
ε Delphini . . .	.	19 22.33	+ 0.31	+ 40.34	+ 0.30	20 3.28	27 7.54	55.74
Groombridge 3241	.	25 39.18	+ 1.03	−131.73	+ 0.98	23 29.46	30 33.49	55.97
μ Aquarii . . .	.	37 40.48	+ 0.25	+ 61.58	+ 0.30	38 42.61	45 46.87	55.74
ν Cygni	.	45 20.01	+ 0.52	+ 0.78	+ 0.39	45 21.70	52 25.69	56.01
61 Cygni	.	54 1.52	+ 0.50	+ 5.27	+ 0.38	54 7.67	21 1 11.63	56.04
a Cephei	.	23 9 27.52	+ 0.79	− 59.93	+ 0.64	23 8 29.02	15 33.14	55.88
β Aquarii . . .	.	16 48.55	+ 0.28	+ 58.12	+ 0.30	17 47.25	24 51.33	55.92
ε Pegasi	.	30 9.30	+ 0.34	+ 41.72	+ 0.30	30 51.66	37 56.05	55.61
11 Cephei	.	34 56.12	+ 1.05	−117.73	+ 0.91	33 0.35	40 4.57	55.78
μ Capricorni. . .	.	38 10.01	+ 0.22	+ 66.69	+ 0.31	39 17.22	46 21.32	55.90
79 Draconis . . .	.	46 35.77	+ 1.16	−143.21	+ 1.03	44 14.75	51 18.93	55.82
a Aquarii. . . .	.	51 17.44	+ 0.29	+ 52.77	+ 0.30	52 10.80	59 14.78	56.02
θ Aquarii. . . .	.	24 2 1.92	+ 0.26	60.48	+ 0.30	24 3 2.96	22 10 7.06	55.90
Mean at 21^h local sidereal time								−1 52 55.84

Normal Equations.

$$15\,\delta t - 0.92\,a = + 74.33 \qquad a = - 78.642$$
$$- 0.92\,\delta t + 13.95\,a = - 1097.11 \qquad \delta t = + 0.160$$

CHEYENNE, WYOMING TERRITORY, *October* 5, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
ι Piscium . . .	W.	25 25 33.95	+ 0.28	+ 46.27	− 0.30	25 26 20.20	23 33 24.59	−1 52 55.61
γ Cephi	.	30 28.91	+ 1.25	−201.71	− 1.33	27 7.12	34 11.60	55.52
Groombridge 4163	.	44 7.86	+ 1.05	−149.71	− 1.07	41 38.13	48 42.32	55.81
a Andromedæ . .	.	54 25.00	+ 0.39	+ 19.59	− 0.34	54 44.64	24 1 49.06	55.58
γ Pegasi	.	59 0.72	+ 0.32	+ 36.13	− 0.31	59 36.86	6 41.33	55.53
Mean at 24^h local sidereal time								−1 52 55.60

Normal Equations.

$$5\,\delta t + 3.21\,a = - 247.54 \qquad a = - 78.00$$
$$3.21\,\delta t + 11.02\,a = - 857.87 \qquad \delta t = + 0.58$$

(10.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

CHEYENNE, WYOMING TERRITORY, *October* 14, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
θ Aquarii. . . .	W.	24 2 50.84	+ 0.05	− 0.70	− 0.35	24 2 49.84	22 10 6.97	−1 52 42.87
π Aquarii. . . .	.	10 30.51	+ 0.06	− 0.59	− 0.35	10 29.63	18 46.61	43.02
9 Draconis, L. C. .	.	16 54.06	− 0.16	− 3.42	+ 1.48	16 51.96	24 9.01	42.95
226 Cephei	.	22 46.08	+ 0.26	+ 2.07	− 1.40	22 47.01	30 4.06	42.95
ζ Pegasi	.	27 50.73	+ 0.07	− 0.48	− 0.36	27 49.96	35 6.88	43.08
ι Cephei	.	38 53.05	+ 0.17	+ 0.91	− 0.84	38 53.29	45 10.27	43.02
a Piscis Australis .	.	43 21.71	+ 0.03	− 1.00	− 0.41	43 20.33	50 37.19	43.14
a Pegasi	.	50 9 35	+ 0.07	− 0.42	− 0.36	50 8.64	58 25.46	43.18
Mean at $22^h\ 30^m$ local sidereal time								−1 52 43.03

Normal Equations.

$$8\,\delta t + 3.99\,a - 7.40\,c = -6.38 \qquad a = -0.91$$
$$3.99\,\delta t + 22.89\,a + 23.74\,c = -12.73 \qquad c = +0.35$$
$$-7.40\,\delta t + 23.74\,a + 45.34\,c = -5.45 \qquad \delta t = -0.02$$

CHEYENNE, WYOMING TERRITORY, *October* 14, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
γ Cephei	E.	25 26 51.23	+ 0.46	+ 1.97	+ 0.88	25 26 54.54	23 34 11.30	−1 52 43.24
Groombridge 4163	.	41 22.86	+ 0.39	+ 1.46	+ 0.71	41 25.42	48 42.13	43.29
ω Piscium . . .	.	45 30.00	+ 0.10	− 0.44	+ 0.20	45 29.86	52 46.89	42.97
4 Draconis, L. C. .	.	58 55.60	− 0.32	− 3.27	− 0.99	55 51.02	24 6 7.60	43.40
a Cassiopeiæ . .	W.	26 26 1.77	+ 0.10	+ 0.34	− 0.36	26 26 1.85	33 18.71	43.14
21 Cassiopeiæ . .	.	30 1.80	+ 0.18	+ 1.54	− 0.75	30 2.77	37 19.31	43.46
ε Piscium . . .	.	49 4.42	+ 0.05	− 0.43	− 0.20	49 3.84	56 20.74	43.10
θ^1 Ceti	.	27 10 24.33	+ 0.04	− 0.59	− 0.20	27 10 23.58	25 17 40.21	43.37
38 Cassiopeiæ . .	.	14 31.84	+ 0.15	+ 1.04	− 0.57	14 32.46	21 49.26	43.20
η Piscium . . .	.	17 24.58	+ 0.07	− 0.35	− 0.21	17 24.09	24 40.83	43.26
o Piscium . . .	.	31 24.62	+ 0.05	− 0.41	− 0.20	31 24.06	38 40.93	43.13
Mean at $24^h\ 30^m$ local sidereal time								−1 52 43.23

Normal Equations.

$$11\,\delta t - 1.12\,a - 8.35\,c = -3.39 \qquad a = -0.76$$
$$-1.12\,\delta t + 36.82\,a - 29.15\,c = -33.68 \qquad c = +0.20$$
$$-8.35\,\delta t - 29.15\,a + 86.78\,c = +42.90 \qquad \delta t = -0.23$$

(10.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

CHEYENNE, WYOMING TERRITORY, *October* 16, 1872.

Name of Star.	Clamp.	T	bB	A	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
Groombridge 3241	E.	22 23 11.27	+ 0.53	+ 1.51	+ 0.33	22 23 13.64	20 30 32.58	−1 52 41.06
α Cygni	.	29 45.57	+ 0.26	+ 0.08	+ 0.14	29 46.05	37 5.29	40.76
μ Aquarii . . .	.	38 28.07	+ 0.12	− 0.71	+ 0.10	38 27.58	45 46.74	40.84
ν Cygni	.	45 5.80	+ 0.28	− 0.01	+ 0.13	45 6.20	52 25.44	40.76
61 Cygni	.	53 51.81	+ 0.29	− 0.06	+ 0.13	53 52.17	21 1 11.41	40.76
π Aquarii . . .	W	24 11 28.03	+ 0.18	− 0.58	− 0.10	24 11 27.53	22 18 46.59	40.94
9 Draconis, L. C. .	.	16 53.41	− 0.47	− 3.39	+ 0.42	16 49.97	24 9.25	40.72
η Aquarii . . .	.	21 30.52	+ 0.19	− 0.60	− 0.10	21 30.01	28 48.96	41.05
ζ Pegasi	.	27 48.17	+ 0.23	− 0.47	− 0.10	27 47.83	35 6.86	40.97
Mean at 21^h local sidereal time								−1 52 40.88

Normal Equations.

$$9\,\delta t + 4.69\,a + 9.48\,c = -2.42 \qquad a = -0.90$$
$$4.69\,\delta t + 18.72\,a + 9.40\,c = -15.04 \qquad c = +0.10$$
$$9.48\,\delta t + 9.40\,a + 37.94\,c = -2.72 \qquad \delta t = +0.10$$

GHEYENNE, WYOMING TERRITORY, *October* 16, 1872.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
4 Draconis, L. C. .	W.	1 58 52.98	− 0.66	− 4.99	+ 1.13	1 58 48.46	0 6 7.70	−1 52 40.76
α Cassiopeiæ . .	.	2 25 58.46	+ 0.50	+ 0.52	− 0.41	2 25 59.07	33 18.71	40.36
21 Cassiopeiæ . .	.	29 57.65	+ 0.99	+ 2.34	− 0.85	30 0.13	37 19.30	40.83
ϵ Piscium . . .	.	49 1.78	+ 0.32	− 0.65	− 0.23	49 1.22	56 20.75	40.47
θ Ceti.	E.	3 10 21.21	+ 0.25	− 0.90	+ 0.23	3 10 20.79	1 17 40.24	40.55
38 Cassiopeiæ . .	.	14 26.64	+ 0.95	+ 1.59	+ 0.66	14 29.84	21 49.29	40.55
η Piscium . . .	.	17 21.33	+ 0.37	− 0.53	+ 0.24	17 21.41	24 40.85	40.56
Mean at 25^h local sidereal time								−1 52 40.58

Normal Equations.

$$7\,\delta t + 2.26\,a + 3.37\,c = -5.92 \qquad a \quad -1.160$$
$$2.26\,\delta t + 25.78 + 26.25\,c = -25.42 \qquad c = +0.225$$
$$3.37\,\delta t + 26.25\,a + 52.52\,c = -20.71 \qquad \delta t = -0.590$$

(10.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

CHEYENNE, WYOMING TERRITORY, *October* 18, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
σ^2 Ursæ Maj., L. C. .	W.	22 51 48.50	− 0.14	− 3.13	+ 0.52	22 51 45.75	59 7.95	−1 52 37.80
ζ Cygni	.	23 0 9.13	+ 0.17	− 0.29	− 0.23	23 0 8.78	21 7 30.88	37.90
α Cephei	.	8 9.66	+ 0.32	+ 0.96	− 0.43	8 10.51	15 32.64	37.87
1 Draconis, L. C. .	.	11 25.78	− 0.62	− 7.48	+ 1.42	11 19.10	9 18 41.04	38.06
β Cephei	.	19 37.72	+ 0.51	+ 1.78	− 0.59	19 39.42	21 27 1.22	38.20
ξ Aquarii. . . .	.	23 37.34	+ 0.13	− 0.97	− 0.20	23 36.30	30 58.24	38.06
ϵ Pegasi	.	30 34.49	+ 0.17	− 0.67	− 0.20	30 33.79	37 55.90	37.89
11 Cephei	.	32 40.02	+ 0.53	+ 1.89	− 0.61	32 41.83	40 3.88	37.95
μ Capricorni . . .	.	39 0.41	+ 0.14	− 1.07	− 0.21	38 59.27	46 21.17	38.10
79 Draconis . . .	.	43 54.07	+ 0.58	+ 2.29	− 0.69	43 56.25	51 18.18	38.07
Mean at 22^h local sidereal time								−1 52 37.99

Normal Equations.

$$10\,\delta t + 5.33\,a = -6.61 \qquad a = -1.256$$
$$5.33\,\delta t + 51.26\,a = -64.32 \qquad \delta t = +0.010$$

CHEYENNE, WYOMING TERRITORY, *October* 18, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
ι Piscium . . .	W.	25 26 2.90	+ 0.02	− 0.58	− 0.20	25 26 2.14	23 33 24.56	−1 52 37.58
Groombridge 4163	.	41 18.63	− 0.03	+ 1.87	− 0.71	41 19.76	48 42.03	37.73
ω Piscium . . .	.	45 25.25	− 0.01	− 0.56	− 0.20	45 24.48	52 46.89	37.59
4 Draconis, L. C. .	.	58 48.54	+ 0.10	− 4.19	+ 0.99	58 45.44	24 6 7.77	37.67
α Cassiopeæ. . .	.	26 24 56.21	− 0.03	+ 0.44	− 0.36	26 24 56.26	33 18.70	37.56
β Ceti.	.	29 51.31	− 0.02	− 0.89	− 0.21	29 50.19	37 12.55	37.64
ϵ Piscium . . .	.	48 59.06	− 0.02	− 0.55	− 0.20	48 58.29	56 20.76	37.53
Mean at 24^h local sidereal time								−1 52 37.61

Normal Equations.

$$7\,\delta t + 4.57\,a = -1.76 \qquad a = -0.975$$
$$4.57\,\delta t + 24.19\,a = -21.82 \qquad \delta t = +0.390$$

(10.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

CHEYENNE, WYOMING TERRITORY, *October* 19, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
σ^2 Ursæ Majoris, L. C.	W.	22 51 45.73	+ 0.17	− 1.04	− 0.08	22 51 44.78	20 59 8.02	−1 52 36.76
ζ Cygni	.	23 0 8.13	− 0.23	− 0.10	+ 0.03	23 0 7.83	21 7 30.87	36.96
α Cephei	.	8 9.55	− 0.40	+ 0.32	+ 0.06	8 9.53	15 32.60	36.93
1 Draconis, L. C. .	.	11 20.45	+ 0.78	− 2.49	− 0.21	11 18.53	18 41.22	37.31
β Aquarii. . . .	.	17 28.70	− 0.14	− 0.31	+ 0.03	17 28.28	24 51.15	37.13
β Cephei	.	19 38.10	− 0.51	+ 0.59	+ 0.09	19 38.27	26 1.17	37.10
ξ Aquarii. . . .	.	23 35.84	− 0.13	− 0.32	+ 0.03	23 35.42	30 58.22	37.20
ϵ Pegasi	.	30 33.38	− 0.17	− 0.22	+ 0.03	30 33.02	37 55.88	37.14
11 Cephei	.	32 40.62	− 0.34	+ 0.63	+ 0.09	32 41.00	40 3.83	37.17
μ Capricorni . .	.	38 58.85	− 0.08	− 0.36	+ 0.03	38 58.44	46 21.16	37.28
79 Draconis . . .	.	43 55.14	− 0.35	+ 0.76	+ 0.10	43 55.65	51 18.12	37.53
π Aquarii . . .	E.	0 11 24.15	− 0.10	− 0.27	− 0.03	0 11 23.75	22 18 46.56	37.19
9 Draconis, L. C. .	.	16 47.94	+ 0.27	− 1.58	+ 0.13	16 46.76	24 9.53	37.23
ζ Pegasi	.	27 44.47	− 0.12	− 0.22	− 0.03	27 44.10	35 6.83	37.27
Mean at 22^h local sidereal time								−1 52 37.16

Normal Equations.

$$14\,\delta t + 11.00\,a - 9.25\,c = -6.54 \qquad a = -0.42$$
$$11.00\,\delta t + 66.64\,a + 47.19\,c = -30.96 \qquad c = -0.03$$
$$-9.25\,\delta t + 47.19\,a + 116.65\,c = -21.10 \qquad \delta t = -0.20$$

CHEYENNE, WYOMING TERRITORY, *October* 19, 1872,

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
o Cephei	E.	25 6 2.45	− 0.56	+ 0.64	+ 0.04	25 6 2.57	23 13 25.74	−1 52 36.83
θ Piscium . . .	.	14 8.37	− 0.20	− 0.32	+ 0.02	14 7.87	21 30.90	36.97
γ Cephei	.	26 47.54	− 0.86	+ 1.45	+ 0.07	26 48.20	34 11.10	37.10
ω Piscium . . .	.	45 24.30	− 0.20	− 0.32	+ 0.02	45 23.80	52 46.88	36.92
4 Draconis, L. C. .	.	58 47.02	+ 0.24	− 2.41	− 0.07	58 44.78	24 6 7.81	36.97
21 Cassiopeiæ . .	W.	26 29 55.48	− 0.09	+ 1.13	− 0.06	26 29 56.46	37 19.27	37.19
32 Camelop., L. C. .	.	40 44.93	+ 0.16	− 4.45	+ 0.15	40 40.79	48 3.69	37.10
ϵ Piscium . . .	.	48 58.09	− 0.02	− 0.31	− 0.02	48 57.74	56 20.76	36.98
θ Ceti	.	27 10 17.73	− 0.02	− 0.44	− 0.02	27 10 17.25	25 17 40.26	36.99
38 Cassiopeiæ . .	.	14 25.80	− 0.08	+ 0.77	− 0.06	14 26.43	21 49.32	37.10
η Piscium . . .	.	17 18.11	− 0.03	− 0.26	− 0.02	17 17.81	24 40.87	36.94
Mean at $24^h\ 30^m$ local sidereal time								−1 52 37.01

Normal Equations.

$$11\,\delta t + 8.08\,a + 4.22\,c = -4.52 \qquad a = -0.560$$
$$8.08\,\delta t + 97.49\,a + 52.40\,c = -53.73 \qquad c = +0.015$$
$$4.22\,\delta t + 52.40\,a + 172.36\,c = -26.64 \qquad \delta t = 0.000$$

(10.) Uniform Tables of Time-Reductions at Receiving-Station—Continued.

CHEYENNE, WYOMING TERRITORY, *October* 21, 1872.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
μ Capricorni. . .	W.	23 38 55.98	+ 0.02	− 0.85	− 0.16	23 38 54.99	21 46 21.13	−1 52 33.86
79 Draconis . . .	.	43 50.79	+ 0.09	+ 1.82	− 0.55	43 52.15	51 17.99	34.16
a Aquarii. . . .	.	51 49.23	+ 0.01	− 0.67	− 0.16	51 48.41	59 14.62	33.79
32 Ursæ Maj., L. C. .	.	24 1 19.94	− 0.03	− 2.33	+ 0.39	24 1 17.97	22 8 43.77	34.20
π Aquarii. . . .	.	11 21.07	+ 0.03	− 0.65	− 0.16	11 20.29	18 46.54	33.75
9 Draconis, L. C. .	.	16 46.57	− 0.08	− 3.76	+ 0.68	16 43.41	24 9.60	33.81
η Aquarii. . . .	.	21 23.47	+ 0.03	− 0.67	− 0.16	21 22.67	28 48.91	33.76
ζ Pegasi	.	27 41.28	+ 0.07	− 0.52	− 0.16	27 40.67	35 6.81	33.86
a Pegasi	E.	50 59.66	+ 0.07	− 0.46	+ 0.16	50 59.43	58 25.41	34.02
o Cephei	.	25 5 58.18	+ 0.18	+ 1.15	+ 0.41	25 5 59.92	23 13 25.68	34.34
θ Piscium . . .	.	14 5.19	+ 0.06	− 0.58	+ 0.16	14 4.83	21 30.89	33.84
λ Draconis, L. C. .	.	16 23.34	− 0.08	− 2.73	− 0.47	16 20.06	23 46.30	33.76
γ Cephei	.	26 41.07	+ 0.29	+ 2.59	+ 0.71	27 44.66	34 11.01	33.65
Mean at 23^h local sidereal time								−1 52 33.91

Normal Equations.

$$13\,\delta t + 7.66\,a + 4.30\,c = -5.93 \qquad a = -1.00$$
$$7.66\,\delta t + 41.22\,a + 3.07\,c = -39.91 \qquad c = +0.16$$
$$4.30\,\delta t + 3.07\,a + 77.44\,c = +9.96 \qquad \delta t = +0.10$$

CHEYENNE, WYOMING TERRITORY, *October* 21, 1872.

Name of Star.	lamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
a Cassiopeæ . .	E.	2 25 51.28	+ 0.09	+ 0.43	+ 0.25	2 25 52.05	0 33 18.69	−1 52 33.36
21 Cassiopeæ . .	.	29 50.46	+ 0.15	+ 1.92	+ 0.52	29 53.05	37 19.22	33.83
32 Camelopard., L. C.	.	40 46.90	− 0.45	− 7.55	− 1.36	40 37.54	48 3.75	33.79
ε Piscium . . .	.	48 54.62	+ 0.06	− 0.53	+ 0.14	48 54.29	56 20.76	33.53
θ Ceti.	W.	3 10 14.40	+ 0.07	− 0.74	− 0.14	3 10 13.59	1 17 40.26	33.33
38 Cassiopeæ . .	.	14 21.72	+ 0.30	+ 1.30	− 0.40	14 22.92	21 49.31	33.61
η Piscium . . .	.	17 14.62	+ 0.15	− 0.44	− 0.14	17 14.19	24 40.87	33.32
Mean at 25^h local sidereal time								−1 52 33.54

Normal Equations.

$$7\,\delta t + 5.91\,a - 8.16\,c = -3.27 \qquad a = -0.950$$
$$5.91\,\delta t + 70.49\,a - 82.36\,c = -75.09 \qquad c = +0.140$$
$$-8.16\,\delta t - 82.36\,a + 122.80\,c = +90.98 \qquad \delta t = +0.490$$

The following table shows the corrections and the rate of the chronometers used at Cheyenne and Salt Lake City:

CHEYENNE.—NEGUS 1499.

Date.	Local sidereal hour.	Correction of chronometer.	Rate per hour.
1872.	h.	h. m. s.	
October 5	22.50	— 1 52 55.725	
14	23.50	43.130	+ 0.058
16	23.00	40.725	+ 0.051
18	23.00	37.800	+ 0.061
19	23.25	37.085	+ 0.030
21	24.00	33.725	+ 0.069

SALT LAKE.—NEGUS 1511.

Date.	Local sidereal hour.	Correction of chronometer.	Rate per hour.
1872.	h.	h. m. s.	
October 5	22.00	— 0 2 10.415	
14	21.75	23.050	— 0.059
16	22.50	26.455	— 0.070
18	22.50	29.760	— 0.069
19	21.75	31.515	— 0.075
21	22.50	35.445	— 0.081

(11.) Grouping of Series of Exchange-Signals.

This table shows the result obtained for longitude each way each night and the mean of all the nights:

Signals sent from—	Stations of record.	Means of signals sent and received.	Chronometric errors.	Local sidereal times.	Difference of longitude.	Means.
1872.		h. m. s.	h. m. s.	h. m. s.	h. m. s.	s.
October 5.						
Salt Lake..	Cheyenne chron.	0 55 6.20	— 1 52 55.69	23 2 10.51		
	Salt Lake chron.	22 36 1.51	— 0 2 10.45	22 33 51.06	0 28 19.45	
Cheyenne..	Cheyenne chron.	1 3 24.84	— 1 52 55.69	23 10 29.15		
	Salt Lake chron.	22 44 20.17	— 0 2 10.46	22 42 9.71	19.44	19.445
October 14.						
Salt Lake..	Cheyenne chron.	1 7 50.17	— 1 52 43.14	23 15 7.03		
	Salt Lake chron.	22 49 10.68	— 0 2 23.12	22 46 47.56	19.47	
Cheyenne..	Cheyenne chron.	1 15 17.75	— 1 52 43.14	23 22 34.61		
	Salt Lake chron.	22 56 38.32	— 0 2 23.13	22 54 15.19	19.42	19.445
October 16.						
Salt Lake..	Cheyenne chron.	1 37 10.90	— 1 52 40.68	23 44 30.22		
	Salt Lake chron.	23 18 37.35	— 0 2 26.51	23 16 10.84	19.38	
Cheyenne..	Cheyenne chron.	1 43 40.42	— 1 52 40.67	23 50 59.75		
	Salt Lake chron.	23 25 6.95	— 0 2 26.52	23 22 40.43	19.32	19.350
October 18.						
Salt Lake..	Cheyenne chron.	1 7 26.35	— 1 52 37.79	23 14 48.56		
	Salt Lake chron.	22 48 58.83	— 0 2 29.77	22 46 29.06	19.50	
Cheyenne..	Cheyenne chron.	1 14 3.64	— 1 52 37.79	23 21 25.85		
	Salt Lake chron.	22 55 36.07	— 0 2 29.79	22 53 6.28	19.57	19.535
October 19.						
Salt Lake..	Cheyenne chron.	0 32 25.80	— 1 52 37.11	22 39 48.69		
	Salt Lake chron.	22 14 0.79	— 0 2 31.55	22 11 29.24	19.45	
Cheyenne..	Cheyenne chron.	0 40 33.11	— 1 52 37.10	22 47 56.01		
	Salt Lake chron.	22 22 8.10	— 0 2 31.56	22 19 36.54	19.47	19.460
October 21.						
Salt Lake..	Cheyenne chron.	1 33 9.20	— 1 52 33.75	23 40 35.45		
	Salt Lake chron.	23 14 51.59	— 0 2 35.50	23 12 16.09	19.36	
Cheyenne..	Cheyenne chron.	1 39 10.98	— 1 52 33.74	23 46 37.24		
	Salt Lake chron.	23 20 53.34	— 0 2 35.51	23 18 17.83	19.41	19.385

Cheyenne east of Salt Lake City . . . . . $0^h\ 28^m\ 19^s.437 \pm 0^s.017$

(12.) Personal Equation.

Whatever differences there may have been between Mr. Austin and myself in recording time, technically known as the personal equation, is still involved in the longitude. To determine this difference, we had two nights' observations together; the one at Salt Lake in September, 1872, the other at the Naval Observatory, May, 1873. In Salt Lake we used different instruments on the same stars, in Washington the same instrument on different stars. The record, in both instances, was made on a chronograph. The result shows a large difference—Mr. Austin observing later than myself, as may be seen by a statement of the following clock-errors:

Salt Lake City, Utah, *September* 13, 1872.

	m.	s.	
Clark	2	37.95	
			$-0^s.20$
Austin	2	38.15	

Naval Observatory, *May* 17, 1873.

	s.	
Clark	$+11.22$	
		$-0^s.30$
Austin	$+10.92$	

Though this is not considered sufficiently satisfactory to apply without further data, it is positive evidence of the existence of an element affecting our results; and I have the more faith in it because it expresses the sign between us which I would indicate reasoning *a priori*. I am convinced that, in my own case at least, personal equation is a variable quantity, and introduces an error which cannot be easily eliminated unless some means be devised by which it may be determined in the course of every evening's observations.

(13.) Probable Error.

The computations were made by the method of least squares. The conditional equations were sometimes formed with and sometimes without the correction for collimation (c); in the former case it was obtained from a preliminary reduction. All the observations at both stations were made under the same circumstances and conditions, except the night of the 14th at Cheyenne, when the signals had to be received by sound in consequence of the failure of the chronograph to work. It accords with the rest, and is included with full weight; and the probable error of the final result is by the formula,

$$\text{Error} = 0.6745\sqrt{\frac{\Sigma(v^2)}{n(n-1)}} = \pm 0''.017.$$

(14.) Resulting Longitude.

From the foregoing I conclude that the difference of longitude between Salt Lake City observatory and the station at Cheyenne is $28^m\ 19^s.437$; which difference, however, is still subject to correction for personal equation; and if any weight is to be given to what is indicated as this equation between Mr. Austin and myself, this longitudinal difference will be reduced by the extent of, perhaps, $0^s.2$ of a second.

(15.) Reduction of the Latitude Observations.

Mean Places of Stars for 1872.0 used for Determination of Latitude of Cheyenne, Wyoming Territory.

No. of pair.	No. in B. A. C.	Right ascension.	Declination.	No. of pair.	No. in B. A. C.	Right ascension.	Declination.
		h. m. s.	° ′ ″			h. m. s.	° ′ ″
	6491	18 54 8	32 30 55.3	30	7721	22 3 35	32 32 52.9
1	6497	55 9	31 58 3.4	31	7731	4 19	32 33 2.3
2	6579	19 8 45	49 36 56.6		7746	6 9	50 11 29.4
	6626	15 22	49 19 57.8				
				32	7858	26 45	39 7 19.4
3	6642	18 37	16 41 23.8	33	7879	30 7	38 57 56.5
	6646	19 2	2 51 40.6	34	7880	30 12	38 58 21.3
4	6647	19 0	16 42 30.2		7906	34 52	43 36 31.1
	6662	19 59	65 28 5.1				
				35	7915	35 45	39 33 26.8
	6722	31 13	36 39 42.7	36	7972	46 15	42 37 57.2
5	6754	37 52	45 13 21.6	37	7978	47 19	39 29 16.4
6	6771	39 40	37 2 46.8		7984	48 17	39 41 41.2
7	6777	40 54	34 42 8.2	38	8023	56 2	41 38 18.2
	6830	48 42	47 36 8.4		8037	58 29	40 35 4.0
8	6924	20 2 27	55 58 15.3	39	8131	23 14 18	23 2 24.9
	6940	5 12	26 31 33.6	40	8153	16 47	59 25 55.0
	6943	6 26	26 25 44.7		8160	18 58	22 42 0.3
9	6976	10 25	56 10 35.7				
					8195	25 0	38 31 59.7
	6933	11 30	47 19 19.5	41	8223	31 18	43 43 17.1
10	6998	13 43	34 35 2.2	42	8237	34 4	43 37 31.7
	7022	17 34	39 50 53.3		8279	42 36	61 30 12.6
11	7041	20 57	42 11 12.8	43	8296	45 52	20 57 33.7
				44	8301	46 9	21 1 53.5
	7101	28 26	41 2 12.5	45	8338	54 13	61 27 54.3
12	7114	29 57	40 39 29.0		8359	57 37	61 34 30.3
13	7174	37 17	41 15 34.3				
					68	0 14 35	67 6 46.1
	7198	40 22	46 49 59.6	46	98	20 53	15 19 0.1
14	7213	42 24	36 1 16.6	47	102	21 33	15 44 14.2
				48	116	24 8	15 19 48.6
	7253	48 42	43 54 12.7	49	122	24 56	15 18 54.0
	7259	49 30	43 54 4.4				
	7273	52 2	44 26 0.0		158	30 30	34 41 41.9
	7290	53 53	43 58 25.2	50	197	37 20	47 9 43.7
	7317	57 47	44 17 12.6	51	198	37 35	47 35 0.1
15, 16	7320	58 6	38 9 9.6				
17, 18	7336	21 1 2	38 7 16.8		255	49 3	59 40 8.8
19, 20	7337	1 3	38 7 8 5	52	264	50 23	22 43 32.6
	7365	6 18	53 2 28.3		290	56 43	53 31 6.2
21	7368	7 28	29 42 10.7	53	299	57 28	28 58 31.5
	7398	12 24	38 51 33.6		341	1 3 25	14 59 29.4
22	7402	13 40	43 24 29.1	54	379	9 35	67 8 26.9
	7410	15 10	23 19 6.6		394	12 38	63 59 9.5
23	7476	23 53	59 11 37.3	55	427	19 21	18 30 19.0
				56	431	19 46	18 34 35.5
24	7453	20 33	36 6 54.9				
25	7462	22 8	36 33 40.7	57	444	23 9	67 44 58.1
	7469	22 48	45 51 36.2		453	24 38	14 41 7.2
	7480	24 40	45 58 37.1				
				58	502	33 2	39 55 39.1
	7555	36 28	54 17 26.4		510	33 58	41 58 10.3
26	7568	38 25	28 9 55.7				
27	7569	38 25	28 9 58.2	59	572	46 30	18 39 55.5
				60	573	46 30	18 40 3.8
	7602	43 1	38 21 46.0		583	50 13	63 59 49.4
28	7681	57 46	44 2 1.2		611	53 32	63 46 13.7
29	7705	22 0 47	44 23 33.4				
				61	657	2 2 7	25 19 58.5
					696	9 4	56 55 17.0

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory.

Date.	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.
1872.		T. D.			
Oct. 1	7101	27 34.5	15.0	39.0	
	7114	5 45.5	. .	. .	30^s late.
	7174	24 53.8	42.0	12.0	
	7273	8 17.5	. .	. .	
	7317	16 66.8	17.0	36.5	
	7336	26 00.9	39.0	16.5	
	7337	25 89.0	. .	. .	
	7365	2 24.0	41.0	12.0	
	7368	31 4.0	13.0	41.0	
	7398	18 64.0	14.0	40.0	
	7402	17 31.2	50.0	5.0	
	7453	6 24.2	. .	. .	
	7462	32 8.0	25.0	30.0	
	7480	15 58.8	15.0	40.0	
	7555	11 73.8	35.0	20.5	
	7568	23 40.7	. .	. .	
	7602	11 98.8	20.0	34 5	
	7681	31 57.9	19.0	38.0	
	7721	33 24.0	. .	. .	
	7731	33 36.8	38.5	18.5	
	7746	5 42.2	3.0	54.0	
	7915	14 90.0	15.0	32.0	
	7972	18 72.0	10.0	40.0	
	7978	10 96.0	10.0	40.0	
	7984	22 92.5	19.0	30.0	
	8131	38 88.0	19.0	30.0	
	8153	26 31.5	10.0	39.0	
	8160	19 17.8	20.0	29.0	
	8195	14 59.4	17.0	31.0	
	8223	14 62.3	13.0	37.0	
	8237	20 15.5	. .	. .	
1872.		T. D.			
Oct. 1	8279	11 43.2	22.5	26.5	
	8296	23 44.5	7.0	42.0	
	8301	27 57.5	. .	. .	
	8338	13 69.6	. .	. .	
	158	10 50.8	19.5	28.0	
	197	33 69.0	9.0	39.5	
	198	9 25.0	. .	. .	
	255	14 12.2	25.0	23.0	
	264	22 17.4	8.0	40.0	
Oct. 3	6642	16 40.6	22.5	27.5	
	6647	17 45.0	. .	. .	
	6662	21 64.8	36.0	15.0	
	6722	1 99.9	27.0	25.0	
	6754	23 1.5	34.0	18.0	
	6771	24 27.4	24.0	28.0	
	6940	29 83.8	31.0	23.0	
	6943	23 20.0	28.0	26.0	
	6976	3 41.5	. .	. .	
	7101	25 48.5	28.5	26.5	
	7174	22 56.8	35.0	20.0	Doubtful.
	7317	13 77.0	31.0	25.0	
	7336	23 20.0	. .	. .	
	7337	23 13.0	32.0	23.5	
	7398	19 29.5	28.5	12.0	
	7402	18 3.7	23.0	18.0	
	7410	24 5.8	31.0	10.0	
	7476	9 71.0	20.0	27.0	
	7555	11 51.0	27.0	17.0	
	7568	23 68.9	26.0	18.0	
	7602	23 33.3	25.0	18.0	
	7681	14 69.0	22.5	21.0	
	7705	32 48.8	. .	. .	

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory.

Date.	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.	Date.	No of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.
1872.		T. D.				1872.		T. D.			
Oct. 3	7721	28 77.6	30.5	11.5		Oct. 8	6722	2 63.0	15.0	31.5	
	7731	28 98.0	. .	. .			6754	23 66.8	37.0	10.0	
	7746	0 22.5	15.5	26.5			6771	24 89.5	16.0	32.0	
	7858	31 32.6	. .	. .			6777	20 93.0	26.0	20.5	
	7879	22 51 0	31.5	12.5			6830	17 67.5	24.0	23.0	
	7880	22 19.0	. .	. .							
	7906	3 15.0	22.0	22.0			6924	15 63.0	33.0	11.5	
							6940	30 14.5	16.5	29.0	
	7972	17 89.0	21.0	23.5			6943	24 46.0	36.0	9.5	
	7978	10 42.8	21.5	23.0	30^s late.		6976	3 75.8	16.5	29.5	
	7984	22 40.6	. .	. .							
							7022	11 83.0	13.0	32.5	
	8023	18 94.0	21.0	24.0			7041	24 15.5	35.5	10.0	
	8037	17 57.8	30.0	14.0							
							7101	25 71.0	26.0	21.0	
	8131	30 35.5	21.0	25.0			7114	3 69.0	. .	. .	20^s late.
	8153	17 39.0	. .	. .			7174	22 73.0	32.5	16.0	
	8160	10 64.5	30.0	15.0							
							7198	1 81.8	31.5	16.5	
	8195	17 0.5	25.0	20.0			7213	30 95.5	23.5	25.0	15^s late.
	8223	16 61.0	25.0	20.0							
	8237	22 14.7	. .	. .			7290	31 26.8	38.0	11.0	
							7317	13 10.0	. .	. .	
	8279	13 66.0	22.0	24.0			7336	22 52.2	. .	. .	
	8296	26 9.7	32.0	13.0			7337	22 42.0	20.5	30.0	
	8301	30 37.0	20.0	26.0							
	8338	15 93.5	32.0	13.0			7410	25 25.0	28.5	23.0	
	8359	9 53.8	. .	. .			7476	9 90.5	28.5	25.5	
	68	6 16.3	34.0	13.5			7555	11 60.0	33.0	20.0	
	98	16 67.4	18.0	29.0			7568	23 71.0	25.5	27.5	
	102	40 94.0	. .	. .	Doubtful.		7602	4 78.5	22.0	31.0	
	116	17 49.8	. .	. .			7681	13 99.0	37.0	17.0	
	122	16 62.0	. .	. .							
	158	11 94.8	30.5	16.0			7721	27 59.8	23.5	29.0	
	198	10 25.0	23.0	24.0			7731	27 86.0	. .	. .	
							7746	— 0 97.0	35.0	18.0	
	255	16 45.5	25.0	22.5							
	264	24 91.5	27.0	20.0			7758	30 21.5	32.0	21.0	
							7879	21 20.0	. .	. .	
	290	9 94.0	28.0	19.0			7880	21 52.5	. .	. .	
	299	24 20.0	27.0	20.0			7906	2 8.0	30.0	21.0	

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory.

Date,	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.
1872.		T. D.			
Oct. 8	7972	17 34.9	32.0	22.0	
	7978	10 3.0	. .	. .	
	7984	22 13.5	31.0	22.0	
	8023	19 2.0	30.0	23.0	
	8037	17 76.0	31.0	23.0	20^s late.
	8131	29 71.0	21.0	34.5	
	8153	16 79.0	36.0	19.0	
	8160	10 4.0	23.0	32.0	
	8195	17 59.5	38.0	17.0	
	8223	17 6.0	25.0	30.0	
	8237	22 63.8	. .	. .	
	8279	12 13.5	35.0	21.0	
	8296	24 68.8	32.5	23.0	
	8301	28 88.7	34.0	20.5	
	8338	14 46.0	29.0	27.5	
	8359	8 8.5	. .	. .	
	68	5 70.5	27.5	23.0	
	98	16 18.0	26.5	24.5	
	116	16 96.5	. .	. .	
	122	15 10.0	. .	. .	
	158	20 8.0	26.0	24.0	
	198	18 39.0	28.0	23.0	
	255	13 51.5	35.0	17.0	
	264	21 93.5	14.0	37.0	
	290	10 70.0	32.5	20.0	30^s late.
	299	24 91.2	27.0	24.5	
	341	15 35.0	25.0	26.0	
	379	22 20.5	27.0	24.0	
	394	5 21.0	39.0	12.0	
	431	23 34.0	20.0	32.0	
	502	6 75.0	29.0	23.0	
	510	27 18.0	26.0	26.5	
1872.		T. D.			
Oct. 8	572	25 8.6	19.0	35.0	
	573	24 98.5	42.0	11.0	
	588	1 11.3	44.0	9.0	
	611	14 36.0	15.0	38.0	
	657	10 36.8	15.0	38.0	
	696	10 21.5	40.5	12.0	
Oct. 9	6646	16 50.4	26.5	25.0	
	6647	17 57.0	. .	. .	
	6662	21 92.0	23.5	28.0	
	6722	3 23.5	26.0	25.0	
	6754	24 19.8	29.0	23.0	
	6771	25 50.5	31.0	21.0	
	6924	15 42.5	20.0	33.0	
	6940	29 91.0	35.0	18.0	
	6943	24 24.0	33.5	30.0	
	6976	3 50.5	35.0	18.0	
	7022	11 35.7	32.0	19.0	
	7041	23 73.5	23.5	29.0	
	7101	25 98.5	. .	. .	
	7114	43 41.0	27.0	27.0	Doubtful.
	7174	23 6.0	38.0	16.0	
	7198	1 10.5	28.0	25.0	
	7213	36 31.5	30.5	23.0	
	7253	28 48.0	. .	. .	
	7259	28 47.0	30.0	23.0	Very faint.
	7290	24 36.0	. .	. .	
	7320	17 42.8	33.5	21.0	
	7336	15 58.0	. .	. .	
	7337	15 52.0	. .	. .	
	7453	5 57.0	25.0	30.0	
	7462	31 43.0	. .	. .	
	7480	20 93.5	33.0	22.0	
	7555	11 24.5	31.0	24.0	
	7568	23 37.3	34.0	210.	

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory.

Date.	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.	Date.	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.
1872.		T. D.				1872.		T. D.			
Oct. 9	7602	4 17.0	18.0	38.0		Oct. 9	394	6 41.5	37.0	20.0	
	7681	13 52.0	39.5	15.5			427	20 43.4	. .	. .	
	7705	25 13.0	37.0	19.0	Doubtful.		431	24 59.0	24.0	34.5	
	7721	28 16.2	12.0	42.0			444	10 94.5	36.0	23.0	
	7731	28 40.5	. .	. .			453	21 72.0	24.0	33.5	
	7746	— 1 69.0	50.0	4.5							
							502	11 83.4	23.5	33.0	
	7858	30 55.0	23.0	34.5			510	25 7.0	41.0	17.0	20^s late.
	7879	21 57.5	. .	. .							
	7880	21 88.0	. .	. .			572	25 7.8	. .	. .	
	7906	2 50.0	38.0	17.0			573	24 97.0	36.0	23.0	
							588	1 13.3	24.0	34.5	
	7972	17 16.5	38.5	19.0			611	14 27.5	. .	. .	
	7978	9 97.5	. .	. .							
	7984	21 80.5	26.0	30.5	10^s late.	Oct. 10	6497	11 68.5	24.0	24.0	
							6579	18 50.2	30.0	20.0	Double star;
	8023	19 34.0	30.0	25.5				18 40.8	32.0	20.0	doubtful.
	8037	18 3.0	38.0	19.0			6626	34 91.5	24.0	24.0	
	8131	29 86.5	13.0	45.0			6642	17 27.2	. .	. .	
	8153	16 71.5	50.0	8.0			6647	18 36.0	15.0	38.0	
	8160	10 0.5	13.0	45.0			6662	22 56.0	42.0	10.0	
	8195	16 70.0	18.5	37.0			6722	4 69.0	26.0	28.0	
	8223	16 27.0	38.0	19.0			6754	25 68.0	36.0	19.0	
	8237	21 84.0	. .	. .			6771	26 95.0	. .	. .	
	8279	10 96.0	42.0	16.0							
	8296	23 50.0	. .	. .			6777	20 55.0	4.5	50.0	
	8301	27 67.5	22.0	36.0	30^s late.		6830	17 17.8	. .	. .	
	8338	13 21.7	46.0	12.0							
	8359	6 70.0	22.0	36.0			6924	15 18.0	22.0	34.0	
	68	9 24.0	38.0	21.0			6940	29 61.5	39.0	17.0	
	98	19 86.0	30.0	28.0			6943	24 11.0	39.0	17.0	
	116	20 54.9	. .	. .			6976	3 29.5	22.0	34.5	
	158	19 24.7	39.0	18.0							
	198	17 46.8	27.0	31.0			7022	13 60.0	26.0	30.0	
							7041	25 82.0	36.5	20.0	
	255	13 6.5	37.0	22.0							
	264	21 65.0	35.5	23.0			7101	27 23.3	26.0	30.0	
	341	15 29.0	30.0	28.0			7114	5 33.5	. .	. .	
	379	22 8.0	33.0	25.0			7174	24 38.0	36.0	21.5	

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory.

Date.	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.
1872.		T. D.			
Oct. 10	7253	27 88.8	. .	. .	
	7259	28 4.0	26.0	31.5	
	7273	— 2 16.0	. .	. .	
	7290	24 85.7	. .	. .	
	7320	17 91.0	. .	. .	
	7336	16 12.5	. .	. .	
	7337	16 3.0	38.0	20.0	
	7453	6 23.2	23.0	36.0	
	7462	32 12.3	. .	. .	
	7469	13 49.0	45.0	13.5	
	7480	15 8.3	42.0	17.0	
	7555	12 48.5	46.0	12.5	
	7568	24 66.5	. .	. .	
	7569	26 50.2	20.5	38.0	
	7602	4 81.0	31.5	27.5	
	7681	13 96.5	38.0	21.5	
	7858	31 53.0	26.0	36.0	
	7879	22 85.0	. .	. .	
	7880	22 53.5	. .	. .	
	7906	3 41.0	46.0	16.0	
	7972	18 57.0	32.5	30.0	
	7978	11 25.0	. .	. .	
	7984	23 24.0	33.0	29.0	
	8023	19 50.0	49.0	13.0	
	8037	18 24.0	21.0	41.0	
	8131	29 95.0	15.0	48.5	
	8153	16 91.0	51.0	12.0	
	8160	10 31.0	21.0	42.0	
	8279	12 87.3	29.5	28.0	
	8296	25 42.5	. .	. .	
	8301	29 66.5	37.5	20.0	
	8338	15 17.0	28.0	30.0	
	8359	8 77.0	37.5	20.0	
	68	10 47.0	27.0	31.5	
	98	20 97.0	37.0	21.0	
	116	21 74.4	. .	. .	
	122	20 89.5	. .	. .	
1872.		T. D.			
Oct. 10	158	19 70.0	18.0	39.0	
	198	17 97.5	42.0	16.0	
	255	15 34.0	26.0	31.5	
	264	23 97.0	39.0	18.0	
	290	10 97.8	30.0	26.5	
	299	25 27.7	37.0	19.0	
	341	16 20.0	37.0	19.0	
	379	22 92.0	24.5	32.5	
	394	8 24.0	27.5	29.0	
	427	22 26.9	33.0	23.0	
	431	26 38.5	. .	. .	
	444	11 38.0	37.0	20.0	20^s late.
	453	22 10.5	23.0	34.0	15^s late.
	502	6 21.5	30.0	27.0	
	510	26 61.0	32.0	26.0	15^s late.
	572	25 94.2	. .	. .	
	573	25 81.0	11.0	47.0	
	588	1 98.0	. .	. .	
	611	15 15.0	48.0	10.0	
Oct. 11	6491	12 31.5	30.0	15.0	
	6579	19 4.0	25.0	20.0	
	6626	35 63.0	. .	. .	
	6642	16 51.5	35.0	13.0	
	6662	21 71.8	22.0	25.5	
	6722	4 59.0	29.0	22.0	
	6754	25 87.0	17.0	34.0	
	6771	26 91.7	. .	. .	
	6777	23 22.0	16.0	35.0	
	6830	20 4.4	30.5	20.0	
	6924	15 40.0	21.0	32.0	
	6940	29 68.0	25.0	27.5	
	6943	24 6.0	22.0	31.0	
	6976	3 51.5	25.0	27.5	
	6983	27 61.0	34.0	17.0	30^s late; doubtful.
	6998	7 58.6	9.5	42.0	Doubtful.

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory,

Date.	No. of star.	Micrometer reading.	Level.		Remarks.	Date.	No. of star.	Micrometer reading.	Level.		Remarks.
			N.	S.					N.	S.	
1872.		T. D.				1872.		T. D.			
Oct. 11	7022	12 4.0	16.0	34.5		Oct. 11	8279	12 62.0	37.0	23.0	
	7041	24 43.0	32.0	19.5			8296	24 95.5	15.0	45.0	
							8301	29 10.0	35.0	25.0	
	7101	27 51.8	. .	. .			8338	14 95.0	15.0	45.0	
	7114	5 60.5	22.5	30.0			8359	8 55.0	. .	. .	
	7174	24 82.3	25.0	28.0							
							68	9 93.0	39.0	21.0	
							98	20 20.0	13.0	48.0	
	7198	0 81.5	20.0	33.5			116	20 96.6	. .	. .	
	7213	35 92.0	31.0	22.0			122	20 12.0	. .	. .	
	7253	28 1.5	. .	. .			158	19 95.0	25.0	35.5	
	7259	28 6.0	. .	. .			198	18 31.0	32.0	29.0	
	7290	23 86.8	. .	. .							
	7320	16 73.0	20.0	35.5			255	14 49.5	38.0	23.5	
	7336	15 98.0	. .	. .			264	22 88.2	19.0	42.0	
	7337	15 87.0	. .	. .							
							290	11 38.8	32.0	28.5	
	7453	7 33.0	33.0	23.0			299	25 45.5	23.0	35.0	
	7462	33 18.9	14.0	43.0							
	7469	14 84.0	14.0	43.0			341	15 92.0	17.0	44.0	
	7480	16 41.6	38.0	18.0			379	22 95.0	34.5	26.0	
	7555	12 32.0	42.0	14.0							
	7568	24 20.6	. .	. .			394	7 21.0	50.0	10.0	
	7569	26 5.0	7.0	49.0			427	20 93.0	3.0	57.0	
							431	25 5.0	. .	. .	
	7602	14 44.0	24.0	32.0							
	7681	23 77.8	26.0	31.0			444	12 6.0	39.0	22.0	30ˢ late.
	7705	2 94.0	29.0	28.0			453	22 46.0	10.0	51.0	15ˢ late.
	7731	33 25.2	18.5	38.0			502	6 99.5	22.0	39.0	
	7746	4 67.9	31.0	26.0			510	27 45.5	34.0	27.5	15ˢ late.
	7972	18 5.5	28.5	30.0							
	7978	10 53.5	25.0	33.0			572	26 86.0	24.0	38.5	
	7984	22 61.3	. .	. .			573	26 80.0	. .	. .	
							588	3 7.0	30.0	32.0	
	8023	19 99.8	31.0	27.0			611	16 28.6	. .	. .	
	8037	18 51.5	22.0	36.0							
						Oct. 12	6491	11 98.5	38.0	15.0	
	8131	29 68.0	23.0	37.0			6579	18 84.0	12.0	42.0	
	8153	16 89.3	28.0	31.5			6626	35 39.0	15.0	41.0	
	8160	10 2.0	25.0	35.0							
							6642	15 54.0	37.0	19.0	
	8195	17 27.5	30.0	30.0			6647	16 57.0	. .	. .	
	8223	16 91.8	27.0	34.0			6662	20 97.0	14.0	42.0	
	8237	22 48.8	. .	. .							

(15.) Reduction of the Latitude-Observations—Continued.

Observations for Latitude.—Station, Cheyenne, Wyoming Territory.

Date.	No. of star.	Micrometer reading.	Level. N.	Level. S.	Remarks.
1872.		T. D.			
Oct. 12	6722	4 56.3	30.0	28.0	
	6754	25 88.5	19.0	39.0	
	6771	26 91.0	31.0	27.0	
	6777	21 86.3	36.0	22.0	
	6830	18 77.8	16.0	42.0	
	6924	15 12.5	37.5	21.5	
	6940	29 37.0	16.0	44.0	
	6943	23 72.2	42.0	18.5	
	6976	3 14.0	16.0	44.0	
	6983	29 58.8	21.0	39.5	30^s late.
	6998	9 67.0	36.0	25.0	
	7022	11 56.0	28.0	32.0	
	7041	24 9.0	23.0	38.0	
	7101	25 39.5	. .	. .	
	7114	3 53.5	25.0	37.0	
	7174	22 69.5	34.0	29.0	
	7198	1 63.8	22.5	39.5	
	7213	36 65.0	35.0	27.0	
	7253	33 67.8	. .	. .	
	7259	33 86.0	38.0	24.0	
	7273	2 97.0	. .	. .	
	7290	29 67.2	. .	. .	
	7320	22 47.0	18.5	44.5	
	7336	20 70.5	. .	. .	
	7337	20 58.0	. .	. .	
	7453	5 88.4	24.0	41.0	
	7462	31 72.7	. .	. .	
	7469	13 30.5	34.0	31.0	
	7480	14 95.6	. .	. .	
	7555	12 20.0	32.5	32.5	
	7568	24 13.5	. .	. .	
	7569	25 98.0	25.0	40.0	
	7602	13 79.0	29.0	35.5	
	7681	22 28.5	30.5	36.0	
	7705	2 34.5	. .	. .	
	7721	33 11.4	. .	. .	
	7731	33 27.3	38.5	27.0	
	7746	4 64.0	27.0	39.0	

Date.	No. of star.	Micrometer reading.	Level N.	Level S.	Remarks.
1872.		T. D.			
Oct. 12	7858	30 10.0	29.0	36.0	
	7879	22 41.2	. .	. .	
	7880	22 6.2	. .	. .	
	7906	3 16.0	33.0	33.0	
	7972	17 77.0	. .	. .	For level take the mean of preceding and following.
	7978	10 28.0	. .	. .	
	7984	22 30.0	. .	. .	
	8023	20 15.5	30.0	18.0	
	8037	18 71.5	13.5	34.5	
	8131	29 81.5	31.0	19.0	
	8153	16 96.5	16.0	33.5	
	8160	10 12.5	29.5	19.5	
	8195	17 25.0	30.0	19.0	
	8223	16 88.3	15.5	34.0	
	8237	22 48.0	. .	. .	
	8279	12 77.0	22.5	26.5	
	8296	25 13.5	. .	. .	
	8301	29 30.5	23.0	26.0	
	8338	14 99.5	23.5	26.5	
	8359	8 62.0	23.0	26.0	
	158	20 7.8	31.5	19.0	
	198	18 53.5	12.5	38.0	
	255	14 6.5	29.0	23.0	
	264	22 32.5	17.5	33.5	
	290	11 61.5	26.5	23.0	
	299	25 69.0	20.0	29.0	
	341	14 97.0	23.0	27.0	
	379	21 90.5	21.0	30.0	
	394	7 96.0	26.5	23.5	
	427	21 75.5	. .	. .	
	431	25 84.0	13.0	37.0	
	444	11 71.0	25.0	25.0	
	453	22 29.5	19.0	31.0	
	502	6 74.0	17.0	34.0	
	510	27 17.0	36.0	15.0	
	572	26 10.0	19.0	32.0	
	573	25 95.5	. .	. .	
	588	2 28.0	25.0	26.0	
	611	15 45.5	. .	. .	

(15.) Reduction of the Latitude-Observations—Continued.

Computations for Latitude of Cheyenne, Wyoming Territory.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1872.		° ′ ″	′ ″	″	″	° ′ ″
Oct. 1	13	40 57 50.5	+ 9 53.10	+ 1.65	0.00	41 7 45.3
	12	41 9 12.3	− 1 27.24	+ 1.65	0.00	46.6
	17	16 57.6	− 9 14.28	+ 0 83	0.00	44.1
	20	12 29.8	− 4 46,63	+ 0.82	0.00	44.0
	21	22 38.5	− 14 55.10	+ 0.28	0.00	43.7
	22	8 20.7	− 0 41.27	+ 5.20	0.00	44.6
	25	16 28.2	− 8 32.57	− 8.25	0.00	47.4
	24	3 5.3	+ 4 50.47	− 8.25	0.00	47.5
	26	14 0.1	− 6 2.67	− 8.80	0.00	48.6
	31	22 35.8	− 14 42.54	− 8.50	0.00	44.8
	30	22 31.1	− 14 35, 77	− 8.50	0.00	46.7
	35	6 0.8	+ 1 58.72	− 12.92	0.00	46.6
	36	3 55.5	+ 4 1.18	− 11.22	0.00	45.5
	37	10 7.8	− 2 10.69	− 11.20	0.00	45.9
	39	14 27.6	− 6 30.52	− 11.00	0.00	46.1
	40	4 15.3	+ 3 41.82	− 10.50	0.00	46.6
	41	7 56.2	+ 0 0.90	− 10.45	0.00	46.6
	42	5 3.5	+ 2 52.84	− 10.40	0.00	45.9
	43	14 10.0	− 6 13.36	− 10.70	0.00	45.9
	45	15 10.4	− 7 11.36	− 11.70	0.00	47.3
	46	13 8.4	− 5 9.62	− 10.70	0.00	48.1
	48	13 32.6	− 5 34.22	− 10.70	0.00	47.7
	49	13 5.3	− 5 5.11	− 10.70	0.00	49.5
	50	55 58.3	+ 12 0.50	− 10.70	0.00	48.1
	51	8 36.5	− 0 39.10	− 10.70	0.00	46.7
	52	12 5.4	− 4 10.26	− 8.25	0.00	46.8
Oct. 3	3	41 5 0.0	+ 2 42.92	+ 4.40	0.00	41 7 47.3
	4	5 33.2	+ 2 10.47	+ 4.40	0.00	48.1
	5	40 56 49.8	+ 10 53.18	+ 4.95	0.00	47.9
	6	41 8 22.0	− 0 39.13	+ 4.00	0.00	46.9
	9	21 22.7	− 13 41.23	+ 2.80	0.00	44.3
	9	18 28.3	− 10 46.02	+ 2.80	0.00	45.1
	12	9 12.5	− 1 30.66	+ 2.00	+ 0.10	43.9
	17	12 34.2	− 4 53.08	+ 3.98	0.00	45.1
	19	12 30.0	− 4 50.91	+ 3.98	0.00	43.1
	22	8 21.0	− 0 39.10	+ 5.91	0.00	47.8
	23	15 40.9	− 7 57.04	+ 3.85	0.00	47.7
	26	14 0.4	− 6 18.52	+ 4.95	0.00	46.8
	28	12 13.3	− 4 28.62	+ 2.33	0.00	47.0
	31	22 36.3	− 14 53.71	+ 2.20	0.00	44.8
	31	22 30.8	− 14 47.36	+ 2.20	0.00	45.6
	32	22 15.0	− 14 35.71	+ 5.20	0.00	44.5

(15.) Reduction of the Latitude-Observations—Continued.

Computations for Latitude of Cheyenne, Wyoming Territory.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1872.		° ′ ″	′ ″	″	″	° ′ ″
Oct. 3	33	41 17 45.9	− 10 1.71	+ 5.20	0.00	41 7 49.4
	34	17 33.5	− 9 51.76	+ 5.50	0.00	47.2
	36	3 55.9	+ 3 51.91	− 1.10	0.00	46.7
	37	10 8.4	− 2 20.36	− 1.10	0.00	46.9
	38	7 0.3	+ 0 42.33	+ 3.57	0.00	46.2
	39	14 28.0	− 6 42.95	+ 3.10	0.00	48.2
	40	4 15.7	+ 3 29.63	+ 2.00	0.00	47.3
	41	7 56.6	− 0 12.28	+ 2.75	0.00	47.1
	42	5 3.9	+ 2 39.81	+ 2.70	0.00	46.4
	43	14 10.4	− 6 26.54	+ 4.67	0.00	48.6
	44	15 10.8	− 7 28.64	+ 3.57	0.00	45.7
	45	18 28.8	− 10 47.46	+ 3.60	0.00	44.9
	46	13 9.0	− 5 26.68	+ 2.60	0.00	44.9
	47	25 45.9	− 18 0.87	+ 2.60	0.00	47.6
	48	13 33.1	− 5 52.29	+ 2.60	0.00	43.4
	49	13 5.8	− 5 25.00	+ 2.60	0.00	43.4
	50	8 37.0	− 0 52.77	+ 3.71	0.00	47.9
	52	12 5.8	− 4 22.94	+ 2.60	0.00	45.5
	53	15 4.4	− 7 23.20	+ 4.40	0.00	45.6
Oct. 8	5	40 56 49.9	+ 10 53.86	+ 2.88	0.00	41 7 46.6
	6	41 8 22.2	− 0 38.13	+ 3.60	0.00	47.7
	7	9 26.4	− 1 41.17	+ 1.78	0.00	47.0
	8	15 12.7	− 7 31.13	+ 2.47	0.00	44.0
	9	18 28.6	− 10 43.42	+ 3.71	0.00	48.9
	11	1 22.3	+ 6 23.06	+ 1.65	0.00	47.0
	12	9 13.0	− 1 32.62	+ 5.91	0.00	46.3
	13	40 57 51.3	+ 9 51.76	+ 6.20	0.00	49.3
	17	41 3 11.1	+ 4 31.83	+ 4.80	0.00	47.7
	20	12 30.7	− 4 49.67	+ 4.80	0.00	45.8
	23	15 41.6	− 7 56.92	+ 2.30	0.00	47.0
	26	14 1.2	− 6 16.38	+ 3.00	0.00	47.8
	30	22 36.3	− 14 56.04	+ 3.30	0.00	43.6
	31	22 31.6	− 14 47.90	+ 3.30	0.00	47.0
	33	17 34.5	− 9 54.25	+ 5.50	0.00	45.8
	34	17 46.9	− 10 4.35	+ 5.30	0.00	47.9
	36	3 56.5	+ 3 47.47	+ 5.30	0.00	49.3
	37	10 9.5	− 2 28.75	+ 5.20	0.00	46.0
	38	7 1.2	+ 0 39.16	+ 4.10	0.00	44.5
	39	14 29.1	− 6 41.55	+ 1.00	0.00	48.5
	40	4 16.9	+ 3 29.79	− 0.33	0.00	46.4
	41	7 57.8	− 0 16.63	+ 4.40	0.00	45.6
	42	5 5.1	+ 2 36.74	+ 4.40	0.00	46.2

(15.) Reduction of the Latitude-Observations—Continued.

Computations for Latitude of Cheyenne, Wyoming Territory.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1872.		° ′ ″	′ ″	″	″	° ′ ″
Oct. 8	43	41 14 11.5	− 6 30.15	+ 6.50	0.00	41 7 47.8
	44	14 42.0	− 7 59.49	+ 3.90	0.00	46.4
	45	18 30.0	− 10 46.53	+ 3.10	0.00	46.6
	46	13 10.2	− 5 25.56	+ 1.80	0.00	46.4
	48	13 34.4	− 5 49.96	+ 1.80	0.00	46.2
	49	13 7.1	− 5 23.10	+ 1.80	0.00	45.8
	51	8 38.2	− 0 52.52	+ 2.00	0.00	47.7
	52	12 7.0	− 4 21.69	− 1.37	0.00	43.9
	53	15 5.2	− 7 21.71	+ 4.10	+ 0.10	47.7
	54	4 13.3	+ 3 33.05	+ 0.55	0.00	46.9
	55	17 7.6	− 9 23.48	+ 4.10	0.00	48.2
	58	57 11.3	+ 10 34.96	+ 1.50	0.00	47.8
	59	20 5.7	− 12 25.08	+ 5.20	0.00	45.8
	60	13 17.8	− 5 30.22	+ 2.20	0.00	49.8
	61	7 50.3	− 0 4.75	+ 1.50	0.00	47.1
Oct. 9	4	41 5 33.3	+ 2 15.20	− 0.90	0.00	41 7 47.6
	5	40 56 49.9	+ 10 51.53	+ 2.10	0.00	43.5
	6	41 8 22.2	− 0 40.62	+ 5.50	0.00	47.1
	8	15 12.8	− 7 30.19	+ 1.10	0.00	43.7
	9	18 28.7	− 10 44.44	+ 2.90	0.00	47.2
	11	1 22.4	+ 6 24.71	+ 2.10	0.00	49.2
	14	25 58.0	− 18 14.33	+ 2.80	0.00	46.5
	15	2 1.3	+ 5 43.50	+ 5.50	0.00	50.3
	16	1 55.2	+ 5 43.18	+ 5.50	0.00	43.9
	19	3 7.2	+ 4 34.75	+ 5.50	0.00	47.5
	26	14 1.4	− 6 16.94	+ 5.50	0.00	50.0
	32	22 16.1	− 14 31.79	+ 2.60	0.00	46.9
	33	17 34.7	− 9 52.85	+ 2.60	0.00	44.5
	34	17 47.1	− 10 2.33	+ 2.60	0.00	47.4
	36	3 56.8	+ 3 43.46	+ 4.10	0.00	44.4
	37	10 9.7	− 2 24.21	+ 4.10	0.00	49.6
	38	7 1.4	+ 0 40.71	+ 6.30	0.00	48.4
	39	14 29.3	− 6 48.70	+ 2.80	0.00	43.4
	41	4 17.0	+ 3 28.55	+ 2.80	0.00	48.4
	42	7 58.1	− 0 13.36	+ 0.10	0.00	44.9
	43	5 5.3	+ 2 39.75	+ 0.10	0.00	45.2
	44	14 11.8	− 6 29.74	+ 3.30	0.00	45.4
	44	15 12.2	− 7 29.35	+ 5.50	+ 0.10	48.3
	45	18 30.2	− 10 51.90	+ 5.50	0.00	43.8
	46	13 10.4	− 5 30.07	+ 5.30	0.00	45.6
	48	13 34.7	− 5 51.48	+ 5.30	0.00	48.5
	49	13 7.4	− 5 25.10	+ 5.30	0.00	47.6

(15.) Reduction of the Latitude-Observations—Continued.

Computations for Latitude of Cheyenne, Wyoming Territory.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1872.		° ′ ″	′ ″	″	″	° ′ ″
Oct. 9	51	41 8 38.5	− 0 55.29	+ 4.67	0.00	41 7 47.9
	52	12 7.3	− 4 26.82	+ 7.60	0.00	48.1
	54	4 13.4	+ 3 31.03	+ 2.75	0.00	47.2
	55	14 59.5	− 7 15.71	+ 1.80	0.00	45.6
	56	17 7.8	− 9 24.88	+ 1.79	0.00	44.7
	57	13 17.4	− 5 34.89	+ 1.00	0.00	43.5
	60	20 10.1	− 12 24.21	+ 0.70	0.00	46.6
	59	13 18.0	− 5 32.40	+ 0.70	0.00	46.3
Oct. 10	1	40 55 42.9	+ 12 1.99	+ 3.30	0.00	41 7 48.2
	4	41 5 33.2	+ 2 10.54	+ 2.47	0.00	46.2
	5	40 56 49.9	+ 10 52.37	+ 4.10	0.00	46.4
	6	41 8 22.2	− 0 39.47	+ 4.10	0.00	46.8
	7	9 26.4	− 1 44.80	+ 4.10	0.00	45.7
	8	15 12.8	− 7 28.65	+ 2.60	0.00	46.8
	9	18 28.8	− 10 46.93	+ 2.60	0.00	44.5
	11	1 22.5	+ 6 19.80	+ 3.40	0.00	45.7
	12	9 13.2	− 1 28.67	+ 2.86	0.00	47.4
	13	40 57 51.5	+ 9 51.92	+ 2.90	0.00	46.3
	15	41 2 1.4	+ 5 41.22	+ 3.40	0.00	46.0
	16	1 57.3	+ 5 45.94	+ 3.40	0.00	46.6
	17	3 11.3	+ 4 31.39	+ 3.40	0.00	46.1
	25	16 29.6	− 8 49.60	+ 5.10	0.00	45.1
	26	14 1.5	− 6 18.55	+ 4.40	0.00	47.3
	33	17 47.2	− 10 4.19	+ 5.50	0.00	48.5
	34	17 34.8	− 9 54.40	+ 5.50	0.00	45.9
	36	3 57.5	+ 3 47.51	+ 1.80	0.00	46.8
	37	10 9.8	− 2 25.14	+ 1.78	0.00	46.4
	38	7 1.6	+ 0 39.16	+ 4.40	0.00	45.2
	39	14 29.5	− 6 45.53	+ 1.50	0.00	45.5
	40	4 17.2	+ 3 25.13	+ 4.90	0.00	47.2
	43	14 12.0	− 6 30.12	+ 5.30	0.00	47.2
	44	15 12.4	− 7 30.50	+ 4.30	0.00	46.2
	45	18 30.4	− 10 49.42	+ 4.30	0.00	45.3
	46	13 10.7	− 5 26.34	+ 3.20	0.00	47.6
	48	13 34.9	− 5 50.40	+ 3.20	0.00	47.7
	49	13 7.6	− 5 24.01	+ 3.20	0.00	46.8
	50	8 38.7	− 0 53.61	+ 1.38	0.00	46.5
	52	12 7.5	− 4 28.22	+ 4.20	0.00	43.5
	53	15 5.5	− 7 24.41	+ 5.94	0.00	47.0
	54	4 13.4	+ 3 28.86	+ 2.75	0.00	45.0
	55	14 59.7	− 7 16.02	+ 2.33	0.00	46.0
	56	17 8.0	− 9 23.95	+ 2.30	0.00	46.4

(15.) Reduction of the Latitude-Observations—Continued.

Computations for Latitude of Cheyenne, Wyoming Territory.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1872.		° ′ ″	′ ″	″	″	° ′ ″
Oct. 10	57	41 13 17.6	− 5 33.33	+ 1.65	0.00	41 7 45.9
	58	40 57 11.5	+ 10 33.88	+ 1.30	0.00	46.7
	60	41 20 10.5	− 12 24.74	+ 0.60	0.00	46.4
	59	13 18.2	− 5 31.31	+ 0.55	0.00	47.4
Oct. 11	1	41 4 12.1	+ 3 29.01	+ 5.50	0.00	41 7 46.6
	2	40 55 42.9	+ 11 58.41	+ 5.50	0.00	46.8
	3	41 5 0.0	+ 2 41.71	+ 5.08	0.00	46.8
	5	40 56 50.0	+ 11 1.38	− 2.75	0.00	48.6
	6	41 8 22.3	− 0 32.54	− 2.70	0.00	47.1
	7	9 26.4	− 1 38.71	− 2.33	0.00	45.4
	8	15 12.9	− 7 23.82	− 3.74	0.00	45.3
	9	18 28.9	− 10 38.54	− 3.20	0.00	47.2
	10	40 57 30.0	+ 10 22.34	− 4.40	0.00	48.0
	11	41 1 22.5	+ 6 25.08	− 1.65	0.00	45.9
	12	9 13.3	− 1 23.76	− 2.90	0.00	46.6
	13	40 57 51.6	+ 9 57.30	− 2.88	0.00	46.0
	14	41 25 58.2	− 18 11.06	− 1.23	0.00	45.9
	15	2 1.5	+ 5 50.74	− 3.40	0.00	48.8
	16	1 57.4	+ 5 52.14	− 3.40	0.00	46.1
	18	3 11.4	+ 4 36.26	− 3.40	0.00	44.3
	24	3 6.8	+ 4 42.39	− 2.40	0.00	46.8
	26	14 1.7	− 6 9.42	− 3.80	0.00	48.5
	31	22 37.7	− 14 48.05	− 3.98	0.00	45.7
	36	10 10.0	− 2 21.66	− 2.60	0.00	45.7
	38	7 1.7	+ 0 46.09	− 2.75	0.00	45.0
	39	14 29.8	− 6 37.42	− 4.80	0.00	47.6
	40	4 17.4	+ 3 33.61	− 3.70	0.00	47.5
	41	7 58.6	− 0 11.10	− 2.00	0.00	45.5
	42	5 5.8	+ 2 42.02	− 2.00	0.00	45.8
	43	14 12.3	− 6 23.37	− 4.40	0.00	44.5
	44	15 12.7	− 7 19.78	− 5.50	0.00	47.4
	45	18 30.7	− 10 38.69	− 5.50	0.00	46.5
	46	13 10.9	− 5 19.19	− 4.67	0.00	47.0
	48	13 35.2	− 5 43.00	− 4.60	0.00	47.6
	49	13 7.9	− 5 16.70	− 4.60	0.00	46.6
	51	9 39.0	− 0 50.97	− 2.00	0.00	46.0
	52	12 7.7	− 4 20.67	− 2.33	0.00	44.7
	53	15 5.8	− 7 17.20	− 2.33	0.00	46.3
	54	4 13.4	+ 3 38.49	− 5.08	0.00	46.8
	55	15 0.0	− 7 6.42	− 3.85	0.00	49.7
	56	17 8.2	− 9 14.47	− 3.80	0.00	49.9
	57	13 17.8	− 5 23.24	− 6.60	0.00	48.0

(15.) Reduction of the Latitude-Observations—Continued.

Computations for Latitude of Cheyenne, Wyoming Territory.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1872.		° ′ ″	′ ″	″	″	° ′ ″
Oct. 11	58	40 57 11.7	+ 10 35.90	− 2.90	0.00	41 7 44.7
	60	41 20 10.5	− 12 19.39	− 4.53	0.00	46.6
	59	13 18.4	− 5 26.77	− 4.50	0.00	47.1
Oct. 12	2	40 55 42.9	+ 12 7.43	− 0.90	0.00	41 7 49.4
	3	41 5 0.1	+ 2 48.76	− 2.75	0.00	46.1
	4	5 33.3	+ 2 16.75	− 2.70	0.00	47.3
	5	40 56 50.0	+ 11 2.69	− 5.00	0.00	47.7
	6	41 8 22.3	− 0 31.86	− 4.40	0.00	46.0
	7	9 26.4	− 1 35.88	− 3.30	0.00	47.2
	8	15 13.0	− 7 22.73	− 3.30	0.00	47.0
	9	18 28.9	− 10 39.69	− 1.23	0.00	48.0
	10	40 57 30.0	+ 10 19.05	− 2.20	+ 0.10	47.0
	11	41 1 22.6	+ 6 29.43	− 5.40	0.00	46.6
	12	9 13.4	− 1 23.92	− 2.20	0.00	47.3
	13	40 57 51.7	+ 9 55.49	− 2.00	0.00	45.2
	14	41 25 58.3	− 18 8.17	− 2.47	0.00	47.6
	15	2 1.6	+ 5 48.34	− 3.30	0.00	46.6
	16	1 57.5	+ 5 54.00	− 3.30	0.00	48.2
	17	16 58.9	− 9 11.20	− 3.30	0.00	44.4
	19	3 7.4	+ 4 42.58	− 3.30	0.00	46.7
	24	3 6.9	+ 4 41.96	− 3.80	0.00	45.1
	26	14 1.8	− 6 10.94	− 4.40	0.00	46.5
	28	12 14.9	− 4 24.02	− 3.30	0.00	47.6
	30	22 33.2	− 14 44.97	− 0.10	0.00	48.1
	31	22 37.9	− 14 49.91	− 0.10	0.00	47.9
	32	22 16.6	− 14 28.39	− 1.90	0.00	46.3
	33	17 47.6	− 9 58.35	− 2.00	0.00	47.2
	34	17 35.2	− 9 47.47	− 2.00	0.00	45.7
	36	3 57.8	+ 3 52.79	− 2.20	0.00	48.4
	37	10 10.2	− 2 20.79	− 2.20	0.00	47.2
	38	7 2.0	+ 0 44.75	− 2.47	0.00	44.3
	39	14 29.9	− 6 39.38	− 1.50	0.00	49.0
	40	4 17.6	+ 3 32.59	− 2.20	0.00	48.0
	41	7 58.8	− 0 11.41	− 2.10	0.00	45.3
	42	5 6.0	+ 2 42.55	− 2.10	0.00	46.5
	43	14 12.5	− 6 24.30	− 1.90	0.00	46.3
	44	15 12.9	− 7 24.75	− 1.70	0.00	46.4
	45	18 30.9	− 10 42.89	− 1.70	0.00	46.3
	50	9 39.2	− 0 47.96	− 3.57	0.00	47.7
	52	12 7.9	− 4 16.72	− 2.75	0.00	48.4
	53	15 6.0	− 7 17.45	− 1.54	0.00	47.0
	54	4 13.4	+ 3 35.54	− 3.57	0.00	45.4
	55	15 0.2	− 7 7.77	− 5.80	0.00	45.6
	56	17 8.4	− 9 15.73	− 5.77	0.00	46.9
	57	13 18.0	− 5 28.98	− 3.30	0.00	45.7
	58	40 57 11.8	+ 10 34.96	+ 1.10	0.00	47.9
	60	41 20 10.8	− 12 20.33	− 3.85	0.00	46.6

(15.) Observations for Latitude, Cheyenne, Wyoming Territory.

Recapitulation.

					°	′	″
For October	1,	1872,	26 pairs	give	41	7	46.377
"	3,		35	"			46.277
"	8,		38	"			47.105
"	9,		35	"			46.531
"	10,		38	"			46.371
"	11,		41	"			46.656
"	12,		44	"			46.902
				Latitude, north,	41	7	46.62

Giving the first series half-weight on account of the smaller number of the observations and the less favorable condition of that night's work, the resulting latitude, and the one adopted for this station, is, 41° 7′ 46″.62, with a probable error of ±0″.08. The latitudes were originally computed by Professor William A. Rogers, of Cambridge, Mass., and revised by Dr. F. Kampf.

(16.) Resulting Astronomical Co-ordinates.

Taking the longitude of the Salt Lake observatory to be $2^h\ 19^m\ 22^s.74$ west of Washington by determination of the United States Coast Survey, and Washington to be $5^h\ 8^m\ 12^s.12$ west of Greenwich according to the report of Rear-Admiral B. F. Sands, Superintendent of the United States Naval Observatory, October 6, 1871, Cheyenne is in longitude west from Washington, in time, $1^h\ 51^m\ 3^s.30$; in arc, 27° 45′ 49″.50; in longitude west from Greenwich, in time, $6^h\ 59^m\ 15^s.42$; in arc, 104° 48′ 51″.30; in latitude, north, 41° 7′ 46″.62±0″.08.

This final result for longitude is subject, as already stated, to a correction for the personal equation of the observers. It is possible, also, that the longitude of Salt Lake may be changed when the observations made last October at Detroit and Ogden by the United States Lake Survey and your expedition respectively are computed. In such an event, of course the longitude of Cheyenne will be correspondingly affected.

Respectfully, yours,

JOHN H. CLARK.

Lieut. Geo. M. Wheeler,
Corps of Engineers, in charge.

REPORT

ON

ASTRONOMICAL OPERATIONS,

CONDUCTED DURING

THE FIELD-SEASON OF 1873,

AT

THE MAIN OR PRIMARY FIELD-STATION, COLORADO SPRINGS, COLORADO TERRITORY,

AND

DEDUCTION OF RESULTS.

BY

Dr. F. KAMPF,

CIVILIAN ASTRONOMICAL ASSISTANT.

U. S. Engineer Office, Geographical and Geological
Explorations and Surveys West of 100th Meridian,
Washington, D. C., January 1, 1874.

Sir: There is presented herewith a report upon the astronomical observations taken by myself, and the party under my charge, at Colorado Springs, Colorado Territory, during the field-season of 1873.

Geographical Position of Station.

Longitude = 104° 49′ 15″.10.
Latitude = 38° 49′ 41″.67.

Colorado Springs is a town in El Paso County, Colorado Territory. It has been built up within five years, and has nearly fifteen hundred inhabitants, and the place promises to become one of considerable importance. During the summer-months the hotels (of which there are quite a large number) are filled with invalids, who flock here on account of the beautiful scenery and the salubrity of the climate. The track of the Denver and Rio Grande Railway passes around the town at a distance from the town-limits of about four thousand feet.

The astronomical point is situated between the town and the railroad, about six hundred and fifty feet distant from the latter, on a slight eminence near the freight-depot of the Denver and Rio Grande Railroad. The observations were conducted on a pier built of bricks, which was replaced two months later by a solid sandstone monument, furnished by Mr. S. G. Ward, of Pueblo.

Physical-Geography Details.

This part of Colorado is not well watered, but the land where irrigated yields almost in every instance splendid harvests.

From the astronomical point there is a clear outlook to the north, south, and east. Looking west, prominent peaks and foot-hills of the Rocky Mountain range are seen running north and south; Pike's Peak, immediately west, being the highest, and Cheyenne Mountain the highest in the south-southwest. At the foot of Cheyenne Mountain there is a creek, the waters of which are brought, by means of ditches, to Colorado Springs. From the station the plains rise a little to the east, at the horizon say one hundred and fifty feet. In the southeast there is a hill about four hundred feet high, called Washington Mountain.

Colorado Springs is laid out regularly, the streets running east and west and north and south; the greatest extension is from north to south.

Generally speaking, it is inadvisable to have the astronomical station near the railroad-track; but in this case the trains ran only during the day, and the observations were never affected by the vibrations of the ground.

Meteorological Conditions.

The meteorological observations made at the station show great changes in temperature during the day. I have been told by several old residents that they never experienced a summer similar to that of 1873. The rainy period of the summer is looked for about the 1st of July, to last only a few days. This year it was noted that from July 28th to August 9th there was no day without rain, accompanied by thunder and lightning. The prevailing winds were from the northeast or southeast, commencing at 10 or 11 o'clock a. m., and increasing in force until 2 or 3 o'clock p. m. Then clouds came up from the southwest or west, bringing much rain, thunder, and lightning. It was generally clear again by 12 p. m.; but I found the air so very undulating, and the stars on that account so faint, that I was sometimes obliged to suspend the observations. It is probable that the temperature of the higher regions of the air was affected by the vicinity of the mountains, and after a rain changed very rapidly, while the lower strata remained under the same conditions.

The following table shows the general direction of the wind at 7 a. m., 2 p. m., and 9 p. m., giving the mean or prevailing direction of the wind for three hours before and three hours after the given time; also the estimated force of wind for the same time. The last column gives the general appearance of the sky, and needs no further explanation. It shows under what particularly unfavorable circumstances the observations were made:

Date.	Direction of wind.			Estimated force.			Remarks.
	7 a.m.	2 p.m.	9 p.m.	7 a.m.	2 p.m.	9 p.m.	
1873.							
July 28	.	S.	NE.	.	2	1	Cloudy during the day; clear after 12 p. m.
29	0	E.	SE.	0	2	2	Clear; heavy dew in the night.
30	N.	SW.	NW.	1	3	2	Heavy wind and rain in the afternoon.
31	N.	SE.	N.	1	1	1	Rain from the west at 3 p. m.
August 1	N.	NE.	NW.	2	4	3	Heavy shower in the afternoon; storm from northeast at 9 p. m.
2	0	NE.	S.	0	5	3	Heavy rain, with thunder and lightning, at 3 p. m.
3	S.	NE.	SE.	2	3	2	Cloudy all day.
4	0	SE.	N.	0	3	1	Cloudy all day; rain in the afternoon.
5	0	SE.	NW.	0	2	1	Clear in the morning, cloudy in the afternoon.
6	NW.	NW.	S.	1	2	1	Cloudy all day; rain in the afternoon.
7	0	SE.	NW.	0	2	1	Cloudy all day; storming from the northwest at 12 m.
8	N.	N.	SE.	1	4	4	Cloudy all day.
9	NW.	SE.	SE.	1	2	1	Cloudy all day; rain at 9.13 p. m.
10	NE.	.	.	1	.	.	Clear.

Description of Observatory at Colorado Springs, Colorado Territory.

As soon as the monument was built, a solid framework, 8 by 10 feet, was constructed, and a large wall-tent put over it. There was an opening in the tent for the meridian-line; this was closed, when necessary, by a fly. During heavy winds the

tent was in danger of being blown away, and it was found necessary to nail the fly to the framework, while the tent itself was fastened to the stakes by strong iron wires. The entrance to the tent was from the west side, and was closed by ropes. In the northwest corner of the observatory a large box was used for a table. On it the switch-board and galvanic battery were placed; the chronometer being also placed there during the observations. The connection from the switch-board to the Western Union Telegraph office was made by a line 600 feet in length, supported by the framework of the tent and one telegraph-post 30 feet in height. A ground-wire was used after switching in the Western Union office to complete the circuit. In the northeast corner of the tent the chronograph was placed upon a solid and insulated framework. Wires for the connection of the chronometer and breaking-key were fastened to the tent-frame. The levels were also set on an insulated post in the southeast corner of the tent. For chairs I used two small boxes, one on the north and the other on the south side of the monument. In arranging and constructing the observing-tent I was assisted by C. D. Gedney and Privates J. Meier and J. Clancy, Battalion of Engineers. They also took the meteorological observations. Mr. G. T. Ellison, at that time in charge of the Western Union office, kindly assisted in sending the telegraphic signals.

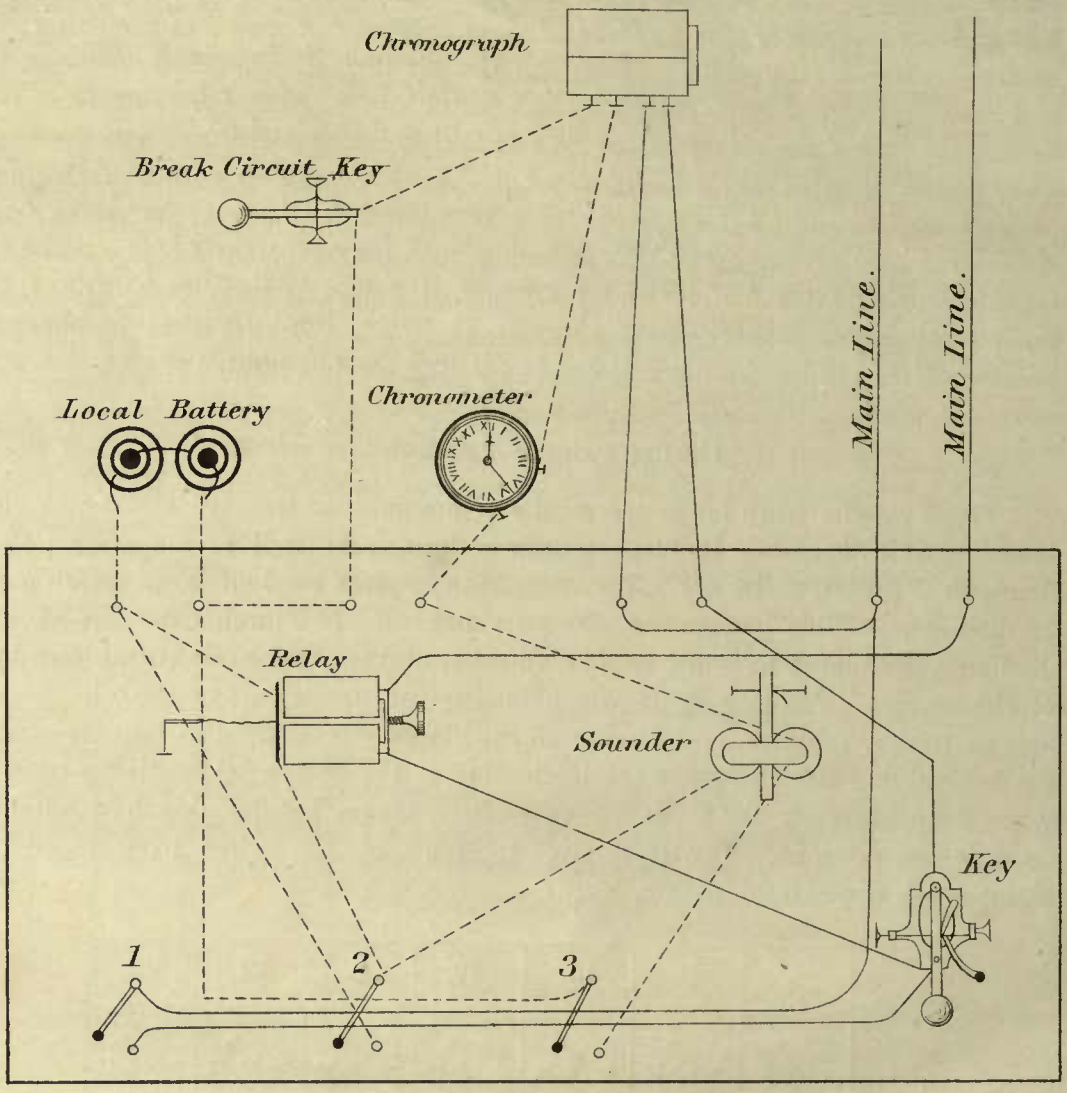
Description of Instruments Used.

Observations were made by means of a combined transit-instrument number 28, made by Würdemann. Its focal length is three feet; radius of aperture, $2\frac{3}{4}$ inches; diameter of pivots, $1\frac{1}{4}$ inches. The diagonal eye-piece used had a magnifying-power of 40 diameters. This instrument was provided with two finding-circles, $3\frac{1}{2}$ inches in diameter, graduated to every twenty minutes, and reading to single minutes by means of the vernier. Another circle was affixed to the upper part of the tube, divided also also to twenty minutes, and having in the center a level used in latitude-observations for determining the change in the inclination of the horizontal revolving-base. Seven wires were placed in the focus for time-observations, besides one horizontal wire for latitude-observations. The equatorial intervals of the wires from mean of wires, clamp west, upper culmination, were:

I.	II.	III.	IV.	V.	VI.	VII.
s.	s.	s.	s.	s.	s.	s.
+ 16.86	+ 12.75	+ 4.59	+ 0.17	− 4.24	− 12.77	− 17.35

One revolution of the micrometer-screw moved the horizontal-wire 62″.12; the the value of one division of the striding-level, which was used at every station, was 0″.75; the value of one division of the zenith-telescope level was 1″.10. The chronograph used was similar to that used at the United States Naval Observatory invented by Professor William Harkness; the barrel being 8 inches in diameter and 24 inches long, and makes one revolution a minute. The chronograph worked very well when it was cleaned before commencing operations at a new station. It had but a single pen, which recorded clock-signals and those made by the observer.

For time-observations and exchange, sidereal chronometer No. 1491, Negus, was always used. The galvanic connections were made by means of a switch-board, the connections of which are given in the following diagram:



SWITCH 1.—Closed when receiving from connected station; Nos. 2 and 3 open.
SWITCH 2.—Closed when sending to connected station; Nos. 1 and 3 open.
SWITCH 3.—Local; throws sounder into local circuit.

Points with which Connections were Made, &c.

Connection was made with Salt Lake City on the nights of July 29th and 30th, and August 2d, 5th, and 6th. Observations for time were made at Colorado Springs on the nights of July 28th, 29th, 30th, and 31st, and August 2d, 4th, 5th, and 6th; at Salt Lake on the nights of July 28th, 29th, 30th, and 31st, and August 1st, 2d, 5th, and 6th.

The reductions of time-observations for Colorado Springs were made in the field by the astronomer, and also those made at Salt Lake after returning from the field. He also made a new reading of the signals sent and received from both stations.

The telegraph-line between Colorado Springs and Salt Lake is 763 miles long, and divided into four circuits. The signals are transmitted from one circuit to another by means of automatic repeaters: one placed at Denver, Colorado Territory; one at Cheyenne, Wyoming Territory; and one at Corinne, Utah: the length of the line being from Colorado Springs to Denver, 75 miles; from Denver to Cheyenne, 106 miles; from Cheyenne to Corinne, 537 miles; and from Corinne to Salt Lake, 45 miles; using at every station sixty-five Grove cells.

The use of the wires was always freely tendered by the Western Union Telegraph Company, although in many cases they were needed at the same time for the transaction of the regular business of the company.

It sometimes occurs when two lines of wires are fixed to the same poles that, during heavy storms, the wires are brought in contact by oscillation, which was overcome in this case by connecting the two wires at an intermediate station, Denver, Colorado, upon the suggestion of Mr. Woodward, the superintendent at that point.

Tabulation of Stars used for Determination of Time at Colorado Springs, Colorado, and Salt Lake City, Utah.

Name of star.	Mean Right Ascension, 1873.0.	Declination.	Colorado Springs.								Salt Lake City.							
			July—				August—				July—				August—			
			28	29	30	31	2	4	5	6	28	29	30	31	1	2	5	6
	h. m. s.	° ′																
ζ Ursæ Minoris	15 48 38.49	+ 78 11.0				*												
ε Coronæ	52 19.90	+ 27 14.8				*	*											
β^1 Scorpii	58 3.26	− 19 27.3				*	*		*									
Groombridge 2320	16 5 58.86	+ 68 8.7				*												
δ Ophiuchi	7 41.48	− 3 21.9				*	*		*		*				*			
τ Herculis	15 55.32	+ 46 37.0				*	*		*		*		*	*	*			
η Draconis	22 16.58	+ 61 48.1					*				*		*	*	*			*
A Draconis	28 14.52	+ 69 2.6				*	*		*									
ζ Ophiuchi	30 10.03	− 10 18.4							*		*		*	*	*		*	*
η Herculis	38 32.55	+ 39 9.9					*		*		*		*	*	*		*	*
Groombridge 2376	43 15.97	+ 42 28.0									*		*	*	*		*	*
κ Ophiuchi	51 39.41	+ 9 34.5	*				*		*		*		*	*	*		*	*
d Herculis	56 54.91	+ 33 45.2									*		*	*	*		*	*
ε Ursæ Minoris	59 3.66	+ 82 14.5	*			*	*		*									
a^1 Herculis	17 8 51.41	+ 14 32.2	*			*	*		*		*		*		*		*	*
44 Ophiuchi	18 36.92	− 24 3.3				*	*											
Groombridge 966, L. C.	22 45.42	+ 74 57.0									*		*		*		*	*
ζ Draconis	27 33.78	+ 52 23.8	*			*												
α Ophiuchi	29 2.35	+ 12 39.3				*											*	*
ω Draconis	37 41.83	+ 68 49.0															*	
μ Herculis	41 29.32	+ 27 47.8	*														*	
72 Ophiuchi	18 1 19.72	+ 9 33.0																*
ρ^1 Sagittarii	6 10.10	− 21 5.4																*
γ Serpentis	14 44.25	− 2 55.8																*
Br. 2313	21 57.51	− 14 39.0														*	*	*
ι Aquilæ	28 17.70	− 8 19.8		*												*		*
α Lyræ	32 38.31	+ 38 40.0		*												*	*	
ζ^1 Lyræ	40 23.95	+ 37 28.0											*			*	*	*
ζ^2 Lyræ	40 25.83	+ 37 28.0											*			*	*	*
β Lyræ	45 23.45	+ 33 13.0		*									*			*		*
σ Sagittarii	47 23.39	− 26 27.1		*		*												
50 Draconis	50 27.42	+ 75 17.0		*									*			*	*	*
ζ Aquilæ	59 34.30	+ 13 40.6		*		*						*	*				*	*
π Sagittarii	19 2 12.61	− 21 14.0														*		*
d Sagittarii	10 12.18	− 19 10.5				*		*				*	*				*	
δ Draconis	12 31.21	+ 67 26.3		*		*		*					*			*	*	
τ Draconis	17 58.93	+ 73 7.1		*	*	*		*					*				*	
δ Aquilæ	19 5.63	+ 2 51.8														*		
α Vulpeculæ	23 25.35	+ 24 23.0														*	*	
μ Aquilæ	27 52.95	+ 7 5.0														*	*	
κ Aquilæ	30 3.46	− 7 18.4		*	*							*	*			*	*	
θ Cygni	33 2.08	+ 49 56.0														*	*	
γ Aquilæ	40 13.29	+ 10 18.3		*	*	*		*		*		*						
α Aquilæ	44 35.17	+ 8 32.1			*	*		*		*		*						
ε Draconis	48 35.44	+ 69 56.6				*		*										
τ Aquilæ	57 56.13	+ 6 55.3						*		*								
κ Cephci	20 13 7.43	+ 77 19.7				*												
π Capricorni	20 2.98	− 18 37.6				*												
ε Delphini	27 8.69	+ 10 52.4				*				*								
Groombridge 3241	30 32.31	+ 72 6.1				*				*								
α Cygni	37 6.15	+ 44 49.6								*								
μ Aquarii	45 48.10	− 9 27.5								*								
61 Cygni	21 1 12.36	+ 38 7.6								*								
ζ Cygni	7 31.88	+ 29 42.4								*								
α Cephei	15 32.83	+ 62 2.9								*								

COLORADO SPRINGS, COLORADO TERRITORY, *July* 28, 1873.

Name of Star.	Clamp.	T.	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
κ Ophiuchi . .	W.	17 1 50.23	− 0.05	+ 0.54	+ 0.60	17 1 51.32	16 51 41.23	−10 10.09
ε Ursæ Minoris .	.	9 20.45	− 0.48	− 5.69	+ 4.37	9 18.65	59 8.70	9.95
a^1 Herculis. . .	.	19 2.47	− 0.11	+ 0.47	+ 0.61	19 3.44	17 8 53.30	10.14
β Draconis . .	.	37 45.68	− 0.11	− 0.42	+ 0.97	37 46.12	27 35.92	10.20
μ Herculis. . .	E.	51 41.99	− 0.04	+ 0.24	− 0.67	51 41.52	41 31.30	10.22
Mean for $17^h\ 26^m$ local sidereal time								−10 10.120

Normal Equations.

$$0 = -0.42 + 5.00\,\delta t - 4.36\,a - 9.98\,c$$
$$0 = -7.12 - 4.36\,\delta t + 26.72\,a + 37.79\,c \qquad a = +1^s.115$$
$$0 = -6.06 - 9.98\,\delta t + 37.79\,a + 61.00\,c \qquad c = -0^s.590$$

COLORADO SPRINGS, COLORADO TERRITORY, *July* 29, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
1 Aquilæ . . .	W.	18 38 31.00	+ 0.01	+ 0.87	− 0.04	18 38 31.84	18 28 20.00	−10 11.84
a Lyræ. . . .	.	42 52.09	− 0.03	0.00	− 0.05	42 52.01	32 40.48	11.53
β Lyræ. . . .	.	55 37.27	− 0.05	+ 0.12	− 0.04	55 37.30	45 25.61	11.69
σ Sagittarii . .	.	57 36.68	− 0.02	+ 1.18	− 0.04	57 37.80	47 26.06	11.74
50 Draconis . .	.	19 0 46.14	− 0.19	− 2.74	− 0.14	19 0 43.07	50 31.28	11.79
ζ Aquilæ . . .	E.	9 47.83	− 0.12	+ 0.51	+ 0.04	9 48.26	59 36.49	11.77
δ Draconis . .	.	22 47.70	− 0.32	− 1.46	+ 0.09	22 46.01	19 12 34.24	11.77
τ Draconis . .	.	28 16.86	− 0.51	− 2.27	+ 0.12	28 14.20	18 2.52	11.68
κ Aquilæ . . .	.	40 16.97	− 0.13	+ 0.84	+ 0.04	40 17.72	30 5.88	11.84
γ Aquilæ . . .	.	50 26.80	− 0.16	+ 0.57	+ 0.04	50 27.25	40 15.56	11.69
Mean, excluding a Lyræ, for $19^h\ 4^m$ local sidereal time								−10 11.76 ± 0s.014

Normal Equations.

$$0 = +2.70 + 10.00\,\delta t - 2.03\,a + 0.57\,c$$
$$0 = -15.73 - 2.03\,\delta t + 13.33\,a - 1.03\,c \qquad a = +1^s.170$$
$$0 = -0.31 + 0.57\,\delta t - 1.03\,a + 42.74\,c \qquad c = +0^s.036$$

COLORADO SPRINGS, COLORADO TERRITORY, *July* 30, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
τ Draconis . .	E.	19 28 14.82	0.00	+ 0.41	− 0.14	19 28 15.09	19 18 2.48	−10 12.61
κ Aquilæ . . .	.	40 18.63	− 0.01	− 0.15	− 0.04	40 18.43	30 5.88	12.55
γ Aquilæ . . .	.	50 28.19	− 0.03	− 0.10	− 0.04	50 28.02	40 15.56	12.46
α Aquilæ . . .	.	54 50.05	− 0.02	− 0.11	− 0.04	54 49.88	44 37.48	12.40
τ Aquilæ . . .	W.	20 8 10.93	+ 0.09	− 0.12	+ 0.04	20 8 10.94	57 58.44	12.50
κ Cephei . . .	.	23 23.07	+ 0.50	+ 0.60	+ 0.18	23 24.35	20 13 11.85	12.50
π Capricorni . .	.	30 18.38	+ 0.09	− 0.19	+ 0.04	30 18.32	20 5.63	12.69
ε Delphini . .	.	37 23.53	+ 0.14	− 0.10	+ 0.04	37 23.61	27 10.98	12.63
Groom. 3241 .	.	40 47.38	+ 0.44	+ 0.38	+ 0.13	40 48.33	30 35.80	12.53
Mean for $20^h\ 0^m$ local sidereal time								−10 12.540 ± 0ˢ.020

Normal Equations.

$$0 = -1.32 + 9.00\,\delta t - 2.93\,a - 4.39\,c$$
$$0 = +4.34 - 2.93\,\delta t + 17.33\,a + 11.83\,c \qquad a = -0^s.213$$
$$0 = +4.77 - 4.39\,\delta t + 11.83\,a + 49.51\,c \qquad c = -0^s.040$$

COLORADO SPRINGS, COLORADO TERRITORY, *July* 31, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ζ Ursæ Minoris .	W.	15 59 1.30	− 0.83	− 6.50	+ 0.31	15 58 54.28	15 48 40.97	−10 13.31
ε Coronæ . . .	.	16 2 34.39	− 0.24	+ 0.48	+ 0.07	16 2 34.70	52 21.55	13.15
β^1 Scorpii . . .	.	8 16.76	− 0.12	+ 1.93	+ 0.07	8 18.64	58 4.95	13.69
Groom. 2320 .	.	16 17.56	− 0.51	− 2.74	+ 0.17	16 14.48	16 6 0.86	13.62
δ Ophiuchi . .	.	17 55.21	− 0.16	+ 1.40	+ 0.06	17 56.51	7 43.12	13.39
τ Herculis. . .	.	26 11.26	− 0.31	− 0.42	+ 0.09	26 10.62	15 57.00	13.62
A Draconis . .	E.	38 33.69	− 0.51	− 2.95	− 0.18	38 30.05	28 16.74	13.31
ε Ursæ Minoris .	.	17 9 33.81	− 1.02	−10.67	− 0.47	17 9 21.65	59 8.25	13.40
α^1 Herculis. . .	.	19 6.30	− 0.29	+ 0.88	− 0.07	19 6.82	17 8 53.27	13.55
44 Ophiuchi . .	.	28 51.09	− 0.14	+ 2.05	− 0.07	28 52.93	18 39.14	13.79
β Draconis . .	.	37 50.74	− 0.45	− 0.80	− 0.10	37 49.39	27 35.86	13.53
α Ophiuchi . .	.	39 17.32	− 0.23	+ 0.94	− 0.06	39 17.97	29 4.30	13.67
Mean, excluding ε Coronæ, for $16^h\ 39^m$ local sidereal time								−10 13.53 ± 0ˢ.03

Normal Equations.

$$0 = -0.23 + 12.00\,\delta t - 7.82\,a' + 2.79\,c$$
$$0 = -3.15 - 7.82\,\delta t + 42.10\,a' - 23.31\,c \qquad a' = +0^s.095$$
$$0 = +8.66 + 2.79\,\delta t - 23.31\,a' + 105.31\,c \qquad c = -0^s.063$$

Adopted azimuth, + 2ˢ.co; azimuth of the instrument, + 2ˢ.095.

COLORADO SPRINGS, COLORADO TERRITORY, *July* 31, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
σ Sagittarii . .	E.	18 57 37.84	− 0.11	+ 1.96	− 0.07	18 57 39.62	18 47 26.06	−10 13.56
ζ Aquilæ . .	.	19 9 49.73	− 0.20	+ 0.86	− 0.07	19 9 50.32	59 36.48	13.84
d Sagittarii . .	.	20 27.04	− 0.12	+ 1.75	− 0.07	20 28.60	19 10 14.75	13.85
δ Draconis . .	.	22 50.87	− 0.48	− 2.43	− 0.17	22 47.79	12 34.19	13.60
τ Draconis . .	W.	28 20.22	− 0.46	− 3.79	+ 0.22	28 16.19	18 2.45	13.74
γ Aquilæ . .	.	50 28.22	− 0.09	+ 0.95	+ 0.07	50 29.15	40 15.56	13.59
a Aquilæ . .	.	54 50.10	− 0.05	+ 0.99	+ 0.06	54 51.10	44 37.48	13.62
ε Draconis . .	.	58 55.16	− 0.10	− 2.94	+ 0.19	58 52.31	48 38.70	13.61
Mean for $19^h\ 18^m$ local sidereal time								−10 13.66 ± 0s.02

Normal Equations.

$$0 = -0.54 + 8.00\,\delta t - 1.36\,a' - 2.57\,c$$
$$0 = +1.20 - 1.36\,\delta t + 10.16\,a' + 9.39\,c \qquad a' = -0^s.054$$
$$0 = +2.70 - 2.57\,\delta t + 9.39\,a' + 32.75\,c \qquad c = -0^s.064$$

Adopted azimuth, +2s.00; azimuth of the instrument, +1s.946.

COLORADO SPRINGS, COLORADO TERRITORY, *August* 2, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
ε Coronæ . .	E.	16 2 36.71	+ 0.02	+ 0.25	+ 0.08	16 2 37.06	15 52 21.37	−10 15.69
β^1 Scorpii . .	.	8 19.57	+ 0.01	+ 0.99	+ 0.07	8 20.64	58 4.92	15.72
δ Ophiuchi . .	.	17 57.94	0.00	+ 0.72	+ 0.07	17 58.73	16 7 43.10	15.63
τ Herculis . .	.	26 12.94	+ 0.04	− 0.22	+ 0.10	26 12.86	15 56.96	15.90
η Draconis . .	.	32 34.83	− 0.01	− 0.89	+ 0.14	32 34.07	22 18.43	15.64
A Draconis . .	.	38 33.66	+ 0.12	− 1.52	+ 0.19	38 32.45	28 16.63	15.82
η Herculis . .	W.	48 49.93	+ 0.09	− 0.01	− 0.08	48 49.93	38 34.26	15.67
κ Ophiuchi . .	.	17 1 56.35	+ 0.04	+ 0.54	− 0.07	17 1 56.86	51 41.18	15.68
ε Ursæ Minoris	.	9 29.37	+ 0.27	− 5.47	− 0.50	9 23.67	59 7.93	15.74
a^1 Herculis . .	.	19 8.68	+ 0.05	+ 0.45	− 0.07	19 9.11	17 8 53.25	15.86
44 Ophiuchi . .	.	28 53.97	+ 0.03	+ 1.05	− 0.07	28 54.98	18 39.13	15.85
Mean for $16^h\ 35^m$ local sidereal time								−10 15.745 ± 0s.020

Normal Equations.

$$0 = +0.93 + 11.00\,\delta t - 3.82\,a' - 2.26\,c$$
$$0 = -4.66 - 3.82\,\delta t + 31.37\,a' + 31.64\,c \qquad a' = +0^s.075$$
$$0 = -7.72 - 2.26\,\delta t + 31.64\,a' + 77.74\,c \qquad c = +0^s.067$$

Adopted azimuth, +1s.00; azimuth of the instrument, +1s.075.

COLORADO SPRINGS, COLORADO TERRITORY, *August* 4, 1873.

Name of Star.	Clamp.	T.	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
d Sagittarii . .	E.	19 20 31.64	− 0.04	+ 1.27	− 0.04	19 20 32.83	19 10 14.76	−10 18.07
δ Draconis . .	.	22 54.29	− 0.23	− 1.77	− 0.09	22 52.20	12 34.10	18.10
τ Draconis . .	.	28 23.53	− 0.34	− 2.73	− 0.12	28 20.34	28 2.33	18.01
γ Aquilæ . .	W.	50 32.95	− 0.04	+ 0.69	+ 0.04	50 33.64	40 15.57	18.07
α Aquilæ . .	.	54 54.92	− 0.02	+ 0.72	+ 0.03	54 55.65	44 37.49	18.16
ε Draconis . .	.	58 58.68	0.00	− 2.13	+ 0.10	58 56.65	48 38.63	18.02
τ Aquilæ . .	.	20 8 15.76	+ 0.04	+ 0.76	+ 0.04	20 8 16.60	57 58.46	18.14
Mean for $19^h\ 44^m$ local sidereal time								−10 18.081 ± 0ˢ.014

Normal Equations.

$$0 = +0.16 + 7.00\,\delta t - 2.26\,a' + 1.15\,c$$
$$0 = -0.93 - 2.26\,\delta t + 7.20\,a' - 6.16\,c \qquad a' = +0^s.110$$
$$0 = +1.58 + 1.15\,\delta t - 6.16\,a' + 31.46\,c \qquad c = -0^s.034$$

Adopted azimuth, + 1ˢ.30; azimuth of the instrument, + 1ˢ.410.

COLORADO SPRINGS, COLORADO TERRITORY, *August* 5, 1873.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
β^1 Scorpii . .	E.	16 8 23.72	+ 0.02	− 0.53	+ 0.03	16 8 23.24	15 58 4.89	−10 18.35
δ Ophiuchi . .	.	18 1.56	+ 0.02	− 0.39	+ 0.03	18 1.22	16 7 43.07	18.15
τ Herculis . .	.	26 15.02	+ 0.03	+ 0.12	+ 0.05	26 15.22	15 56.90	18.32
A Draconis . .	.	38 33.74	− 0.03	+ 0.82	+ 0.09	38 34.62	28 16.47	18.15
ζ Ophiuchi . .	.	40 30.40	− 0.01	− 0.45	+ 0.03	40 29.97	30 11.78	18.19
η Herculis . .	W.	48 52.39	+ 0.09	+ 0.01	− 0.04	48 52.45	38 34.21	18.24
κ Ophiuchi . .	.	17 1 59.61	+ 0.06	− 0.29	− 0.03	17 1 59.35	51 41.15	18.20
ε Ursæ Minoris	.	9 22.66	+ 0.32	+ 2.96	− 0.23	9 25.71	59 7.48	18.23
α^1 Herculis . .	.	19 11.54	+ 0.07	− 0.24	− 0.03	19 11.34	17 8 53.22	18.12
Mean for $16^h\ 33^m$ local sidereal time								−10 18.220 ± 0ˢ.017

Normal Equations.

$$0 = -0.02 + 9.00\,\delta t - 3.43\,a' - 3.39\,c$$
$$0 = +1.32 - 3.43\,\delta t + 30.26\,a' + 35.00\,c \qquad a' = -0^s.081$$
$$0 = +0.57 - 3.39\,\delta t + 35.00\,a' + 71.85\,c \qquad c = +0^s.031$$

Adopted azimuth, − 0ˢ.50; azimuth of the instrument, − 0ˢ.581.

COLORADO SPRINGS, COLORADO TERRITORY, *August* 6, 1873.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	m. s.
γ Aquilæ . .	E.	19 50 35.06	− 0.03	− 0.08	+ 0.07	19 50 35.02	19 40 15.57	−10 19.45
α Aquilæ . .	.	54 56.72	− 0.02	− 0.08	+ 0.07	54 56.69	44 37.49	19.20
κ Cephei . .	W.	20 23 30.70	+ 0.11	+ 0.45	− 0.30	20 23 30.96	13 11.66	19.30
ε Delphini . .	.	37 30.42	+ 0.02	− 0.08	− 0.07	37 30.29	27 11.01	19.28
Groom. 3241 .	.	40 54.84	+ 0.11	+ 0.28	− 0.21	40 55.02	30 35.72	19.30
α Cygni . . .	.	47 27.87	+ 0.04	+ 0.02	− 0.09	47 27.84	37 8.49	19.35
μ Aquarii . .	.	56 10.27	− 0.06	− 0.12	− 0.07	56 10.02	45 50.65	19.37
61 Cygni . . .	E.	21 11 33.94	+ 0.02	0.00	+ 0.08	21 11 34.04	21 1 14.86	19.18
ζ Cygni . . .	.	17 53.39	+ 0.03	− 0.03	+ 0.07	17 53.46	7 34.14	19.32
α Cephei . . .	.	25 54.58	+ 0.07	+ 0.13	+ 0.14	25 54.92	15 35.56	19.36
Mean for $20^h\ 28^m$ local sidereal time								−10 19.311 ± 0ˢ.017

Normal Equations.

$$0 = -2.07 + 10.00\,\delta t - 3.18\,a - 4.67\,c$$
$$0 = +1.57 - 3.18\,\delta t + 13.31\,a + 17.08\,c \qquad a = -0^s.159$$
$$0 = +0.59 - 4.67\,\delta t + 17.08\,a + 44.96\,c \qquad c = +0^s.067$$

SALT LAKE CITY, UTAH TERRITORY, *July* 28, 1873.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
δ Ophiuchi . .	W.	8 0 38.60	− 0.04	− 1.13	− 0.06	8 0 37.37	16 7 43.15	+ 8 7 5.78
τ Herculis . .	.	8 51.22	− 0.07	+ 0.24	− 0.09	8 51.30	15 57.07	5.77
η Draconis . .	.	15 11.68	− 0.10	+ 1.23	− 0.13	15 12.68	22 18.62	5.94
ζ Ophiuchi . .	.	23 7.53	− 0.03	− 1.28	− 0.07	23 6.15	30 11.98	5.83
η Herculis . .	.	31 28.72	− 0.06	− 0.06	− 0.08	31 28.52	38 34.70	6.18
Groom. 2376 .	E.	36 11.71	− 0.07	− 0.06	+ 0.09	36 11.67	43 17.80	6.13
κ Ophiuchi . .	.	44 36.08	− 0.04	− 0.84	+ 0.06	44 35.26	51 41.23	5.97
d Herculis . .	.	49 51.00	− 0.05	− 0.24	+ 0.08	49 50.79	56 56.75	5.96
α^1 Herculis . .	.	9 1 48.06	− 0.04	− 0.75	+ 0.06	9 1 47.33	17 8 53.30	5.97
Groom. 966 .	.	15 44.37	− 0.07	− 5.62	− 0.25	15 38.43	22 44.46	6.03
Mean for $17^h\ 0^m$ local sidereal time								+ 8 7 5.956 ± 0ˢ.012

Normal Equations.

$$0 = +0.15 + 11.00\,\delta t + 6.08\,a - 5.12\,c \qquad \delta t = -0^s.938$$
$$0 = -19.16 + 6.08\,\delta t + 14.92\,a - 11.02\,c \qquad a = +1^s.619$$
$$0 = +15.06 - 5.12\,\delta t - 11.02\,a + 31.57\,c \qquad c = -0^s.064$$

These equations were used when v Serpentis was observed; the observation is excluded for the final result on account of the doubtful position of the star.

SALT LAKE CITY, UTAH TERRITORY, *July* 29, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
ζ Aquilæ . .	W.	10 52 32.11	− 0.07	− 0.62	− 0.26	10 52 31.16	18 59 36.49	+ 8 7 5.33
d Sagittarii . .	.	11 3 10.94	− 0.04	− 1.42	− 0.27	11 3 9.21	10 14.75	5.54
κ Aquilæ . .	.	23 1.82	− 0.05	− 1.15	− 0.26	23 0.36	30 5.88	5.52
γ Aquilæ . .	.	33 11.16	− 0.06	− 0.80	− 0.26	33 10.04	40 15.56	5.52
α Aquilæ . .	.	37 33.04	− 0.06	− 0.83	− 0.25	37 31.90	44 37.48	5.58
Mean for $19^h\ 0^m$ local sidereal time.								+ 8 7 5.478

Normal Equations.

$0 = +1.13 + 5.00\,\delta t + 3.20\,a$ $\qquad a = -1^s.530$

$0 = +0.94 + 3.20\,\delta t + 2.19\,a$ $\qquad c$ (adopted) $= +0^s.255$

SALT LAKE CITY, UTAH TERRITORY, *July* 30, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	△T
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
τ Herculis . .	E.	8 8 51.15	− 0.07	+ 0.27	+ 0.35	8 8 51.70	16 15 57.03	+ 8 7 5.33
η Draconis . .	.	15 11.14	− 0.06	+ 1.37	+ 0.50	15 12.95	22 18.55	5.60
ζ Ophiuchi . .	.	23 7.63	− 0.02	− 1.43	+ 0.24	23 6.42	30 11.84	5.42
η Herculis . .	.	31 28.70	− 0.01	− 0.07	+ 0.31	31 28.93	38 34.32	5.39
Groom. 2376 .	.	37 12.03	− 0.01	− 0.07	+ 0.32	37 12.27	43 17.78	5.51
κ Ophiuchi . .	W.	43 36.83	+ 0.01	− 0.94	− 0.24	43 35.66	51 41.21	5.55
d Herculis . .	.	49 51.81	+ 0.01	− 0.27	− 0.29	49 51.26	56 56.73	5.47
α^1 Herculis . .	.	9 1 48.92	0.00	− 0.83	− 0.24	9 1 47.85	17 8 53.28	5.43
Groom. 966 .	.	15 44.09	+ 0.08	− 6.27	+ 0.92	15 38.82	22 44.31	5.49
Mean for $17^h\ 0^m$ local sidereal time.								+ 8 7 5.466 ± $0^s.018$

Normal Equations.

$0 = +\ 2.18 + 9.00\,\delta t + 4.56\,a + 7.86\,c$ $\qquad \delta t = +0^s.466$

$0 = +20.03 + 4.56\,\delta t + 13.76\,a + 11.26\,c$ $\qquad a = -1^s.805$

$0 = +\ 9.63 + 7.86\,\delta t + 11.26\,a + 29.51\,c$ $\qquad c = +0^s.239$

SALT LAKE CITY, UTAH TERRITORY, *July* 30, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
ζ^1 Lyræ . . .	W.	10 33 21.07	− 0.14	− 0.12	− 0.26	10 33 20.55	18 40 26.11	+ 8 7 5.56
ζ^2 Lyræ . . .	.	33 22.95	− 0.14	− 0.12	− 0.27	33 22.42	40 27.99	5.57
β Lyræ . . .	.	38 20.74	− 0.13	− 0.28	− 0.25	38 20.08	45 25.60	5.52
50 Draconis . .	.	43 23.17	− 0.32	+ 3.89	− 0.83	43 25.91	50 31.23	5.32
ζ Aquilæ . .	.	52 32.22	− 0.08	− 0.82	− 0.22	52 31.10	59 36.49	5.39
a Sagittarii . .	E.	11 3 10.79	− 0.03	− 1.60	+ 0.22	11 3 9.38	19 10 14.75	5.37
δ Draconis . .	.	5 26.49	− 0.12	+ 2.04	+ 0.55	5 28.96	12 34.22	5.26
τ Draconis . .	.	11 53.29	− 0.32	+ 3.11	+ 0.72	11 56.80	18 2.49	5.69
κ Aquilæ . .	.	23 1.79	− 0.11	− 1.31	+ 0.21	23 0.58	30 5.88	5.30
Mean for $19^h\ 0^m$ local sidereal time								+ 8 7 5.443 ± 0ˢ.033

Normal Equations.

$$0 = -\ 8.65 + 9.00\,\delta t - 2.80\,a - 0.57\,c \qquad \delta t = +\ 0^s.443$$
$$0 = +\ 21.01 - 2.80\,\delta t + 11.39\,a + 0.30\,c \qquad a = -\ 1^s.744$$
$$0 = -\ 8.05 - 0.57\,\delta t + 0.30\,a + 41.98\,c \qquad c = +\ 0^s.210$$

SALT LAKE CITY, UTAH TERRITORY, *July* 31, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
τ Herculis . .	E.	8 8 50.88	− 0.02	+ 0.16	+ 0.56	8 8 51.58	16 15 57.03	+ 8 7 5.45
η Draconis . .	.	15 10.90	− 0.02	+ 1.16	+ 0.81	15 12.85	22 18.52	5.67
ζ Ophiuchi . .	.	23 7.05	− 0.01	− 1.20	+ 0.39	23 6.23	30 11.83	5.60
η Herculis . .	.	31. 28.13	− 0.03	− 0.06	+ 0.49	31 28.53	38 34.31	5.78
Groom. 2376 .	.	37 11.42	− 0.03	− 0.06	+ 0.52	37 11.85	43 17.76	5.91
κ Ophiuchi . .	W.	44 36.33	+ 0.34	− 0.79	− 0.38	44 35.50	51 41.20	5.70
d Herculis . .	.	49 51.18	+ 0.55	− 0.16	− 0.46	49 51.11	56 56.71	5.60
Mean for $17^h\ 0^m$ local sidereal time								+ 8 7 5.673 ± 0ˢ.037

Normal Equations.

$$0 = -\ 5.69 + 7.00\,\delta t + 0.63\,a + 5.04\,c \qquad \delta t = +\ 0^s.67$$
$$0 = +\ 2.50 + 0.63\,\delta t + 1.51\,a - 1.63\,c \qquad a = -\ 1^s.520$$
$$0 = -\ 11.01 + 5.04\,\delta t - 1.63\,a + 13.63\,c \qquad c = +\ 0^s.381$$

SALT LAKE CITY, UTAH TERRITORY, *August* 1, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
δ Ophiuchi . .	W.	8 0 38.81	+ 0.06	− 1.19	− 0.22	8 0 37.46	16 7 43.11	+ 8 7 5.65
τ Herculis . .	.	8 51.32	+ 0.14	+ 0.26	− 0.32	8 51.49	15 56.98	5.58
η Draconis . .	.	15 11.63	+ 0.20	+ 1.30	− 0.47	15 12.66	22 18.47	5.81
ζ Ophiuchi . .	.	23 7.60	+ 0.07	− 1.35	− 0.23	23 6.09	30 11.82	5.73
η Herculis . .	E.	31 28.39	− 0.03	− 0.07	+ 0.29	31 28.58	38 34.29	5.71
Groom. 2376 .	.	36 11.82	− 0.03	− 0.07	+ 0.30	36 12.02	43 17.74	5.72
κ Ophiuchi . .	.	44 36.19	− 0.02	− 0.89	+ 0.22	44 35.50	51 41.19	5.69
d Herculis . .	.	49 50.99	− 0.05	− 0.26	+ 0.27	49 50.95	56 56.70	5.75
a Herculis . .	.	9 1 48.02	0.00	− 0.78	+ 0.23	9 1 47.47	17 8 53.26	5.79
Groom. 966 .	.	15 45.11	+ 0.43	− 6.02	− 0.85	15 38.67	22 44.51	5.84
Mean for 17^h 0^m local sidereal time.								+ 8 7 5.727 ± 0^s.016

Normal Equations.

$$0 = +12.58 + 10.00\,\delta t + 5.26\,a - 3.56\,c \qquad \delta t = -0^s.283$$
$$0 = +28.40 + 5.26\,\delta t + 14.25\,a - 11.76\,c \qquad a = -1^s.706$$
$$0 = -27.83 - 3.56\,\delta t - 11.76\,a + 30.51\,c \qquad c = +0^s.222$$

SALT LAKE CITY, UTAH TERRITORY, *August* 2, 1873.

Name of Star.	Clamp.	T.	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
Brad. 2313 .	W.	10 14 56.60	− 0.07	− 1.55	− 0.27	10 14 54.71	18 21 59.87	+ 8 7 5.16
1 Aquilæ . .	.	21 16.58	− 0.08	− 1.39	− 0.27	21 14.84	28 20.00	5.16
a Lyræ . . .	.	25 35.81	− 0.13	− 0.09	− 0.34	25 35.25	32 40.44	5.19
ζ^1 Lyræ . . .	.	33 21.40	− 0.08	− 0.13	− 0.32	33 20.87	40 26.08	5.21
ζ^2 Lyræ . . .	.	33 23.28	− 0.06	− 0.13	− 0.32	33 22.77	40 27.96	5.19
β Lyræ . . .	.	38 20.93	− 0.04	− 0.29	− 0.32	38 20.28	45 25.58	5.30
50 Draconis . .	.	43 23.21	− 0.03	+ 4.08	− 1.04	43 26.22	50 31.08	4.86
π Sagittarii . .	E.	55 11.66	− 0.02	− 1.74	+ 0.27	55 10.17	19 2 15.21	5.04
δ Draconis . .	.	11 5 26.07	− 0.11	+ 2.14	+ 0.69	11 5 28.79	12 34.14	5.35
δ Aquilæ . .	.	12 3.89	− 0.01	− 1.13	+ 0.26	12 3.01	19 7.94	4.93
a Vulpeculæ .	.	16 22.63	0.00	− 0.57	+ 0.29	16 22.35	23 27.55	5.20
μ Aquilæ . .	.	21 51.14	+ 0.03	− 1.02	+ 0.26	21 50.41	27 55.23	4.82
κ Aquilæ . .	.	23 1.96	+ 0.05	− 1.37	+ 0.27	23 0.91	30 5.89	4.98
θ Cygni . . .	.	26 58.51	+ 0.15	+ 0.46	+ 0.41	26 59.53	33 4.44	4.91
Mean for 19^h 0^m local sidereal time.								+ 8 7 5.093 ± 0^s.030

Normal Equations.

$$0 = +1.86 + 14.00\,\delta t + 1.50\,a - 1.63\,c \qquad \delta t = +0^s.093$$
$$0 = +16.36 + 1.50\,\delta t + 9.98\,a + 6.59\,c \qquad a = -1^s.828$$
$$0 = +2.03 - 1.63\,\delta t + 6.59\,a + 38.46\,c \qquad c = +0^s.264$$

SALT LAKE CITY, UTAH TERRITORY, *August* 5, 1873.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
ζ Ophiuchi . .	W.	8 23 9.01	− 0.03	− 1.30	− 0.28	8 23 7.40	16 30 11.79	+ 8 7 4.39
η Herculis . .	.	31 30.15	− 0.05	− 0.06	− 0.36	31 29.68	38 34.21	4.53
Groom. 2376 .	.	36 13.61	− 0.04	− 0.06	− 0.37	36 13.14	43 17.66	4.52
κ Ophiuchi . .	.	44 37.98	− 0.02	− 0.85	− 0.28	44 36.83	51 41.15	4.32
d Herculis . .	.	49 52.96	− 0.02	− 0.25	− 0.33	49 52.36	56 56.64	4.28
a^1 Herculis . .	E.	9 1 49.56	− 0.05	− 0.76	+ 0.28	9 1 49.03	17 8 53.23	4.20
Groom. 966 .	.	15 47.06	− 0.15	− 5.67	− 1.06	15 40.18	22 44.86	4.68
a Ophiuchi . .	.	23 0.44	− 0.11	− 0.79	+ 0.28	22 59.82	29 4.25	4.43
ω Draconis . .	.	30 36.93	− 0.39	+ 2.14	+ 0.76	30 39.44	37 44.29	4.85
μ Herculis . .	.	34 27.09	− 0.18	− 0.41	+ 0.31	34 26.81	41 31.42	4.61
Mean for $17^h\ 0^m$ local sidereal time								+ 8 7 4.461 ± 0ˢ.041

Normal Equations.

$$0 = +\ 4.45 + 10.00\,\delta t + 4.90\,a - 3.77\,c \qquad \delta t = +\ 0^s.461$$
$$0 = +\ 27.37 + 4.90\,\delta t + 15.14\,a - 17.34\,c \qquad a = -\ 1^s.643$$
$$0 = -\ 35.79 - 3.77\,\delta t - 17.34\,a + 32.90\,c \qquad c = +\ 0^s.275$$

SALT LAKE CITY, UTAH TERRITORY, *August* 5, 1873.

Name of Star.	Clamp.	T	*b*B	*a*A	*c*C	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
Brad. 2313 .	E.	10 14 56.77	− 0.20	− 1.28	+ 0.25	10 14 55.54	18 21 59.86	+ 8 7 4.32
a Lyræ . . .	.	25 35.62	− 0.32	− 0.08	+ 0.32	25 35.54	32 40.41	4.87
ζ^1 Lyræ . . .	.	33 21.46	− 0.25	− 0.10	+ 0.31	33 21.42	40 26.05	4.63
ζ^2 Lyræ . . .	.	33 23.26	− 0.25	− 0.11	+ 0.31	33 23.21	40 27.93	4.71
50 Draconis . .	.	43 23.26	− 0.78	+ 3.35	+ 0.97	43 26.80	50 30.93	4.13
ζ Aquilæ . .	W.	52 33.23	− 0.11	− 0.70	− 0.25	52 32.17	59 36.47	4.30
d Sagittarii . .	.	11 3 12.05	− 0.05	− 1.38	− 0.26	11 3 10.36	19 10 14.76	4.40
δ Draconis . .	.	5 28.76	− 0.23	+ 1.76	− 0.64	5 29.65	12 34.07	4.42
τ Draconis . .	.	11 56.15	− 0.29	+ 2.76	− 0.85	11 57.77	18 2.28	4.51
a Vulpeculæ .	.	16 23.87	− 0.11	− 0.46	− 0.27	16 23.03	23 27.54	4.51
μ Aquilæ . .	.	20 52.23	− 0.08	− 0.84	− 0.25	20 51.06	27 55.23	4.17
κ Aquilæ . .	.	23 2.97	− 0.07	− 1.13	− 0.25	23 1.52	30 5.89	4.37
θ Cygni . . .	.	31 0.49	− 0.15	+ 0.37	− 0.38	31 0.33	38 4.41	4.08
Mean for $19^h\ 0^m$ local sidereal time								+ 8 7 4.418 ± 0ˢ.039

Normal Equations.

$$0 = -\ 6.50 + 13.00\,\delta t - 1.44\,a - 4.04\,c \qquad \delta t = +\ 0^s.418$$
$$0 = +\ 19.41 - 1.44\,\delta t + 12.55\,a - 1.04\,c \qquad a = -\ 1^s.503$$
$$0 = -\ 11.73 - 4.04\,\delta t - 1.04\,a + 47.87\,c \qquad c = +\ 0^s.247$$

SALT LAKE CITY, UTAH TERRITORY, *August* 6, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
η Draconis . .	W.	8 15 12.63	+ 0.14	+ 1.41	− 0.50	8 15 13.68	16 22 18.28	+ 8 7 4.60
ζ Ophiuchi . .	.	23 8.83	+ 0.04	− 1.46	− 0.24	23 7.17	30 11.77	4.60
η Herculis . .	.	31 30.12	+ 0.06	− 0.07	− 0.30	31 29.81	38 34.19	4.38
Groom. 2376 .	.	36 13.36	+ 0.07	− 0.07	− 0.32	36 13.04	43 17.64	4.60
κ Ophiuchi . .	.	44 37.76	+ 0.07	− 0.96	− 0.24	44 36.63	51 41.13	4.50
d Herculis . .	.	49 52.82	+ 0.14	− 0.28	− 0.28	49 52.40	56 56.62	4.22
a^1 Herculis . .	E.	9 1 49.27	+ 0.08	− 0.85	+ 0.24	9 1 48.74	17 8 53.21	4.47
Groom. 966 .	.	15 47.77	0.00	− 6.42	− 0.90	15 40.45	22 44.95	4.50
a Ophiuchi . .	.	22 0.29	0.00	− 0.89	+ 0.24	22 59.64	29 4.24	4.60
Mean for 17^h 0^m local sidereal time								+ 8 7 4.497 ± 0ˢ.029

Normal Equations.

$$0 = +\ 3.82 + 9.00\,\delta t + 5.19\,a - 9.79\,c \qquad \delta t = +\,0^s.897$$
$$0 = +\ 24.10 + 5.19\,\delta t + 13.97\,a - 12.41\,c \qquad a = -\,1^s.850$$
$$0 = -\ 20.84 - 9.79\,\delta t - 12.41\,a + 28.44\,c \qquad c = +\,0^s.234$$

SALT LAKE CITY, UTAH TERRITORY, *August* 6, 1873.

Name of Star.	Clamp.	T	bB	aA	cC	T′	AR.	ΔT
		h. m. s.	s.	s.	s.	h. m. s.	h. m. s.	h. m. s.
72 Ophiuchi . .	E.	9 54 17.89	− 0.01	− 0.82	+ 0.13	9 54 17.19	18 1 21.74	+ 8 7 4.55
μ^1 Sagittarii . .	.	59 9.42	− 0.03	− 1.45	+ 0.14	59 8.08	6 12.47	4.39
η Serpentis . .	.	10 7 42.86	− 0.06	− 1.05	+ 0.13	10 7 41.88	14 46.39	4.51
Brad. 2313 .	.	14 56.65	− 0.06	− 1.30	+ 0.14	14 55.43	21 59.85	4.42
1 Aquilæ . .	.	21 16.55	− 0.07	− 1.16	+ 0.13	21 15.45	28 19.98	4.53
ζ^1 Lyræ . . .	W.	33 21.89	− 0.16	− 0.11	− 0.17	33 21.45	40 26.04	4.59
ζ^2 Lyræ . . .	.	33 23.76	− 0.16	− 0.11	− 0.17	33 22.32	40 27.92	4.60
β Lyræ . . .	.	38 21.56	− 0.10	− 0.24	− 0.16	38 21.06	45 25.55	4.49
50 Draconis . .	.	43 23.76	− 0.22	+ 3.40	− 0.52	43 26.42	50 30.87	4.45
ζ Aquilæ . .	.	52 33.02	− 0.05	− 0.72	− 0.14	52 32.11	59 36.47	4.36
π Sagittarii . .	.	55 12.39	− 0.03	− 1.45	− 0.14	55 10.77	19 2 15.21	4.44
Mean for 19^h 0^m local sidereal time								+ 8 7 4.485 ± 0ˢ.016

Normal Equations.

$$0 = +\ 0.31 + 11.00\,\delta t + 3.27\,a - 4.63\,c \qquad \delta t = +\,0^s.485$$
$$0 = +\ 10.84 + 3.27\,\delta t + 9.08\,a + 10.82\,c \qquad a = -\,1^s.525$$
$$0 = +\ 15.07 - 4.63\,\delta t + 10.82\,a + 27.60\,c \qquad c = +\,0^s.133$$

Taking the mean of the determinations of the corrections of the chronometer, the following table shows the corrections and the adopted rates of the chronometers used at Colorado Springs and Salt Lake City:

NEGUS 1491.

Date.	Local sidereal hour.	Correction of chronometer.	Adopted hourly rate.
1873.	h.	h. m. s. s.	s.
July 28	17.433	− 0 10 10.120 ± 0.020	+ 0.064
29	19.067	11.760 ± 0.014	+ 0.034
30	20.000	12.540 ± 0.020	+ 0.048
31	17.975	13.596 ± 0.028	+ 0.047
Aug. 2	16.583	15.745 ± 0.020	+ 0.044
4	19.733	18 081 ± 0.014	+ 0.007
5	16.550	18.220 ± 0.017	+ 0.039
6	20.467	− 0 10 19.311 ± 0.017	+ 0.060

NEGUS 1511.

Date.	Local sidereal hour.	Correction of chronometer.	Adopted hourly rate.
1873.	h.	h. m. s. s.	s.
July 28	17.0	+ 8 7 5.956 ± 0.012	− 0.019
29	19.0	5.478 ± 0.020	− 0.010
30	18.0	5.455 ± 0.026	+ 0.009
31	17.0	5.673 ± 0.037	+ 0.002
Aug. 1	17.0	5.727 ± 0.016	− 0.024
2	19.0	5.093 ± 0.030	− 0.019
5	18.0	4.440 ± 0.040	+ 0.002
6	18.0	+ 8 7 4.491 ± 0.024	0.000

Signals for Determination of Longitude between Salt Lake City, Utah, and Colorado Springs, Colorado Territory.

Date.	Arbitrary signals sent from—			
	Salt Lake.		Colorado Springs.	
	Colorado Springs chronometer.	Salt Lake chronometer.	Colorado Springs chronometer.	Salt Lake chronometer.
1873.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
July 29	18 7 29.91	9 21 54.77	18 13 30.52	9 27 55.60
	40.10	22 4.90	40.52	28 5.60
	50.00	14.85	55.10	20.15
	8 0.02	24.87	14 5.62	30.70
	10.00	34.90	15.96	41.03
	20.00	44.90	25.53	50.60
	30.10	54.96	35.56	29 0.62
	40.00	23 4.87	45.43	10.50
	50.16	14.97	55.57	20.65
	59.87	24.70	15 5.60	30.70
	9 10.16	34.99	15.75	40.85
	20.19	45.00	25.55	50.63
	30.19	55.00	35.48	30 0.53
	40.20	24 5.00	46.10	11.18
	50.18	15.00	55.00	20.09
	10 0.17	25.00	16 7.00	32.10
	10.40	35.22	15.60	40.70
	20.20	45.03	25.88	50.98
	30.20	55.10	35.10	31 0.20
	Mean. 18 9 0.108	Mean. 9 23 24.949	Mean. 18 15 5.098	Mean. 9 29 30.169

Date.	Arbitrary signals sent from—			
	Salt Lake.		Colorado Springs.	
	Colorado Springs chronometer.	Salt Lake chronometer.	Colorado Springs chronometer.	Salt Lake chronometer.
1873.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
July 30	18 47 22.40	10 1 46.37	18 58 45.11	10 13 9.48
	32.00	56.00	55.54	19.90
	41.97	2 5.97	59 5.54	29.90
	51.88	15.89	15.61	40.00
	48 2.00	26.00	25.57	49.92
	12.00	36.02	35.60	59.94
	21.98	46.00	45.51	14 9.90
	32.00	56.00	55.50	19.88
	42.00	3 6.00	19 0 5.50	29.86
	52.00	16.00	15.58	39.94
	49 2.00	26.00	25.60	49.93
	12.49	36.47	35.59	59.94
	22.00	46.10	45.53	15 9.90
	32.00	56.00	56.60	20.93
	42.38	4 6.38	1 5.59	29.90
	52.41	16.43	16.67	41.00
	50 2.50	26.48	25.66	49.98
	12.40	36.41	35.57	59.90
	22.59	46.60	45.60	16 9.95
	Mean. 18 48 52.158	Mean. 10 3 16.164	Mean. 19 0 15.656	Mean. 10 14 40.008

Signals for Determination of Longitude, &c.—Continued.

Date.	Arbitrary signals sent from—			
	Salt Lake.		Colorado Springs.	
	Colorado Springs chronometer.	Salt Lake chronometer.	Colorado Springs chronometer.	Salt Lake chronometer.
1873.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
August 2	18 37 37.98	9 51 59.00	18 42 55.56	9 57 16.90
	47.31	52 8.31	43 5.52	26.86
	57.47	18.47	15.60	36.92
	38 7.46	28.44	26.53	47.83
	17.55	38.54	36.59	57.91
	27.50	48.50	46.49	58 7.80
	38.00	59.01	55.54	16.87
	47.79	53 8.79	44 5.60	26.93
	57.51	18.50	16.40	37.71
	39 7.64	28.65	25.60	46.90
	17.57	38.55	35.60	56.90
	27.90	48.90	45.56	59 6.86
	37.64	58.66	55.53	16.87
	47.80	54 8.90	45 8.50	29.82
	57.90	18.90	15.53	36.88
	40 7.97	29.00	25.59	46.87
	17.81	38.82	35.57	56.85
	27.90	48.90	45.59	10 0 6.86
	38.00	59.00	55.56	16.90
	Mean. 18 39 7.721	Mean. 9 53 28.728	Mean. 18 44 25.914	Mean. 9 58 47.234

Date.	Arbitrary signals from—			
	Colorado Springs.		Salt Lake.	
	Colorado Springs chronometer.	Salt Lake chronometer.	Colorado Springs chronometer.	Salt Lake chronometer.
1873.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
August 5	18 45 15.62	9 59 35.14	18 49 55.38	10 4 14.66
	25.60	45.10	50 5.30	24.50
	35.52	55.00	15.28	34.50
	45.55	10 0 5.01	25.35	44.60
	55.56	15.02	35.29	54.51
	46 5.50	25.00	45.59	5 4.85
	15.50	35.00	55.60	14.86
	25.52	45.00	51 5.56	24.80
	35.54	55.02	15.50	34.78
	45.58	1 5.04	25.42	44.72
	56.54	16.00	35.60	54.85
	47 6.59	26.03	45.70	6 4.97
	16.57	36.03	56.00	15.32
	26.58	46.02	52 5.62	24.90
	36.56	56.00	15.76	35.02
	45.70	2 5.18	25.61	44.90
	55.10	14.50	35.68	54.96
	48 5.52	25.00	45.72	7 5.02
	15.54	35.03	56.28	15.50
	Mean. 18 46 45.800	Mean. 10 1 5.269	Mean. 18 51 25.596	Mean. 10 5 44.854

Signals for Determination of Longitude, &c.—Continued.

Date.	Arbitrary signals sent from—			
	Salt Lake.		Colorado Springs.	
	Colorado Springs chronometer.	Salt Lake chronometer.	Colorado springs chronometer.	Salt Lake chronometer.
1873.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Aug. 6	18 15 35.24	9 29 53.60	18 24 15.60	9 38 34.24
	45.18	30 3.59	25.55	44.16
	55.00	13.50	35.61	54.22
	16 5.40	23.80	45.60	39 4.21
	15.24	33.65	55.59	14.20
	25.19	43.53	25 5.61	24.24
	35.03	53.50	15.12	33.61
	45.29	31 3.65	25.61	44.27
	55.18	13.53	34.60	53.21
	17 5.30	23.69	44.61	40 3.24
	15.47	33.86	54.60	13.20
	25.48	43.87	26 4.60	23.22
	35.00	53.50	15.68	34.30
	45.40	32 3.80	25.60	44.25
	55.30	13.65	35.00	53.62
	18 5.60	23.98	45.10	41 3.64
	15.59	33.97	55.62	14.22
	25.64	44.00	27 5.60	24.20
	35.61	54.03	16.53	35.16
	Mean. 18 17 5.323	Mean . 9 31 23.721	Mean. 18 25 45.360	Mean . 9 40 3.969

July 30, the breaks for the seconds of Salt Lake and Colorado Springs coincide. By measuring the differences where I find the full minute, I develop the fact that the Colorado Springs chronometer breaks $0^s.110$ later than the Salt Lake break; therefore the mean of the signals sent from Salt Lake and received on the Colorado Springs chronograph is,

$18^h\ 48^m\ 52^s.048$.

The same happens on August 2. The Colorado Springs chronometer is $0^s.095$ later than the Salt Lake chronometer on the Colorado Springs chronograph; therefore the mean is,

$18^h\ 39^m\ 7^s.626$.

Final Results for Longitude.

Signals sent from—	Stations of record.	Mean of signals sent and received.	Time-correction.	Corrected time.	Difference of longitude.	Double wave-time.	Means.
1873.		h. m. s.	h. m. s.	h. m. s.	h. m. s.	s.	s.
July 29.							
Salt Lake	Colo. Springs chron.	18 9 0.11	− 0 10 11.72	17 58 48.39			
	Salt Lake chron. . .	9 23 24.95	+ 8 7 5.46	17 30 30.41	0 28 17.98		
Colorado Springs .	Colo. Springs chron.	18 15 5.10	− 0 10 11.72	18 4 53.38			
	Salt Lake chron. . .	9 29 30.17	+ 8 7 5.46	17 36 35.63	17.75	0.23	17.865
July 30.							
Salt Lake	Colo. Springs chron.	18 48 52.05	− 0 10 12.48	18 38 39.57			
	Salt Lake chron. . .	10 3 16.16	+ 8 7 5.46	18 10 21.62	17.95		
Colorado Springs .	Colo. Springs chron.	19 0 15.66	− 0 10 12.49	18 50 3.17			
	Salt Lake chron. . .	10 14 40.01	+ 8 7 5.46	18 21 45.47	17.70	0.25	17.825
August 2.							
Salt Lake	Colo. Springs chron.	18 39 7.63	− 0 10 15.83	18 28 51.80			
	Salt Lake chron. . .	9 53 28.73	+ 8 7 5.11	18 0 33.84	17.96		
Colorado Springs .	Colo. Springs chron.	18 44 25.91	− 0 10 15.83	18 34 10.08			
	Salt Lake chron. . .	9 58 47.24	+ 8 7 5.11	18 5 52.35	17.73	0.23	17.845
August 5.							
Colorado Springs .	Colo. Springs chron.	18 46 45.80	− 0 10 18.30	18 36 27.50			
	Salt Lake chron. . .	10 1 5.27	+ 8 7 4.44	18 8 9.71	17.79		
Salt Lake	Colo. Springs chron.	18 51 25.60	− 0 10 18.31	18 41 7.29			
	Salt Lake chron. . .	10 5 44.85	+ 8 7 4.44	18 12 49.29	18.00	0.21	17.895
August 6.							
Salt Lake	Colo. Springs chron.	18 17 5.32	− 0 10 19.17	18 6 46.15			
	Salt Lake chron. . .	9 31 23.72	+ 8 7 4.49	17 38 28.21	17.94		
Colorado Springs .	Colo. Springs chron.	18 25 45.36	− 0 10 19.18	18 15 26.18			
	Salt Lake chron. . .	9 40 3.97	+ 8 7 4.49	17 47 8 46	17.72	0.22	17.830

Colorado Springs east of Salt Lake City . . . . . $0^h\ 28^m\ 17^s.852 \pm 0^s.009$

Mean Places of Stars for 1873.0, used for Determination of Latitude of Colorado Springs, Colorado Territory.

No. of pair.	No. in B. A. C.	Right ascension.	Declination.	No. of pair.	No. in B. A. C.	Right ascension.	Declination.
		h. m. s.	° ′ ″			h. m. s.	° ′ ″
1	5587	16 34 57	12 38 35.4	25	7297	20 55 5	39 45 23.86
	5628	40 3	64 49 48.4		7320	58 9	38 9 23.70
2	5747	56 55	33 45 14.08	26	7361	21 6 13	22 33 45.2
	5775	17 1 13	43 59 9.46		7401	13 27	55 15 54.42
3	5790	3 38	40 40 59.86	27	7444	18 55	25 37 43.49
	5834	10 38	36 57 13.04		7489	27 11	52 3 36.28
4	5871	16 46	46 21 58.58	28	7505	29 35	37 57 56.32
	5927	26 7	31 15 15.10		7521	31 52	39 50 37.76
5	5978	33 41	61 58 18.9	29	7554	36 28	40 13 45.02
	5991	36 16	16 0 44.7		7566	38 10	37 42 10.92
6	6079	51 20	56 53 35.36	30	7621	46 12	66 12 8.4
7	6110	56 57	20 50 5.7		7641	50 45	11 28 27.5
	6157	18 3 20	20 47 46.2	31	7683	57 48	57 23 17.18
8	6238	16 4	28 48 39.4		7733	22 4 30	20 21 16.4
	6255	18 18	49 3 28.30	32	7757	7 50	27 58 46.49
9	6357	33 55	39 33 26.28		7825	20 17	49 45 25.22
10	6365	35 54	38 15 1.54	33	7832	22 17	— 0 40 9.8
	6391	40 14	39 28 51.50		7857	25 44	78 8 18.1
11	6468	50 13	33 48 27.32	34	7874	28 44	78 10 19.9
	6475	51 28	43 46 47.30		7880	30 13	38 58 39.82
12	6520	57 51	46 45 20.56	35	Gr.3873	39 8	38 32 7.36
	6571	19 6 54	31 4 22.42		7931	38 21	38 48 1,90
13	6586	9 17	65 45 57.5	36	7951	41 18	— 4 53 13.7
	6615	13 44	12 8 35.4		7990	47 55	82 28 47.5
14	6652	19 49	20 1 21.6	37	8003	52 51	11 3 3.3
	6681	23 29	57 46 18.90	38	8039	58 43	66 31 29.0
15	6698	27 3	34 11 3.32		8077	23 4 55	66 33 9.5
	6720	30 43	43 40 2.52	39	8147	16 26	19 51 47.4
16	6731	32 42	44 24 56.30	40	8188	24 11	57 50 55.98
	6784	41 36	33 26 0.74		Gr.4110	32 21	57 57 5.58
17	6819	46 42	18 20 49.49	41	8296	45 57	20 57 54.22
	6852	51 19	59 22 23.28	42	8310	48 3	56 47 34.04
18	6863	52 51	57 54 55.94		8317	49 12	56 42 18.74
	6901	59 31	19 37 42.0	43	Gr.4216	57 39	49 9 47.30
19	6918	20 1 40	51 28 32.38		8374	0 0 1	28 19 15.15
	6944	6 41	26 6 2.7	44	28	6 55	40 20 3.36
20	6963	9 26	42 59 40.52		67	14 26	37 15 53.68
	6998	13 46	34 35 13.28	45	87	18 54	1 14 10.80
21	7022	17 40	39 51 4.58		105	22 45	76 19 6.8
	7061	22 52	38 1 27.56	46	121	24 47	53 49 15.16
22	7084	26 10	36 30 32.70		178	34 52	23 55 57.42
	7101	28 29	41 2 24.58	47	201	38 4	54 31 33.26
23	7140	32 51	20 45 23.4	48	Gr. 137	39 0	54 36 37.4
	7189	39 8	56 55 44.74		250	48 10	22 56 25.71
24	7243	45 37	50 18 41.56	49	285	55 52	31 7 18.84
	7256	49 8	27 34 33.08		330	1 2 8	46 33 49.88
				50	357	5 49	31 24 3.54
					441	22 30	46 21 4.10
				51	474	28 42	48 4 23.02
					514	34 29	29 24 13.5

Observations for Latitude.—Station, Colorado Springs.

Date.	No. of star.	Microm. reading.	Level.		Remarks.	Date.	No. of star.	Microm. reading.	Level.		Remarks.
			N.	S.					N.	S.	
1873.		t. d.	d.	d.		1873.		t. d.	d.	d.	
July 31	7505	6 10.6	24.0	28.0	Air very undulating.	Aug. 2	6238	2 62.8	24.0	17.7	
	7521	15 1.3	28.3	24.0			6255	15 0.7	8.3	33.4	
	7554	17 54.2	31.0	21.3			6357	13 31.0	20.0	22.0	
	7566	1 57.2	17.0	35.3	Changed length of bubble.		6365	4 53.2	11.9	29.4	Very faint.
	7621	11 6.9	19.5	14.0			6391	8 95.0	23.0	19.3	
	7641	9 96.0	9.7	24.6			6468	11 94.6	21.0	21.8	
	7683	13 5.3	18.0	16.0			6475	8 8.1	17.0	26.0	
	7733	8 2.8	15.5	18.5			6520	14 39.0	24.4	18.7	
	7757	7 80.9	17.3	16.8			6571	4 36.4	9.3	33.4	
	7825	12 72.6	31.0	3.0			6586	17 10.2	21.8	20.9	Changed inclination.
	7832	16 70.9	22.0	11.3			6615	2 31.2	23.9	18.5	
	7857	5 96.4	13.0	20.3			6652	6 63.0	18.0	24.6	
	7874	7 93.6	13.3	20.3			6681	14 89.3	30.4	12.3	
	7951	10 89.2	18.0	16.8			6698	3 52.3	20.8	22.0	
	7990	7 41.6	26.0	9.0			6720	15 11.5	27.0	16.0	
	8003	12 23.5	16.8	18.2			6731	15 81.0	23.9	19.0	
	8039	7 68.5	26.3	8.7			6784	4 56.9	17.3	26.2	
	8077	9 33.1	25.7	9.7			6819	7 75.5	18.0	26.0	
	8147	5 97.1	15.0	20.9			6852	11 64.6	28.6	16.0	
	8188	9 37.4	31.2	5.0			6863	5 25.6	26.0	18.4	
	Gr. 4110	15 32.3	31.0	5.0			6901	11 67.0	16.5	28.5	
	8296	10 27.5	18.0	17.9			6918	8 12.0	18.9	26.2	
	8310	16 17.1	18.0	18.0			6944	12 52.4	30.9	14.4	
	8317	11 11.4	18.0	18.0			6963	7 75.8	21.7	23.6	
	Gr. 4216	5 39.0	18.0	18.3			6998	11 90.7	26.0	19.5	
	8374	15 31.5	21.2	15.0			7022	16 49.0	20.5	25.2	
	28	8 17.5	16.4	20.0			7061	3 54.0	32.9	13.3	
	67	11 56.7	16.3	20.0			7084	12 98.9	20.9	25.0	
	87	12 22.0	17.3	19.0			7101	6 98.9	29.4	16.9	
	105	6 34.0	18.9	18.0			7140	8 9.8	22.5	23.0	
Aug. 2	5587	13 2.6	16.0	25.4	Air little undulating.		7189	10 5.3	31.7	14.8	
	5628	2 83.9	41.5	. .			7243	16 77.0	18.6	28.0	Faint.
	5747	7 23.7	19.8	22.3			7256	3 20.0	32.3	14.3	
	5775	12 27.8	21.8	20.3			7297	16 55.0	26.0	21.0	
	5790	8 79.0	21.3	20.7			7320	1 57.0	20.3	27.2	
	5834	9 79.8	14.3	27.9			7361	4 70.1	25.0	22.8	
	5978	18 32.0	22.3	19.5			7401	14 82.5	27.9	20.2	
	5991	— 0 78.7	13.0	29.0			7444	9 14.0	25.7	22.2	
	6079	11 34.6	25.0	17.0			7489	11 21.9	25.0	23.3	
	6110	7 8.9	9.3	32.0							
	6157	9 35.1	8.0	33.6							

Observations for Latitude.—Station, Colorado Springs—Continued.

Date.	No. of star.	Microm. reading.	Level. N.	Level. S.	Remarks.
1873.		t. d.	d.	d.	
Aug. 2	7505	.5 48.0	24.7	23.5	
	7521	14 45.6	24.6	23.5	Cloudy.
4	7505	5 50.6	24.3	15.5	Air good.
	7521	14 23.7	3.0	37.0	
	7554	17 79.8	22.6	17.3	
	7566	1 83.1	7.4	32.7	
	7621	10 19.3	23.9	16.2	Changed the
	7641	9 10.0	5.0	35.3	inclination.
	7683	12 44.7	22.7	18.0	
	7733	7 26.9	23.0	18.0	
	7757	7 21.0	25.2	15.8	
	7825	12 4.6	20.7	21.0	
	7832	15 53.0	23.0	18.3	
	7857	4 88.9	23.8	17.8	
	7874	6 86.5	23.6	18.0	
	7880	9 46.8	20.3	21.0	Wrong setting.
	Gr. 3873	17 49.3	30.0	11.3	
	7951	10 20.8	23.0	18.4	
	7990	6 63.9	20.3	21.0	
	8003	11 59.9	17.9	23.0	
	8039	7 7.0	27.4	14.0	
	8077	8 68.5	27.8	14.8	
	8147	5 42.0	19.8	22.8	
	8188	8 91.0	33.7	9.0	
	Gr. 4110	14 83.0	32.7	9.8	
	8296	9 51.0	28.0	14.5	
	8310	15 46.0	14.0	28.6	
	8317	10 38.9	13.5	29.2	
	Gr. 4216	5 4.3	24.7	18.0	
	8374	14 99.5	16.6	26.0	
	28	7 99.1	25.0	18.0	
	67	11 26.2	20.3	22.3	
	87	11 44.4	22.0	20.8	
	105	5 70.3	25.6	17.3	
	121	11 58.0	17.3	25.7	
	178	5 88.5	28.8	14.5	
	201	4 49.3	19.0	24.3	
		9 35.0	15.3	28.0	
	250	15 42.0	27.0	16.3	
	285	9 26.5	18.0	25.3	
	330	11 11.2	32.0	12.0	

Date.	No. of star.	Microm. reading.	Level. N.	Level. S.	Remarks.
1873.		t. d.	d.	d.	
Aug. 4	357	6 96.9	23.0	21.0	
	441	12 63.9	25.8	18.3	
	474	5 60.8	21.8	22.2	
	514	16 5.3	14.8	29.0	
5	6238	2 96.0	19.8	15.0	Very heavy
	6255	15 39.1	−1.0	35.4	wind.
	6652	6 41.2	15.0	21.0	
	6681	14 59.7	21.6	15.0	
	6698	3 41.8	20.2	16.0	
	6720	14 87.3	16.0	21.0	
	6731	15 13.4	20.2	17.0	
	6784	3 84.3	17.9	20.1	
	6819	6 99.0	18.0	20.0	
	6852	10 95.0	28.0	10.2	
	6863	6 50.4	22.4	16.0	
	6901	12 83.0	17.5	21.0	
	6918	8 5.6	17.3	21.2	
	6944	12 53.0	21.0	17.2	
	6963	8 27.0	20.8	18.0	
	6998	12 36.0	22.4	16.5	
	7022	15 64.0	25.8	13.9	
	7061	2 64.9	19.0	20.0	
	7084	12 22.5	21.3	17.3	
	7101	6 18.0	19.3	20.0	
	7140	7 71.8	20.0	19.2	
	7189	9 55.2	18.0	21.3	
	7243	16 70.0	20.3	19.0	
	7256	3 19.6	16.6	23.0	
	7297	16 44.0	23.9	15.8	
	7320	1 60.5	9.0	30.8	
	7361	4 18.0	23.3	16.0	
	7401	14 12.7	9.8	30.0	
	7444	10 34.0	18.0	21.8	
	7489	12 40.9	24.3	15.7	
	7505	5 71.0	24.5	15.0	
	7521	14 60.3	10.8	29.0	
	7554	18 30.9	23.5	16.6	
	7566	2 21.0	14.8	25.8	
	7621	9 77.0	20.0	21.0	
	7641	8 44.8	23.3	18.0	

Observations for Latitude.—Station, Colorado Springs—Continued.

Date.	No. of star.	Microm. reading.	Level. N.	Level. S.	Remarks.
1873.		t. d.	d.	d.	
Aug. 5	7683	12 54.6	19.9	22.0	
	7733	7 42.1	22.0	20.0	
	7757	6 86.9	19.0	23.0	
	7825	11 67.5	24.7	18.0	
	7832	15 72.1	20.3	22.0	
	7857	4 98.5	20.2	22.0	
	7874	6 94.2	20.3	22.0	
	7880	12 80.0	21.6	20.8	
	7931	5 63.8	21.5	21.4	
	7951	11 1.5	23.0	19.8	
	7990	7 35.8	13.5	29.3	
	8003	11 84.0	24.8	18.0	
	8039	7 19.8	15.4	28.0	
	8077	8 79.2	14.4	29.0	
	8147	5 33.1	26.0	17.9	
	8188	8 56.3	13.0	31.0	
	Gr. 4110	14 50.0	13.7	31.5	
	8296	9 39.3	30.0	13.5	
	8310	15 27.1	10.3	33.2	
	8317	10 19.4	9.8	33.7	
	Gr. 4216	5 21.0	23.5	19.8	
	8374	15 19.4	13.8	29.5	
	28	8 5.0	19.0	25.0	
	67	11 31.0	25.2	18.8	
	87	11 66.5	27.2	17.0	
	105	5 80.4	12.6	32.0	
	121	11 85.1	20.0	24.7	
	178	6 18.9	24.0	21.3	
	201	4 48.9	23.6	22.0	
		9 40.4	23.3	22.3	
	250	15 50.8	19.0	27.4	
	285	8 41.6	22.3	23.5	
	339	10 20.9	25.9	20.3	
	357	7 30.7	26.0	19.7	
	441	12 78.4	15.5	30.3	
	474	5 33.7	18.6	25.0	
	514	15 68.0	25.0	19.0	
6	7554	17 64.0	21.7	12.0	Air very good.
	7566	1 46.9	15.8	18.3	
	7621	9 95.3	13.7	20.3	
	7641	8 60.1	25.0	9.0	

Date.	No. of star.	Microm. reading.	Level. N.	Level. S.	Remarks.
1873.		t. d.	d.	d.	
Aug. 6	7683	12 87.7	20.0	14.0	
	7733	7 62.5	21.0	13.3	
	7832	15 20.5	20.2	15.3	
	7857	4 43.0	12.0	23.6	
	7874	6 40.9	12.2	23.5	
	7880	13 7.0	20.2	15.0	
	7931	5 96.9	14.5	20.8	
	7951	10 71.0	14.8	20.3	
	7990	7 21.4	15.4	19.9	
	8003	12 17.8	19.9	15.0	
	8039	7 54.9	13.0	22.0	
	8077	9 16.2	13.0	22.0	
	8147	5 91.0	18.4	17.2	
	8188	9 17.3	13.0	23.0	
	Gr. 4110	15 10.3	12.8	23.2	Cloudy.
7	7297	16 75.0	17.9	14.7	
	7320	1 71.7	16.0	17.3	
	7361	5 77.7	15.3	18.2	
	7401	16 0.9	29.0	4.6	
	7444	9 78.5	16.7	17.0	
	7489	11 89.0	20.0	14.0	
	7505	5 64.7	19.8	13.8	
	7521	14 74.1	18.0	15.8	
	7554	17 81.2	19.0	14.9	
	7566	1 63.6	17.0	16.3	
	7621	10 19.0	18.5	16.0	
	7641	8 86.0	18.9	16.0	
	7683	12 99.1	16.0	18.3	
	7733	7 84.2	20.3	14.0	
	7757	7 33.3	19.0	15.3	
	7825	12 37.0	31.0	. .	
	7832	15 95.9	20.0	15.0	15^{s} after merid.
	7857	5 46.2	29.8	5.5	15^{s} after merid.
	7874	7 45.0	29.7	6.0	15^{s} after merid.
	7880	13 75.3	13.9	21.4	15^{s} after merid.
	7931	6 36.2	35.4	0.0	15^{s} after merid.
	8003	11 79.0	19.4	16.2	Changed incl'n.
	8039	7 25.4	18.9	16.9	
	8077	8 86.6	18.6	17.3	

Observations for Latitude.—Station, Colorado Springs—Continued.

Date.	No. of star.	Microm. reading.	Level. N.	Level. S.	Remarks.	Date.	No. of star.	Microm. reading.	Level. N.	Level. S.	Remarks.
1873.		t. d.	d.	d.		1873.		t. d.	d.	d.	
Aug. 7	8147	5 80.5	19.8	16.8		Aug. 9	5747	7 25.0	18.0	21.6	
	8188	9 21.2	20.3	16.6			5775	12 36.0	27.0	13.0	
	Gr. 4110	15 14.2	20.3	16.6			5790	9 22.8	19.5	20.4	
	8296	10 45.3	22.0	14.8			5834	10 11.7	22.0	18.0	
	8310	16 46.5	17.3	19.8			5871	8 46.8	22.3	17.9	
	8317	11 38.9	17.0	20.2			5927	10 34.2	16.0	25.0	
	Gr. 4216	4 85.3	19.6	17.6			5978	18 74.0	18.5	22.6	
	8374	14 90.6	8.3	29.0			5991	— 0 62.7	30.3	10.8	
	28	8 42.0	22.0	15.2			6079	12 24.2	24.0	17.9	
	67	11 76.1	9.7	28.2			6110	7 90.9	16.0	26.0	
	87	11 92.6	18.0	19.6			6157	10 16.0	16.3	25.9	Cloudy, heavy rain, and storm.
	105	6 8.0	14.7	22.9			7444	10 1.0	19.0	24.3	
	121	11 88.3	17.3	20.2			7489	12 23.2	34.0	9.7	
	178	6 30.3	15.2	22.2			7505	6 14.6	26.0	16.0	
	201	4 59.9	20.0	17.3			7521	15 28.7	21.8	21.8	
		9 54.6	21.8	15.9			8003	11 93.5	25.0	19.5	Cloudy; thro' clouds.
	250	15 77.0	1.0	36.0			8039	7 52.0	30.0	14.5	Setting of mic. uncertain.
	474	5 68.4	17.3	20.2			8077	9 23.2	30.4	14.0	
	514	16 24.0	5.9	31.8	Cloudy.						

Computations for Latitude.—Station, Colorado Springs.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1873.		° ′ ″	′ ″	″	″	° ′ ″
July 31	28	38 54 19.62	− 4 36.72	+ 0.08	0.00	38 49 42.98
	29	58 0.46	− 8 16.16	− 2.36	0.00	41.94
	30	50 18.86	− 0 34.45	− 2.59	0.00	41.82
	31	52 19.10	− 2 36.11	− 0.27	0.00	42.72
	32	52 7.84	− 2 32.75	+ 7.83	0.00	42.92
	33	44 6.75	+ 5 33.88	+ 0.93	0.00	41.56
	34	45 7.61	+ 4 32.34	+ 1.01	0.00	40.96
	36	47 49.29	+ 1 48.02	+ 5.01	0.00	42.32
	37	47 18.07	+ 2 21.36	+ 4.45	0.00	43.88
	38	48 8.24	+ 1 30.23	+ 4.01	0.00	42.48
	39	51 23.23	− 1 45.73	+ 5.58	0.00	43.08
	40	54 27.92	− 4 50.57	+ 5.52	0.00	42.87
	41	52 45.50	− 3 3.19	0.00	0.00	42.31
	42	50 7.84	− 0 26.07	0.00	0.00	41.77
	43	44 32.40	+ 5 8.36	+ 1.63	0.00	42.39
	44	47 59.51	+ 1 45.38	− 2.00	0.00	42.89
	45	46 41.05	+ 3 2.72	− 0.22	0.00	43.55
Aug. 2	1	38 44 17.10	+ 5 16.52	+ 8.83	0.00	38 49 42.45
	2	52 18.27	− 2 36.61	− 0.27	0.00	41.39
	3	49 12.95	+ 0 31.09	− 3.58	0.00	40.46
	5	59 37.08	− 9 53.67	− 3.63	0.00	39.78
	6	51 56.02	− 2 12.26	− 4.03	+ 0.30	40 03
	7	50 46.29	− 1 1.99	− 4.84	+ 0.30	39.76
	8	46 9.43	− 6 24.60	− 5.14	0.00	39.69
	9	54 19.47	− 4 32.73	− 5.36	+ 0.04	41.42
	10	52 2.04	− 2 17.25	− 3.79	0.00	41.04
	11	47 42.42	+ 2 0.07	− 2.69	0.00	39.80
	12	54 56.64	− 5 11.50	− 5.06	+ 0.04	40.08
	13	57 20.68	− 7 39.54	+ 1.73	0.00	42.91
	14	53 53.73	− 4 16.72	+ 3.16	0.00	40.17
	15	55 37.74	− 6 0.15	+ 2.69	0.00	40.28
	16	55 33.12	− 5 49.24	− 1.10	0.00	42.78
	17	51 40.50	− 2 0.84	+ 1.26	0.00	40.92
	18	46 23.19	+ 3 19.28	− 1.21	0.00	41.26
	19	47 21.81	+ 2 16.82	+ 2.53	0.00	41.16
	20	47 31.17	+ 2 8.90	+ 1.26	0.00	41.33
	21	56 20.23	− 6 42.34	+ 4.12	0.00	42.01
	22	46 32.70	+ 3 6.41	+ 2.31	0.00	41.42
	23	50 37.75	− 1 0.74	+ 4.51	0.00	41.52
	24	56 41.06	− 7 1.60	+ 2.36	0.00	41.80
	25	57 27.43	− 7 45.41	− 0.55	0.00	41.47
	26	54 53.13	− 5 14.55	+ 2.72	0.00	41.30
	27	50 43.09	− 1 4.59	+ 1.43	0.00	39.93
	28	54 20.25	− 4 38.88	+ 0.63	0.00	42.00
4	28	38 54 20.87	− 4 31.26	− 6.93	0.00	38 49 42.68
	29	58 1.72	− 8 16.08	− 5.50	0.00	40.14
	30	50 19.96	− 0 33.94	− 6.21	0.00	39.81
	31	52 20.47	− 2 40.89	+ 2.67	0.00	42.25
	32	52 9.08	− 2 30.25	+ 2.50	0.00	41.33
	33	44 7.72	+ 5 30.66	+ 2.94	0.00	41.32
	34	45 8.56	+ 4 29.25	+ 2.83	0.00	40.64

Computation for Latitude.—Station, Colorado Springs—Continued.

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1873.		° ′ ″	′ ″	″	″	° ′ ″
Aug. 4	35	38 45 26.65	+ 4 9.33	+ 4.95	0.00	38 49 40.93
	36	47 50.22	+ 1 50.91	+ 1.10	0.00	42.23
	37	47 19.18	+ 2 20.71	+ 2.28	0.00	42.17
	38	48 9.34	+ 1 30.54	+ 2.17	0.00	42.05
	39	51 24.36	− 1 48.43	+ 5.97	0.00	41.90
	40	54 29.04	− 4 52.37	+ 5.50	0.00	42.17
	41	52 46.58	− 3 4.87	− 0.30	0.00	41.41
	42	50 8.94	− 0 27.31	- 0.60	0.00	41.03
	43	44 33.51	+ 5 9.20	− 0.74	0.00	41.97
	44	48 0.60	+ 1 41.61	+ 1.37	0.00	43.58
	45	46 41.93	+ 2 58.41	+ 2.61	0.00	42.95
	46	52 36.80	− 2 56.95	+ 1.65	0.00	41.50
	47	44 1.61	+ 5 39.49	+ 1.48	0.00	42.58
	48	46 33.68	+ 3 8.59	− 0.55	0.00	41.72
	49	50 36.07	− 0 57.39	+ 3.49	0.00	42.17
	50	52 35.44	− 2 56.16	+ 2.61	0.00	41.89
	51	44 19.92	+ 5 24.52	− 4.01	0.00	40.43
5	14	38 53 55.48	− 4 14.31	+ 0.16	0.00	38 49 41.33
	15	55 38.54	− 5 55.89	− 0.22	0.00	42.43
	16	55 33.94	− 5 50.80	+ 0.27	0.00	43.41
	17	51 41.30	− 2 3.04	+ 4.45	0.00	42.71
	18	46 24.00	+ 3 16.55	+ 0.80	0.00	41.35
	19	47 22.65	+ 2 18.81	+ 0.03	0.00	41.49
	20	47 32.05	+ 2 7.06	+ 2.39	0.00	41.50
	21	56 21.11	− 6 43.62	+ 3.00	0.00	40.49
	22	46 33.60	+ 3 7.71	+ 0.91	0.00	42.22
	23	50 38.61	− 0 56.98	− 0.69	0.00	40.94
	24	56 41.96	− 6 59.55	− 1.40	0.00	41.01
	25	57 28.36	− 7 40.90	− 3.77	0.00	43.69
	26	54 54.04	− 5 9.06	− 3.55	0.00	41.43
	27	50 44.02	− 1 4.28	+ 1.32	0.00	41.06
	28	54 21.19	− 4 36.30	− 2.39	0.00	42.50
	29	58 2.03	− 8 20.18	− 1.13	0.00	40.72
	30	50 20.23	− 0 41.07	+ 1.18	0.00	40.34
	31	52 20.61	− 2 39.25	− 0.03	0.00	41.33
	32	52 9.39	− 2 29.32	+ 0.74	0.00	40.81
	33	44 7.96	+ 5 33.62	− 0.96	0.00	40.62
	34	45 8.81	+ 4 32.80	− 0.94	0.00	40.70
	35	53 24.22	− 3 42.42	+ 0.25	0.00	42.05
	36	47 50.47	+ 1 53.65	− 3.47	0.00	40.65
	37	47 19.46	+ 2 24.22	− 1.59	0.00	42.09
	38	48 9.61	+ 1 34.70	− 2.14	0.00	42.17
	39	51 24.65	− 1 40.42	− 2.72	0.00	41.51
	40	54 29.34	− 4 44.89	− 2.67	0.00	41.78
	41	52 46.87	− 3 2.65	− 1.76	0.00	42.56
	42	50 9.22	− 0 24.89	− 2.03	0.00	42.30
	43	44 33.78	+ 5 10.19	− 3.30	0.00	40.67
	44	48 0.87	+ 1 41.30	+ 0.11	0.00	42.28
	45	46 42.16	+ 3 2.13	− 2.53	0.00	41.76
	46	52 37.05	− 2 55.93	− 0.55	0.00	40.57
	47	44 1.87	+ 5 42.35	− 1.87	0.00	42.35
	48	46 33.93	+ 3 9.65	− 2.03	0.00	41.55

Computations for Latitude.—Station, Colorado Springs—Continued

Date.	Number of pair.	Half-sum of declinations.	Corrections.			Latitude.
			Mic. and ref.	Level.	Meridian.	
1873.		° ′ ″	′ ″	″	″	° ′ ″
Aug. 5	49	38 50 36.36	− 0 55.71	+ 1.21	0.00	38 49 41.86
	50	52 35.67	− 2 50.17	− 2.34	0.00	43.16
	51	44 20.15	+ 5 21.35	− 0.11	0.00	41.39
6	29	38 58 2.34	− 8 22.41	+ 1.98	0.00	38 49 41.91
	30	50 20.51	− 0 42.00	+ 2.58	0.00	41.09
	31	52 20.90	− 2 43.18	+ 3.77	0.00	41.49
	33	44 8.20	+ 5 34.84	− 1.84	0.00	41.20
	34	45 9.05	+ 4 33.33	− 1.76	0.00	40.62
	35	53 24.54	− 3 40.63	− 0.30	0.00	43.61
	36	47 50.71	+ 1 54.85	− 2.75	0.00	42.81
	37	47 19.75	+ 2 23.82	− 1.13	0.00	42.44
	38	48 9.89	+ 1 33.71	− 1.13	0.00	42.47
	39	51 24.94	− 1 41.39	− 2.42	0.00	41.13
	40	54 29.62	− 4 45.64	− 2.53	0.00	41.45
7	25	38 57 28.97	− 7 47.05	− 0.52	0.00	38 49 41.40
	26	54 54.62	− 5 17.90	+ 3.16	0.00	39.88
	27	50 44.96	− 1 5.41	+ 1.57	0.00	41.12
	28	54 21.81	− 4 42.15	+ 2.23	0.00	41.89
	29	58 2.66	− 8 22.63	+ 1.32	0.00	41.35
	30	50 20.77	− 0 41.32	+ 1.48	0.00	40.93
	31	52 21.20	− 2 39.99	+ 1.10	0.00	42.31
	32	52 10.01	− 2 46.49	+ 9.54	0.00	43.06
	33	44 8.46	+ 5 26.19	+ 8.06	0.00	42.71
	34	45 9.29	+ 4 29.41	+ 7.89	0.00	41.59
	35	53 24.86	− 3 49.63	+ 7.70	+ 0.06	42.99
	37	47 20.02	+ 2 30.93	+ 1.43	0.00	42.38
	38	48 10.18	+ 1 30.85	+ 1.24	0.00	42.27
	39	51 25.22	− 1 45.86	+ 1.84	0.00	41.20
	40	54 29.91	− 4 50.11	+ 1.84	0.00	41.64
	41	52 47.44	− 3 6.79	+ 1.29	0.00	41.94
	42	50 9.79	− 0 29.08	+ 1.10	0.00	41.81
	43	44 34.35	+ 5 12.31	− 5.14	0.00	41.52
	44	48 1.43	+ 1 43.79	− 3.22	0.00	42.00
	45	46 42.62	+ 3 1.67	− 2.69	0.00	41.60
	46	52 37.52	− 2 53.38	− 2.72	0.00	41.42
	47	44 2.38	+ 5 47.07	− 8.88	0.00	40.57
	48	46 34.45	+ 3 13.37	− 8.00	0.00	39.82
	51	44 20.60	+ 5 27.95	− 7.92	0.00	40.63
9	2	38 52 19.24	− 2 38.76	+ 2.86	0.00	38 49 43.34
	3	49 13.96	+ 0 27.62	+ 0.85	0.00	42.43
	4	48 44.25	+ 0 58.23	− 1.26	0.00	41.22
	5	59 38.12	−10 1.74	+ 4.23	0.00	40.61
	6	51 57.25	− 2 14.62	− 1.07	0.00	41.56
	7	50 47.51	− 1 4.69	− 0.96	0.00	41.86
	27	50 45.21	− 1 9.03	+ 5.23	0.00	41.41
	28	54 22.43	− 4 44.00	+ 2.86	0.00	41.29
	37	47 20.56	+ 2 17.17	+ 5.77	+ 0.19	43.88
	38	48 10.77	+ 2 26.10	+ 6.02	+ 0.19	43.28

Mean latitude of Colorado Springs, Colorado . . 38° 49′ 41″.67 ± 0″.035

The observations for latitude were made under very unfavorable circumstances. Undulations in the atmosphere, heavy winds, and great changes in temperature constantly affected the instrument.

It is customary in this office to select for latitude only thirty-five pairs of stars, which have to be observed on five different nights. But the observer is dependent upon the weather, and is frequently disappointed, although after waiting I preferred to select a greater number of pairs, believing that the final result of a latitude is better when depending upon various star-places, giving the probability that the errors resulting from the declination-places of the stars will more nearly compensate each other, and that this part of the probable error of the final result will come within that resulting from observation alone.

The mean latitude is obtained by taking the mean of all single results. For the different days the mean latitude is found to be as follows:

		°	′	″
July	31	38	49	42.491
August	2			41.043
	4			41.702
	5			41.652
	6			41.864
	7			41.585
	9			41.947

showing a great difference between the first and second day, arising from the disturbed condition of the air.

The probable error of one observation is,

$$\varepsilon_o = \pm 0.6745 \sqrt{\frac{\Sigma(v)^2}{n-1}}$$

where v is the difference between the mean results and the single results and n the number of observations; therefore the probable error of the mean result is,

$$\varepsilon_r = \pm 0.6745 \sqrt{\frac{\Sigma(v)^2}{n(n-1)}}$$

If it is proper to place all the observations in the final result with the same weight (as in determining the longitude of a station from different nights' work) the formula should be used in this way; but in determining the latitude of a station, every single result obtained also depends upon the places of the stars forming the different pairs. It is certainly wrong to determine the probable error of the latitude-result by this formula, (it would give, for latitude of Colorado Springs, a probable error less than 0″.01,)

though it is frequently done. If nearly the same number of stars are observed every night under the same conditions, I should prefer to determine the probable error of the final result after the manner of Mr. John H. Clark.

Let—

Probable error of one pair of stars, including constant errors of zenith-telescope observations . . . . . $= \varepsilon_p$

Probable error of one observation . . . . . $= \varepsilon_o$

Number of pairs used at the station . . . . . $= m$

Number of observations . . . . . $= n$

then probable error of the final result,

$$\varepsilon_r = \pm \sqrt{\frac{\varepsilon_p^2}{m} + \frac{\varepsilon_o^2}{n}}$$

The formula shows that if the stars used are not very good, it is then better to select a larger number of pairs of stars, giving the probability that the final result will be more independent of the declinations.

From all the observations of pairs of stars observed on three or more nights, I find the probable error of one observation—

$$\varepsilon_o = \pm 0''.428$$

and that of the final result,

$$\varepsilon_r = \pm 0''.035.$$

Taking the value for ε_p, found by Maj. C. B. Comstock, of the United States Lake Survey, for stars taken from Professor Safford's Catalogue for 981 Stars, $\pm 0''.53$, the probable uncertainty of the final result will be, $\pm 0''.082$.

Resulting Astronomical Co-ordinates for the Astronomical Monument at Colorado Springs, Colorado Territory, using, for the longitude of Washington and Salt Lake, the same data as in Clark's report.

	In time. h. m. s.	In arc. ° ′ ″	
Longitude . . .	1 51 4.888	27 46 13.30	west of Washington.
	6 59 17.008	104 49 15.10	west of Greenwich.
Latitude (north)		38 49 41.67 $\pm 0''.035$	

Respectfully submitted.

DR. F. KAMPF,
Civilian Astronomical Assistant.

First Lieut. GEO. M. WHEELER,
Corps of Engineers, in charge.

UNITED STATES ENGINEER OFFICE,
GEOGRAPHICAL AND GEOLOGICAL EXPLORATIONS AND SURVEYS
WEST OF THE 100TH MERIDIAN, *May* 1, 1873.

Memorandum of instructions for conducting observations for longitude and latitude at a main or primary astronomical station for the field-season of 1873.

The fixed observatory, with which connection will be made, is in Temple Square, Salt Lake City, Utah, and in charge of Assistant John H. Clark. Every observer is responsible for the receiving of the signals from the connecting-stations for certain reductions of results, as full as possible, and will follow such other instructions that may, from time to time, be given. This station will be changed during the season, probably in the month of August, to the United States engineer observatory, to be constructed at Ogden, Utah.

1.—*Observations for Longitude.*

In carrying on the astronomical campaign, preference will be given to the longitude-results for those nights that are clear at both stations; that is, the observers in charge, after having completed the necessary arrangements for the observations and exchange of signals, will, from this time on, exchange signals each night that shall be fair at the two stations, unless unavoidable difficulties arise to prevent.

It will be carefully observed that weather-signals are sent by telegraph each evening about 6 p. m. while the exchanges are going on and until the full series at a station shall have been completed. In case of uncertainty as to the possibility for observing for any one night, this may be indicated in the first dispatch; and subsequent dispatch or dispatches, between this time and 10 p. m., shall determine whether exchanges shall be made that night or not.

Some convenient and concise form will be adopted for the weather-signals, and in no case must there be a failure as regards forwarding them.

It may be admissible, contingent upon the stage of the prosecution of the work, should the weather at Salt Lake at about 6 p. m. look unfavorable, that the observer at the distant station should at once conclude to take that night for latitude-work, which may be done after informing the observer at the Salt Lake or the receiving station.

For the conducting of the observations for the exchanges for a single night, the following instructions will be adhered to: The transit of stars for time-determinations, consisting of not less than three time and two circumpolar stars in each position of the instrument, both before and after the transmission of the signals, will be taken. Of course, should the night be sufficiently clear, so that it seems possible to make the time-determinations at both stations, by the modification of the above, so that at one or both of the stations the transits of stars may be made entirely before or entirely after the sending of the signals, the strict following-out of the above is not necessary.

These instructions are made with the understanding that a twenty-six or thirty-

two inch Würdemann instrument is used, with recording-apparatus in shape of a chronograph or register.

The time set for the transmission of signals should be as near 9.30 p. m. local time of the Salt Lake meridian as possible; and great care should be taken that both observers shall be on hand simultaneously, so that as little delay as possible shall ensue in the use of the telegraph-wires.

In the transmission of signals the record is to be made upon the chronograph or register at the two places over a space of five minutes in time, the connecting or Salt Lake station sending for the first five minutes and the distant station receiving, and *vice versa.*

In addition to these, which may be known as the chronograph-signals, arbitrary signals will be sent, by the use of a break-circuit key, at about ten seconds apart, at fractional parts of a second, making a series of thirty-one arbitrary signals during the five minutes.

In order that the observer at a station may conclude that he has accomplished six nights of first-class observations, it becomes necessary that there should be an exchange of the approximate results. Each observer will therefore send to the other, upon each subsequent night or as soon thereafter as practicable, the approximate error of his chronometer and the mean of seven arbitrary signals, sent and received, selected from the middle of the set of thirty-one. This may be concisely expressed in a telegram.

For the full satisfaction of an observer at the distant station, such further computation shall be sent and received as shall seem necessary to a clear understanding of the case; as an observer will be held responsible should he leave the station and go to another before he is certain that the results upon final computation would prove satisfactory.

2.—*Observations for Latitude.*

These will be conducted through five complete and clear nights, so that there shall not be less than 175 pairs of observations upon 35 separate and distinct pairs of stars, each pair of which observations shall give a first-class result.

These instructions are furnished to the observers with a view to their clearly understanding the class of results intended, and will always be carried out, unless unforeseen difficulties arise, in which event, as the observers will not hereafter be within speedy communication of these headquarters, it will be necessary for them to adopt immaterial modifications upon their own responsibility. It is, of course, understood that each observer is responsible for and receives the credit of his own work.

A report will be made by each observer, at intervals not exceeding fifteen days, of the work under his charge.

A full daily journal will be kept by each observer. Great care will be taken as to the character of the record upon this journal, which should be clear and explicit. The position of the station in reference to surrounding natural objects should be clearly described, and imperishable meridian-marks firmly planted. When possible, a special survey and plat will be made.

The day following an exchange of the chronographic record of time and exchange-signals, said signals will be carefully copied into a record-book, which, like all other records, must be made in duplicate.

It is intended that computations in the field shall be carried on to such an extent as circumstances may permit.

The time that can be allotted to each of these stations, in order to accomplish the expected results for the season, is from twenty to twenty-five nights; and as observations are required only for eleven nights, the remaining interval should be employed in computation.

The order of sequence for an astronomical report is furnished herewith, and the records and journal will be so kept as to comprise all the data necessary for the full expression of results in accordance therewith.

Official:

GEO. M. WHEELER,
First Lieutenant Corps of Engineers, in charge.

U.S. Engineer dept.
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