SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

MAGNETICAL OBSERVATIONS

IN THE

ARCTIC SEAS.

BY

ELISHA KENT KANE, M.D., U.S.N.

MADE DURING THE SECOND GRINNELL EXPEDITION IN SEARCH OF SIR JOHN FRANKLIN, IN 1853, 1854, AND 1855, AT VAN RENSSELAER HARBOR, AND OTHER POINTS ON THE WEST COAST OF GREENLAND.

REDUCED AND DISCUSSED,

BY

CHARLES A. SCHOTT,
ASSISTANT U. S. COAST SURVEY.

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CONTENTS.

INTRODUCTORY LETTER.

WASHINGTON, *May* 17, 1858.

PROFESSOR JOSEPH HENRY, LL.D.,

Secretary of the Smithsonian Institution:

DEAR SIR: The records of the magnetic observations made under the direction of Dr. Kane, in the second expedition to the Arctic regions, were placed in my hands by his late lamented father, Judge Kane, in December last.

Dr. Kane had selected Assistant Charles A. Schott, of the Coast Survey, for the reduction of a considerable portion of the observations made in that expedition; and I, therefore, placed these in Mr. Schott's possession for reduction and discussion. The work has been faithfully performed, and I recommend it for publication in the "Smithsonian Contributions to Knowledge." It is proper to state that the instruments were furnished by the Coast Survey and the Smithsonian Institution, and that the computations have been made at the expense of the latter.

Very respectfully, yours,

A. D. BACHE.

SECTION I.

MAGNETIC DECLINATION.

1854.

COMMENTS AND ADJUSTMENTS.

Instruments.—The observations for diurnal inequality as well as those for absolute declination, were made with a Jones unifilar magnetometer (No. 3), kindly loaned by Prof. A. D. Bache, Superintendent U. S. Coast Survey. The azimuth circle reads to 20″ and the centre division of the scale reads 280. The magnet was suspended by means of a silk thread 9½ inches in length. Several trials to determine the effect of torsion gave such small quantities that it was not considered necessary to take the same into account. The instrument was not originally intended to give absolute declinations, but at the Winter Quarters the observer succeeded in obtaining a few values for absolute declination by detaching the box, containing the magnet, from the circle which bears the telescope. The same was then moved in azimuth until a well defined object within the small range of its vertical motion could be observed. The focus of the telescope was adjusted to the distance. We find the instrument "perched on a pedestal of frozen gravel," the contents of two barrels. This mounting was considered as stable as the rock underneath. On the 9th of June, 1854, Mr. Sountag examined the instrument in reference to local disturbance, and found no sensible deviation arising from such a source. "The local deviation seems to have corrected itself; the iron in our comfortless little cell seems to have been so distributed that our results were not affected by it." (Narrative, vol. I.) The adjustments were made according to Riddel's magnetical instructions. The mirror attached to the suspended magnet faces the magnetic north. The following are the determinations for the angular value of a scale division:—

Circle.	Scale.	Circle.	Scale.	
Readings; January 13, 1854.				Winter Quarters, Van Rensselaer Harbor.
120° 60′–58′	45^{d}.5	118° 11′–07′	253^{d}.0	Taking alternate means, we obtain from each set the values:— $1^{d}=0'.797$.
120 16—14	100.7	117 34—30	303.0	
120 16—14	92,5	117 34—30	303.2	
119 30—27	153.5	116 49—46	351.0	
119 30—27	148.0	116 49—46	354.5	
118 48—45	199.0	116 13—10	394.0	
118 48—45	201.0	116 05—00	405.5	
118 11—07	250.5	115 31—29	451.0	

Circle.	Scale.	Circle.	Scale.	
Readings; January 16, 1854.				(Dr. Hayes, observer.)
119° 31′–31′	452^{d}	121° 53′–55′	256^{d}	$1^{d}=0'.741$.
120 48—46	350	123 19—18	150	
120 48—46	353	123 19—18	149	
122 09—06	251	124 42—40	42	
Readings; February 16, 1854.				
127° 04′–04′	62^{d}.5	121° 34′–34′	453^{d}.0	$1^{d}=0'.839$.
125 55—56	153.0	122 55—56	356.0	
125 55—56	136.0	122 55—56	360.0	
124 18—17	257.0	124 23—24	249.0	
124 18—17	259.7	124 23—24	254.0	
123 00—00	355.0	125 47—47	150.0	
123 00—00	354.5	125 47—47	145.5	
121 34—34	463.0	127 05—05	42.0	

Value resulting, equal mean of all or one division of scale = 0′.804.
Value adopted = 0′.80.

An {increase / decrease} of scale readings indicates a movement of the north end of the magnet to the {east / west}.

A well rated pocket chronometer, nearly showing Greenwich mean time, was used for noting the time.

Diurnal Variation.—The observations for changes of magnetic declination were made during the months of January, February, and March, 1854, at the following dates:—

January 10–11	and	February 10–11
" 13–14	"	" 14–15
" 24–25	"	" 17–18
" 27–28	"	" 21–22
" 31–32	"	" 28–29
February 3–4	"	March 3–4
" 7–8	"	" 7–8

To these must be added the term days during the same period of the year, viz: January 18–19, February 24–25, and March 22–23. The remaining three terms in April, May, and June, of the same year, furnish values of the change of the diurnal inequality at a later season. Readings (the mean of two extremes during a vibration when the magnet was in motion) were taken every sixth minute, commencing, with but one exception, between 4 and 5 o'clock in the afternoon. The error of the chronometer has been applied and the time in the abstracts is given in local mean (astronomical) time. The readings are, as stated above, uncorrected for torsion, and are expressed in scale divisions. In regard to the observers, Dr. Kane remarks in his narrative: "It was not until the close of the winter that I was able to take my share in the preceding (the observations for variation) or the term-day observations; and I desire to express my obligations to Dr. Hayes and

Mr. Bonsal, as well as to George Stephenson, for their zealous and intelligent co-operation with Mr. Sonntag and myself." Each set of observations extends over twenty-four hours; they were taken nearly one minute earlier (between 56^s and 40^s) than indicated in the abstract. The general remark on page 435 of the second volume of the Narrative, "the scale reading 280 corresponds to a magnetic declination of 108° 3′ west, etc.," appears to leave no doubt that the instrument was left undisturbed, and there being no statement to the contrary, we can assume the hourly and daily means at the several days of observation to refer to the same zero or to be comparable amongst themselves. At a later period in June, 1854, the azimuth circle appears to have turned about 19 minutes.

Term-day Observations.—There were six in number. The observations commence at 10 P. M., mean Göttingen time, or about $4^h\ 37^m\ 34^s$ mean Fern Rock time, the difference of longitude being assumed to equal $5^h\ 22^m\ 26^s$. The observations were not taken at the precise instant as indicated in the abstracts; the small deviation is noted at the head of each table.

Absolute Declination.—The expedition not being provided with a proper instrument, the magnetometer was temporarily converted into a declinometer by Mr. Sonntag, who determined the declination on June 9th, the 14th, and the 26th, 1854. The top of a mountain was used as a mark; it bore south 22° west (magnetic).

The mirror attached to the magnets can be inverted so that the mean reading of mirror direct and mirror reversed corresponds to the reading of the magnetic axis of the magnet.

Geographical Position of Observatory.—The latitude and longitude of the astronomical observatory has been determined as follows: Lat. 78° 37′.0 north, Long. 70° 40′ west of Greenwich. (See p. 305, vol. II. of the Narrative, also pp. 385 and 387 of the same volume.) The island (Observatory Island) on which the observatory (Fern Rock Observatory) was placed, was some fifty paces long by perhaps forty broad. (See p. 116, vol. I. of Narrative.) The magnetic observatory was adjoining; it was of stone, ten feet square, with a wooden floor as well as roof, and supplied with a copper fire grate. No iron was used in its construction.

The following is an extract of note 56, p. 464, of vol. I. of the Narrative: "The subjoined are given as aids to physical inquiry on the part of future travellers: Directions to sites of Rensselaer harbor. The observatory was placed upon the northernmost of the rocky group of islets that formed our harbor. It is seventy-six English feet from the highest and northernmost salient point of this island, in a direction S. 14° E., or in one with said point and the S. E. projection of the southernmost islet of the group. A natural face of gneiss rock formed the western wall of the observatory. A crevice in this rock has been filled with melted lead, in the centre of which is a copper bolt. Eight feet from this bolt, and in the direction indicated by the crevice, stood the magnetometer. This direction is given in case of local disturbance from the nature of the surrounding rocks."

The highest point of the island was about thirty feet above the mean tide level of the harbor. The observatory was known by the name of "Fern Rock Observatory."

OBSERVATIONS FOR CHANGES OF THE MAGNETIC DECLINATION AT VAN RENSSELAER HARBOR, 1854.

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, January 10 and 11, 1854.												
4h	300d	300d	299d.3	299d	295d.5	294d	294d	294d	293d	291.d5	5h	296d.0
5	291	290.8	290.7	300	295.2	292.8	292	290.8	289	288.4	6	292.1
6	290.2	292	290.6	288	290	287.5	284	282.5	281	280	7	286.6
7	280	279	277	276	277.5	278	279.5	280	280.5	281	8	278.9
8	282	283	284	284	285	285	287	286	286	285	9	284.7
9	286	287	286	288	290	289	292	290	287	286	10	288.1
10	289	292	294	295	295	297.5	298	303	304	303	11	297.0
11	300.5	300	300	299	298	298	297	298.5	303	304	12	299.8
12	304	306	307	308	310	307.5	311	311.5	310	310.2	13	308.5
13	310	309	308.5	308.2	309.3	310	309.8	306	313	314	14	309.8
14	312	310	310	309	308	306	303.3	303.5	306	308	15	307.6
15	309.5	308	305.8	306	304.5	303	301.5	306	306	305	16	305.5
16	304	302	298	298	301	301	295	290	289	289	17	296.7
17	289	286	287	288	292	287	302	299	297	299	18	292.6
18	287	285	283	283	282	268	252	241	244	246	19	267.1
19	249	255	256	254	257	270	291	295	294	298	20	271.9
20	290	277	273	271	273	250	275	270	260	251	21	269.0
21	260	266	257	249	248	247	251	253	255.3	248.6	22	253.5
22	246.3	255	260	258	256.5	254	256.5	258.5	257	256	23	255.8
23	258	262	267.5	270	272	278.5	282.3	279.0	280	273.5	0	272.3
0	272	270	263	259	253	251	250	246	254	252	1	257.0
1	252	360	265	268	269	271	273	273	274	274	2	267.9
2	274	279	275	274	278	276	275	276	276	280	3	276.3
3	291	289	294	297	300	301	302	304	304	305	4	298.7
4	312	314	310	312	314						Mean	284.7
Fern Rock Observatory, January 13 and 14, 1854.												
								300d	299d	295d	4h	
4h	302d	304d	308d	311d	314d	317d	315d	313	316	319	5	311d.9
5	317	314	311	313	315	319	322	328	335	337	6	321.1
6	339	340	336	331	326	330	328	316	329	335	7	331.0
7	340	338	344	346	348	343	342	342	345	349	8	343.7
8	350	364	371	371	368	366	358	356	350	349	9	360.3
9	344	338	334	329.5	329	327	330	336	342	342	10	335.1
10	339	339.5	335.5	340	347.5	350	349	348.7	350.2	354.8	11	345.4
11	354	352	350.8	353	351	347	343	343	344.8	342.8	12	348.1
12	341	342	343.8	344	343.5	343	342	340.5	340	341	13	342.1
13	341	342	343	347	346	346	347	357	352	348	14	346.9
14	355	352	354	356	352	348	345	344	346	349	15	350.1
15	350	351	352	358	362	371	377	378	374	372	16	364.5
16	370	368	371	374	374	374	371	365	359	358	17	368.4
17	352	352	346	341	339	330	328	325	324	320	18	335.7
18	321	323	330	335	345	347	337	330	293	295	19	325.6
19	295	292.5	288	280	260	263.5	269.5	274	269.8	272	20	276.4
20	274	284	254	263	257.7	266.5	272.5	270	267	285	21	269.4
21	295	297	285	271	272.8	276	271.5	270	266	266	22	277.0
22	265	264	265.5	267	269	270	270	269	266	264	23	267.0
23	261	267	274	275	277	269	262	250	246	242	0	262.3
0	212	218	224	231	242	252	252	255	264	273	1	242.3
1	276	277	278	278	278	276.5	276	277	282	289	2	278.8
2	290	287	288	288	292	301	311	310	305.8	309	3	298.2
3	306	299	296.5	297.5	299.5	300.5	307	318	319.5	315.5	4	305.9
4	315	319	316								Mean	317.0

Value of a division of the scale 0′.80.

Increase of scale readings corresponds to a movement of the north end of the magnet to the east.

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, January 24 and 25, 1854.												
								305d	305d	305d	4h	
4h	307d.3	310d	313d	315d	317d	318d	323d	326	331	333	5	319d.3
5	337	340	342	346	348	350	353	355	353.5	354	6	347.8
6	355	355	357	357	359	360	361.5	363	361	369	7	359.7
7	373	371	366	363	368	367	366	367	367	366	8	367.4
8	364	363	362	357	356	358	360	362	364	365	9	361.1
9	364	361	358	362	365	367	363	359	357	356.5	10	361.2
10	355	354	354.5	357	356	358	358.5	360.5	359	358.5	11	357.1
11	356.5	354	356	358.5	359	361	363	364	359	352	12	358.3
12	350	352	353.5	351.5	352	354	356	359.5	361	363	13	355.2
13	360	355	359	368	370	370	373	366	361	358	14	364.0
14	360	366	365	361	359	353	351	350.8	350	349	15	356.5
15	347	348	347	344	344	344.5	342	343	340	340	16	344.0
16	340	342	344	344	344	344	343	343	343	342	17	342.9
17	340	338	338	337	337	338	338	339	341	342	18	338.8
18	344	345	348	348	347	346	346	346	347	347	19	346.4
19	347	348	348	349	350.5	350	349.5	348	346	336	20	347.2
20	322	316	318	318.5	320	321	308	305	304	301	21	313.3
21	301.5	300.5	292	291	286	291.5	304	302	310	314	22	299.2
22	317	315	315	314	316	316	318	316	314	314	23	315.5
23	315	313	312	313	314	310	309	309	308	300	0	310.3
0	298	301	304	302	292	287	282	285	288	294	1	293.3
1	300	305	300	294	292	304	304	311	309	310	2	302.9
2	312	314	316	312	308	310.5	314	315	315	314.5	3	313.1
3	316	316.5	318	316	310.5	310	310	312	315.6	318.5	4	314.3
4	311.5	310.5										
											Mean	337.0
Fern Rock Observatory, January 27 and 28, 1854.												
4h	306d	305d	307d	313d	320d	327d	321d	315d	312d	308d	5h	313d.4
5	304	302	302	306	307	308	306	308	314	316	6	307.3
6	320	325	330	332	328	326	324	323	325	326	7	325.9
7	326	328	323	324	324	325	325	320	319	320	8	323.4
8	319	319	319	319	318	319	320.5	321	322	322	9	319.8
9	322	322	322	322	323	324	323.7	324	323	323	10	322.9
10	322	320	322	323.7	325.8	326.5	327	327.3	325	328	11	324.7
11	329	329.8	330	329	328	326	326	337	338	334.7	12	330.7
12	332	342	342.2	341	339.5	334	331	328	330	331	13	335.1
13	331.4	336	337	334	330	336	334	332	331	330	14	333.1
14	330	332	334	330	338	347	357	353	348	344	15	341.3
15	346	348	348	346	345	345	346	351	356	350	16	348.1
16	346	345	347	348	349	355	359	364	368	370	17	355.1
17	378	380	384	386	388	389.5	388	387	387.5	386	18	385.4
18	386	386	386	386	385	381	378	375	375	374	19	381.2
19	374	373	370.8	365	365	360	355	355.5	352	349.5	20	362.0
20	360	365	362	360	356	353	352	351.5	353	356	21	356.8
21	354.5	356	357.5	360	362	364.5	365	365.5	363	361	22	363.8
22	359	360	361	362	363	365	367	368	365	363	23	363.3
23	360	356	341	346	341.5	336	337	338	338	335	0	342.8
0	332	335	339	342	341	340	340	341	342	346	1	339.8
1	351	356	360	359	358	363	355	362	357	354	2	357.5
2	350	350	350	348	346	350	345	344	349	350	3	348.2
3	352	352	353	355	358	359	354	340	333	332	4	348.8
4	336	340	343	345	345							
											Mean	342.9

Value of a division of the scale 0′.80.

Increase in scale readings corresponds to a movement of the north end of the magnet to the east.

Aurora visible on the 27th and 28th.

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, January 31 and February 1, 1854.												
								304d	306d	325d	4h	
4h	332d.5	340d	341d.5	335d.5	345d	333d.5	334d.5	330	330	328	5	335d.0
5	326	327	328.5	324	318	311	313	320	325	330	6	322.2
6	338	344	348	356	358	359.5	356	357	358	358	7	353.2
7	359	359	360	360.5	361	362	363.5	365	367	368.5	8	362.5
8	370	372	372	374	371	370	371	371	371	372	9	371.4
9	372	372	373	373	374	372	372	372	371	370	10	372.1
10	368	368	367	364	361	365	371	370	369	367	11	367.0
11	365	366	370	377	376	377	380	387	384	382	12	376.4
12	379	374	375	376	374	373	370	368	374	375	13	373.8
13	376	376	380	384.5	385	384	383.5	382	380	378	14	380.9
14	379	381.5	383	384	385.5	383	380	379	376	370	15	380.1
15	368	365	364	365	367	369	371	373.5	374	375	16	369.1
16	374.5	375	375	374.5	374	375	374	374	373	373	17	374.2
17	373	374	374.5	375	374	374	374	375	378	382	18	375.3
18	385	387	390	389	388	388	389	390	385	386	19	387.2
19	387	388	389.8	387	389	389	389	387	387	386	20	387.9
20	385	385	385	384.5	383	382	382	382	376	370	21	381.4
21	367	369	370	370	292	288	278	284	285	291	22	319.4
22	294	297	311	328	338	348	359	359.5	351	350	23	333.5
23	342	338	334	318.5	314	312	311	314	318	323	0	322.4
0	329.5	331	322	332	333	342	346	350	359	365	1	340.9
1	370	370	370	375	381	379	375	372	368	364	2	372.4
2	359	356	355	354	352	351	351	350	363	373	3	356.4
3	375	377	377	380	383	376	376	378	380	386	4	378.8
4	390	396	400	398	396	407	419	430	440		5	
											Mean	362.2
Fern Rock Observatory, February 3 and 4, 1854.												
								336d	335d	342d	8h	
8h	348d	353d	358d	363d.5	367d.5	372d	374d	374	374	376	9	366d.0
9	377	376	375	373	370	365	363	362	362	363	10	368.6
10	369	370	372	372.5	374	377	378	378.7	379	385	11	375.5
11	386	388	390	393	400	408	407	404	402	398	12	397.6
12	403	408	406	407	410	408	406	405	408	410	13	407.1
13	413	410	411	415	435	450	454	456	457	430	14	433.1
14	425	415	412	411	411	410	406	405	400	400	15	409.5
15	400.5	400	398	397	396	394	390	385	392	408	16	396.0
16	411	414	418.5	408	397	393	389	389.5	389	389	17	399.8
17	390	392	393	391	389	388	378	362	342	337	18	376.2
18	335.5	336	342	351	362	380	386	409	367	350	19	361.8
19	339	320	308	323	316	309	296	285	270	262	20	302.8
20	261.5	260	258	261	262	275	270	274	278	287	21	268.6
21	295	302	303	299	296	300	303	320	334	340	22	309.2
22	355	354	344	332	340	362	350	342	340	344	23	346.3
23	348	352	345	341	330	320	315	314	314	315	0	329.4
0	320	332	336	340	345	340	339	350	348	346	1	339.6
1	346.5	346	345	350	340	332	340	346	325	305	2	337.5
2	298	308	315.5	316	314	311	311	310	308.5	306	3	309.8
3	304	302	300	294	286	294	301	307	319	333	4	304.0
4	345	349	349	353	358	361	362	364	364	362	5	356.7
5	360	358	356	359	362	362	364	362	368	370	6	362.1
6	369	366	371	375	378	377	375	380	390	389	7	376.0
7	389	379	373	371	370	370	370	371	371		8	(373.5)
											Mean	358.6

Value of a division of the scale 0′.80.

Increase in scale readings corresponds to a movement of the north end of the magnet to the east.

NOTE.—Another stove had been put up temporarily; it was removed at the close of the observations.

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, February 7 and 8, 1854.												
								316^d	317^d	317^d	4^h	
4^h	316^d.5	317^d	317^d	316^d	314^d	314^d	315^d	315	316	317	5	315^d.7
5	319	320	322	323	322	320	321	323	326	329	6	322.5
6	333	336	339	342	344	345	347	349	345	339	7	341.9
7	341	345	349	355	355	361	454	346	352	356	8	351.4
8	357	356.5	356	355	354	354	355	355	355	356	9	355.3
9	356	356	356	355	354	352	352	354	355	360	10	355.0
10	369	370	369	368	368	369	370	372	374	375	11	370.4
11	377	379	375	370	367	368	368	368	368	368	12	370.8
12	367	367	368	369	370	372	375	377	380	383	13	372.8
13	386	389	392	395	396	394	392	389	389	390	14	391.2
14	389	387	386	384	381	378	375	372	369	365	15	378.6
15	362	359	355	350	346	342	337	336	334	333	16	345.4
16	333	334	334	335	336	338	339	339	338	336	17	336.2
17	330	325	320	314	311	308	304	302	301	302	18	311.7
18	302	302	298	294	290	287	284	280	276	273.5	19	288.6
19	271	270	268	266.5	274	283	287	290	294	294	20	279.7
20	295	297	298	300	301	305	307	310	313	313	21	303.9
21	313	312	312	311	303	295	287	294	294	295	22	301.6
22	297	298	296	295	293	294	301	310	319	326	23	302.9
23	322	323	325	323	322	321	319	318	314	312	0	319.9
0	306	299	300	301	303	306	310	320	328	334	1	310.7
1	335	336	337	336	332	329.5	330	332	332	330	2	332.9
2	327.5	320	313	308	301	296	288	291	308	315	3	306.7
3	317	315	312	309	313	320	329	333	333	334	4	321.5
4	336	341	347	350	352						5	
											Mean	332.8
Fern Rock Observatory, February 10 and 11, 1854.												
								251^d	254^d	256^d	4^h	
4^h	261^d	266^d	272^d	284^d	294^d	300^d	306^d	312	318	323	5	293^d.6
5	330	340	352	366	368	362	354	352	355	362	6	354.1
6	360	358	357.5	360	366	365	365	364	366	368	7	362.9
7	371	373	376	378	380	384	385	385	390	396	8	381.8
8	396	395.5	394	392.7	394	390	390	389	387	387	9	391.4
9	387	386	386	386	380	382	382	382	382	382	10	383.5
10	382	381	380	378	377	376	376	375	374	374	11	377.3
11	376	380	383	385	385	385	386	386	386	387	12	383.9
12	388	389	389	392	393	392	390	390	392	394	13	390.9
13	396	397	396	394	392	400	412	420	424	422	14	405.3
14	422	430	444	460	464	470	487	480	493.5	498	15	464.8
15	501	504	503	499	479	460	448	429	417	407	16	464.7
16	405	400	398	397	395	389	383	379	371	368	17	388.5
17	362	370	377	373	369	365	357	348	348	350	18	361.9
18	350	329	329	325	321	317	312.5	297	288	280	19	314.8
19	272	265	263	261	261	262	262	263	265	266	20	264.0
20	267	268	269	270	273	276	279	274	270	265	21	271.1
21	261	256	251	246	240	238	225	231	239	235	22	242.2
22	216	196	196	193	203	203	202	201	206	211	23	202.7
23	215	216	215	215	211	208	205	203	200	195	0	208.3
0	200	203	201	201	200	199	203	211	215	220	1	205.3
1	227	232	239	254	280	300	314	325	320	320	2	281.1
2	319	319	319	321	327	331	345	350	362	369	3	336.2
3	353	359	361	363	365	365	361	364	365	364	4	362.0
4	361	361	354	351	347						5	
											Mean	337.2

Value of a scale division 0′.80.

Increase of scale readings corresponds to a movement of the north end of the magnet to the east.

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, February 14 and 15, 1854.												
4h			304d	303d	304d	303d	307d	311d	316d	324d	5h	(307.d0)
5	331d	339d	343	347	350	352	355	358	359	360	6	349.4
6	362	362	365	369	372	380	387	396	401	410	7	380.4
7	393	398	398	401	417	449	440	435	440	440	8	421.1
8	435	434	428	420	420	412	405	408	413	422	9	419.7
9	439	450	470	478	487	486	486	494	482	465	10	473.7
10	462	458	451	443	438	432	426	431	443	457	11	444.1
11	472	483	494	493	491	487	483	477	458	436	12	477.4
12	434	414	410	409	410	407	406	408	413	419	13	413.0
13	428	441	452	456	459	462	473	464	465	462	14	456.2
14	458	454	450	449	447	446	458	473	478	481	15	459.4
15	486	489	491	492	490	492	494	494	490	485	16	490.3
16	478	470	468	460	452	444	434	430	428	420	17	448.4
17	416	420	414	414	409	404	401	399	396	394	18	406.7
18	391	376	376	377	378	392	391	366	359	356	19	376.2
19	349	344	338	320	312	334	340	336	329	329	20	333.1
20	331	339	350	356	359	354	349	345	331	317	21	343.1
21	296	292	289	292	292	291	289	287	284	278	22	289.0
22	275	273	258	246	244	238	234	228	223	218	23	243.7
23	212	208	211	186	160	138	146	136	132	129	0	165.8
0	131	144	159	171	181	192	203	211	218	226	1	183.6
1	236	244	245	246	247	257	269	252	236	238	2	247.0
2	241	242	240	243	247	254	249	249	251	254	3	247.0
3	257	266	278	292	316	322	316	311	319	332	4	300.9
4	331	351	360								Mean	360.7
Fern Rock Observatory, February 17 and 18, 1854.												
4h	190d	184d	172d	172d	169d	172d	181d	193d 188	193d 196	194d 198	4h 5	182d.2
5	193	183	185	188	180	182	185	195	207	208	6	190.6
6	208	230	258	298	296	286	272	271	270	270	7	265.9
7	265	258	252	244	237	230	227	225	226	228	8	239.2
8	232	235	238	242	249	255	260	260	261	262	9	249.4
9	262	263	265	268	273	276	279	281	291	300	10	275.8
10	302	300	280	273	260	249	242	236	228.5	237	11	260.7
11	241	247.5	245	240	236	231	232	230	229	227.8	12	235.9
12	225	222	240	238	242	239	236	230	247	253	13	237.2
13	261	248	240	231	233	237	250	244	242	240	14	242.6
14	238	236	235	238	243	242	240.5	237	234	231	15	237.4
15	229	229.5	234	239.5	239	238	240	241	243	247	16	238.0
16	249	251	250	247	245	242	237	233	228	223	17	240.5
17	218	220	223	228	232	235	237	238	239	240	18	231.0
18	235	232	230	233	235	237	233	228	234	237	19	233.4
19	240	234	228	220	204	166	164	147	130	152	20	188.5
20	179	188	206	230	256	250	241	236	226	217	21	222.9
21	218	221	224	221	217	208	221	237	244	245	22	225.6
22	244	248	254	250	247	244	242	241	240.5	240	23	245.0
23	240	250	252	247.5	238	227	220	219	216	214	0	232.3
0	214	215	216	220	226	232	236	240	247	255	1	230.1
1	262	271	180*	190	187	184	181	177	175	174	2	198.1
2	169	163	156	150	144	146	148	147	152.5	151	3	152.6
3	154	151	161	175	187	192	201	202	202	208	4	183.3
4	210	209	226	233							Mean	226.6

Value of a scale division 0′.80.

Increase of scale readings corresponds to a movement of the north end of the magnet to the east.

NOTE.—The mean in brackets includes two interpolated values.

* A sudden change of 90d occurring at 6h 30m chronometer time (Greenwich time nearly).

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, February 21 and 22, 1854.												
								270d	269d	268d	4h	
4h	268d	268d	273d	276d	271d	260d	252d	252	252	252	5	262d.4
5	252	253	256	256	253	254	256	257	258	260	6	255.5
6	261	263	263	265	267	267	268	269	271	273	7	266.7
7	274	275	276	277	280	282	286	291	296	301	8	283.8
8	302	302	303	303	302	302	301	302	301	299	9	301.7
9	296	293	290	289	287	286	284	283	283	283.5	10	287.4
10	282.5	280.5	278.5	276	274	274	274	279	284	287	11	278.9
11	288	289	290	294	297	299	300	296	294	293	12	294.0
12	292	292	290	287	284	281	276	276	275	280	13	283.3
13	285	287	290	293	297	290	282	280	278	276	14	288.3
14	276	278	282	282	284	285	287	287	287	288	15	283.6
15	288	288	289	290	293	293	294	294	296	296	16	292.1
16	295	295	293	292	291	291	293	290	287	283	17	291.0
17	280	278	275	272	271	268	267	266	265	263	18	270.5
18	261	260	258	255	254	255	257	260	262	263	19	258.5
19	264	262	259	260	261	261	260.5	260	259	256	20	260.2
20	251	244	240	242	230	218	216	212	205	203	21	226.1
21	206	210	216	221	223	224	230	237	250	250	22	226.7
22	250	250	254	257	258	262	260	260	261	263	23	257.5
23	261	260	260	258	260	261	262	262	262	262	0	260.8
0	262	262	262	262	263	263	262	261	261	260	1	261.8
1	259	259	258	257	258	259	259	260	261	263	2	259.3
2	264	266	269	271	273	275	277	280	278	274	3	272.7
3	274	275	278	290	294	304	293	286	282	280	4	285.6
4	283	282	279	276								
											Mean	271.2
Fern Rock Observatory, February 28 and March 1, 1854.												
								220d	220d	219d	4h	
4h	218d	216d	213d	207d	200d	191d	183d	179	180	182	5	196d.9
5	184	186	189	191	192	193	193	192	193	193	6	190.6
6	195	198	202	210	219	227	230	244	256	260	7	224.1
7	272	274	280	278	242	226	220	250	300	320	8	266.2
8	344	333	321	310	306	322	335	341	350	362	9	332.4
9	353	352	350	355	368	365	360	370	371	372	10	361.6
10	374	378	399	402	408	404	398	394	390	400	11	394.7
11	398	396	397	402	405	408	407	421	436	440	12	411.0
12	452	476	484	483	450	438	418	400	390	381	13	437.2
13	372	363	354	343	337	343	347	352	357	364	14	353.2
14	372	355	340	324	315	320	326	330	333	335	15	335.0
15	331	327	325	324	322	325	314	320	315	314	16	321.7
16	326	338	346	363	362	356	348	342	342	339	17	346.2
17	325	322	324	318	316	324	312	310	318	322	18	319.1
18	319	318	317	314	312	316	317	314	314	317	19	315.8
19	320	315	314	310	308	309	308	307	308	308	20	310.7
20	306	306	302	298	297	299	302	302	301	301	21	301.4
21	298	299	300	301	296	284	274	269	264	268	22	285.3
22	272	278	280	283	286	288	284	279	276	280	23	280.6
23	285	303	320	332	341	350	362	374	366	356	0	338.9
0	345	333	321	310	296	293	305	296	289	280	1	306.8
1	274	276	266	264	258	256	252	259	251	255	2	261.1
2	278	260	261	262	265	268	276	280	286	291	3	272.7
3	299	301	299	302	306	310	314	316	317	320	4	308.4
4	319	317	318	315	312						5	
											Mean	311.3

Value of a scale division 0′.80.

Increase of scale readings corresponds to a movement of the north end of the magnet to the east.

Mean local time.	36m.	42m.	48m.	54m.	00m.	06m.	12m.	18m.	24m.	30m.	Mean local time.	Hourly means.
Fern Rock Observatory, March 3 and 4, 1854.												
								250^d	247^d	246^d	4^h	
4^h	248^d	249^d	240^d	238^d	242^d	245^d	248^d	250	260	265	5	248^d.5
5	258	269	281	284	380	279	277	274	275	277	6	275.4
6	280.5	279	272.5	275	270	280	286	290	298	296	7	282.7
7	283	311	315	332	329	326	321	329	347	349	8	324.2
8	356	356	360	352	347	346	330	302	291	283	9	332.3
9	287	290	282	286	275	264	265	267	269	270	10	275.5
10	272	274	276	278	280	282	285	287	290	292	11	281.6
11	295	298	302	306	313	318	322	325	327	329	12	313.6
12	330	337	345	349	352	350	348	345	343	336	13	343.5
13	325	321	313	302	295	299	308	314	309	302	14	308.8
14	297	294	288	292	286	284	280	276	272	285	15	285.4
15	291	294	291	289	282	276	268	264	260	258	16	277.3
16	257	257	256	258	259	260	262	260	258	258	17	258.5
17	257	255	251	244.5	238	230	220	205	190	172	18	226.2
18	152	144	133	134	136	140	143	160	174	198	19	151.4
19	209	216	210	205	201	195	190	186	181	177	20	197.0
20	173	170	167	164	171	178	184	189	193	199	21	178.8
21	206	200	194	188	183	178	172	170	169	164	22	182.4
22	152	160	156	156	153	155	157	154	150	150	23	154.3
23	156	176	195	184	155	160	125	131	131	134	.0	154.7
0	135	137.5	155	179	195	184	187	200	197.5	192	1	176.2
1	195	200	190	185	182	179	150	136	150	156	2	172.3
2	173	190	200	206	217	204	196	190	186	183	3	194.5
3	189	192	199	204	209	216	222	229	234	243	4	213.7
4	249	251	254	257								
											Mean	242.0
Fern Rock Observatory, March 7 and 8, 1854.												
									190^d	202^d	4^h	
4^h	218^d	223^d	213^d	218^d	228^l	224^d	221^d	231^d	230	235	5	224^d.1
5	242	243	246	247	251	270	275	275	274	274	6	259.7
6	269	261	268	260	273	270	269	255	268	271	7	266.4
7	275	271	279	284	278	269	281	282	281	286	8	278.6
8	292	304	294	302	303	312	306	299	297	293	9	300.2
9	284	288	286	287	291	294	300	305	298	290	10	292.3
10	287	280	276	270	277	280	286	281	278	273	11	278.8
11	269	272	267	270	272	274	267	268	272	280	12	271.1
12	273	279	284	290	289	291	294	291	283	274	13	284.8
13	290	288	285	282	283	291	297	300	296	291	14	290.3
14	285	278	281	284	298	291	289	286	284	283	15	285.9
15	281	282	285	288	290	292	295	297	298	298	16	290.6
16	299	300	302	297	291	285	280	278	283	288	17	290.3
17	292	296	299	297	295	293	289	287	281	275	18	290.4
18	269	264	260	256	260	255	258	260	266	270	19	261.8
19	275	272	277	264	270	268	270	259	271	268	20	269.4
20	264	276	278	270	264	260	268	282	284	286	21	273.2
21	280	278	281	285	287	274	291	297	295	291	22	285.9
22	284	276	274	268	263	257	264	271	286	293	23	273.6
23	300	299	287	285	281	274	278	271	267	265	0	280.7
0	261	246	252	245	247	243	242	246	250	252	1	248.4
1	252	252	250	250	249	250	252	255	256	258	2	252.4
2	260	265	270	272	275	276	276	280	285	280	3	273.9
3	285	284	274			258	242	247	258	263	4	(264.3)
4	262	265	268	258	245						5	
											Mean	274.5

Value of a scale division 0′.80.

Increase of scale readings corresponds to a movement of the north end of the magnet to the east.

NOTE.—The mean in brackets includes two interpolated values.

Diurnal Range of the Declination.—The diurnal range being an index to the magnitude of the diurnal excursions, is best presented before the examination of the diurnal inequality. The following table contains the highest and lowest scale readings in the hourly series, and the maximum and minimum values observed, together with the corresponding ranges. One division of scale = 0′.80.

Daily Range of the Declination.

DATE.	IN HOURLY SERIES.		OBSERVED.		RANGE.	
1854.	Highest.	Lowest.	Maximum.	Minimum.	In hourly series.	Total observed.
January 10–11	309d.8	253d.5	314d.0	241d.0	56d.3	73d.0
" 13–14	368.4	242.3	378.0	212.0	126.1	166.0
" 18–19	357.9	109.7	369.0	85.0	248.2	284.0
" 24–25	367.4	293.3	373.0	282.0	74.1	91.0
" 27–28	385.4	307.3	389.5	302.0	78.1	87.5
" 31–32	387.9	319.4	440.0	278.0	68.5	162.0
February 3– 4	433.1	268.6	457.0	258.0	164.5	199.0
" 7– 8	391.2	279.7	396.0	266.5	111.5	119.5
" 10–11	464.8	202.7	504.0	195.0	262.1	309.0
" 14–15	490.3	165.8	494.0	129.0	324.5	365.0
" 17–18	275.8	152.6	302.0	130.0	123.2	172.0
" 21–22	301.7	226.1	304.0	203.0	75.6	101.0
" 24–25	531.3	321.4	558.5	268.0	209.9	290.5
March 0– 1	437.2	190.6	484.0	179.0	246.6	305.0
" 3– 4	343.5	151.4	360.0	125.0	192.1	235.0
" 7– 8	300.2	224.1	312.0	190.0	76.1	122.0
" 22–23	290.5	238.8	304.0	228.0	51.7	76.0

The mean diurnal total range observed during the above period becomes 2° 28′.6, and the maximum diurnal range observed took place on the 14–15 February, and amounted to 4° 52′.0. For comparison with similar quantities at other high latitude stations we may take Lake Athabasca, where the greatest range in any one day between October, 1843, and February, 1844, was 2° 35′, it happened October 16, 1843; at Fort Simpson the maximum range was 7° 27′, observed on the 16th of April, 1844, in a series of observations extending over April and May, 1844. The mean diurnal range during January and February, 1844, at Lake Athabasca, was 31′.4, and the mean range at Fort Simpson in April and May of that year was 1° 12′, these two quantities, however, were taken from the hourly series.

If we classify the ranges according to this magnitude we obtain the following results:—

Daily range	less than	1°	1
"	between	1 and 2°	6
"	"	2 and 3	4
"	"	3 and 4	3
"	"	4 and 5	3
"	greater than	5	0

The diurnal range in the winter months, January, February, and March, when compared with its annual fluctuation, is probably below the mean value of the year.

Diurnal Inequality of the Declination.—The following table contains the hourly means of all observations at the Winter quarters, between January 10 and March 23, 1854. The remaining observations on term-days at a later season have been excluded on account of their isolation. The above period includes the coldest season of the year, and during more than one-half of the period the sun was below the horizon.

The hourly means were made out separately for each month, the general mean includes seventeen values for each of the twenty-four hours. In January we have complete observations on six days, in February on seven, and in March on four days. The table also contains the monthly means, and all numbers are expressed in scale divisions (one division = 0′.80).

ABSTRACT OF HOURLY MEANS DURING THE MONTHS OF JANUARY, FEBRUARY, AND MARCH, 1854, OBSERVED AT FERN ROCK MAGNETIC OBSERVATORY.

(The readings are given in scale divisions; the values taken from the term-day observations embrace the same number of single readings between the same times.)

Fern Rock mean time.	5h.	6h.	7h.	8h.	9h.	10h.	11h.	12h.	13h.	14h.	15h.	16h.	17h.
Fern Rock Observatory, January and March, 1854.													
Jan'y 10–11	296.0	292.1	286.6	278.9	284.7	288.1	297.0	299.8	308.5	309.8	307.6	305.5	296.7
" 13–14	311.9	321.1	331.0	343.7	360.3	335.1	345.4	348.1	342.1	346.9	350.1	364.5	368.4
" 18–19	308.2	316.9	317.3	313.3	319.9	321.8	343.3	346.7	338.4	345.3	347.8	353.8	357.9
" 24–25	319.3	347.8	359.7	367.4	361.1	361.2	357.1	358.3	355.2	364.0	356.5	344.0	342.9
" 27–28	313.4	307.3	325.9	323.4	319.8	322.9	324.7	330.7	335.1	333.1	341.3	348.1	355.1
" 31–32	335.0	322.2	353.2	362.5	371.4	372.1	367.0	376.4	373.8	380.9	380.1	369.1	374.2
Means	313.9	317.9	329.0	331.5	336.2	333.6	339.1	343.3	342.2	346.7	347.2	347.5	349.2
Feb'y 3– 4	*356.7	*362.1	*377.0	*(373.5)	366.0	368.6	375.5	397.6	407.1	433.1	409.5	396.0	399.8
" 7– 8	315.7	322.5	341.9	351.4	355.3	355.0	370.4	370.8	372.8	391.2	378.6	345.4	336.2
" 10–11	293.6	354.1	362.9	381.8	391.4	383.5	377.3	383.9	390.9	405.3	464.8	464.7	388.5
" 14–15	(307.0)	349.4	380.4	421.1	419.7	473.7	444.1	477.4	413.0	456.2	459.4	490.3	448.4
" 17–18	182.2	190.6	265.9	239.2	249.4	275.8	260.7	235.9	237.2	242.6	237.4	238.0	240.5
" 21–22	262.4	255.5	266.7	283.8	301.7	287.4	278.9	294.0	283.3	288.3	283.6	292.1	291.0
" 24–25	344.7	429.6	461.2	514.1	531.3	526.4	491.8	498.3	498.2	496.2	501.2	512.4	520.8
Means	294.6	323.4	350.9	366.4	373.5	381.5	371.3	379.7	371.8	387.6	390.7	391.3	375.0
March 0– 1	196.9	190.6	224.1	266.2	332.4	361.6	394.7	411.0	437.2	353.2	335.0	321.7	346.2
" 3– 4	248.5	275.4	282.7	324.2	332.3	275.5	281.6	313.6	343.5	308.8	285.4	277.3	258.5
" 7– 8	224.1	259.7	266.4	278.6	300.2	292.3	278.8	271.1	284.8	290.3	285.9	290.6	290.3
" 22–23	261.3	246.3	258.5	258.6	240.9	238.8	270.1	280.3	274.3	266.7	260.8	269.6	269.8
Means	232.7	243.0	257.9	281.9	301.5	292.1	306.3	319.0	334.9	304.8	291.8	289.8	291.2
General means	286.9	302.5	321.3	334.2	343.3	343.5	344.6	352.6	352.7	353.5	352.0	352.1	346.2

Fern Rock mean time.	18h.	19h.	20h.	21h.	22h.	23h.	Noon. 0h.	1h.	2h.	3h.	4h.	Daily means.
Jan'y 10–11	292.6	267.1	271.9	269.0	253.5	255.8	272.3	257.0	267.9	276.3	298.7	284.7
" 13–14	335.7	325.6	276.4	269.4	277.0	267.0	262.3	242.3	278.8	298.2	305.9	317.0
" 18–19	347.7	327.9	348.1	336.3	306.4	236.2	109.7	246.6	289.3	333.1	321.3	313.9
" 24–25	338.8	346.4	347.2	313.3	299.2	315.5	310.3	293.3	302.9	313.1	314.3	337.0
" 27–28	385.4	381.2	362.0	356.8	363.8	363.3	342.8	339.8	357.5	348.2	348.8	342.9
" 31–32	375.3	387.2	387.9	381.4	319.4	333.5	322.4	340.9	372.4	356.4	378.8	362.2
Means	345.9	239.2	332.3	321.0	303.2	295.2	270.0	286.7	311.5	320.9	328.0	326.8
Feb'y 3– 4	376.2	361.8	302.8	268.6	309.2	346.3	329.4	339.6	337.5	309.8	304.0	358.6
" 7– 8	311.7	288.6	279.7	303.9	301.6	302.9	319.9	310.7	332.9	306.7	321.5	332.8
" 10–11	361.9	314.8	264.0	271.1	242.2	202.7	208.3	205.3	281.1	336.2	362.0	337.2
" 14–15	406.7	376.2	333.1	343.1	289.0	243.7	165.8	183.6	247.0	247.0	300.9	360.7
" 17–18	231.0	233.4	188.5	222.9	225.6	245.0	232.3	230.1	198.1	152.6	183.3	226.6
" 21–22	270.5	258.5	260.2	226.1	226.7	257.5	260.8	261.8	259.3	272.7	285.6	271.2
" 24–25	492.4	494.0	448.1	433.8	321.4	401.2	(389.9)	378.7	377.7	407.7	443.7	454.8
Means	350.1	332.5	296.6	295.6	273.7	285.6	272.3	272.8	290.5	290.4	314.4	334.6
March 0– 1	319.1	315.8	310.7	301.4	285.3	280.6	338.9	306.8	261.1	272.7	308.4	311.3
" 3– 4	226.2	151.4	197.0	178.8	182.4	154.3	154.7	176.2	172.3	194.5	213.7	242.0
" 7– 8	290.4	261.8	269.4	273.2	285.9	273.6	380.7	248.4	252.4	273.9	(264.3)	274.5
" 22–23	255.0	286.0	(285.0)	(275.8)	254.7	287.0	290.1	287.0	247.3	244.8	290.5	266.6
Means	272.7	253.8	265.5	257.3	252.1	248.9	266.1	254.6	233.3	246.5	269.2	273.6
General means	330.4	316.3	302.0	295.5	279.0	280.3	270.0	273.5	284.4	290.8	308.6	317.3

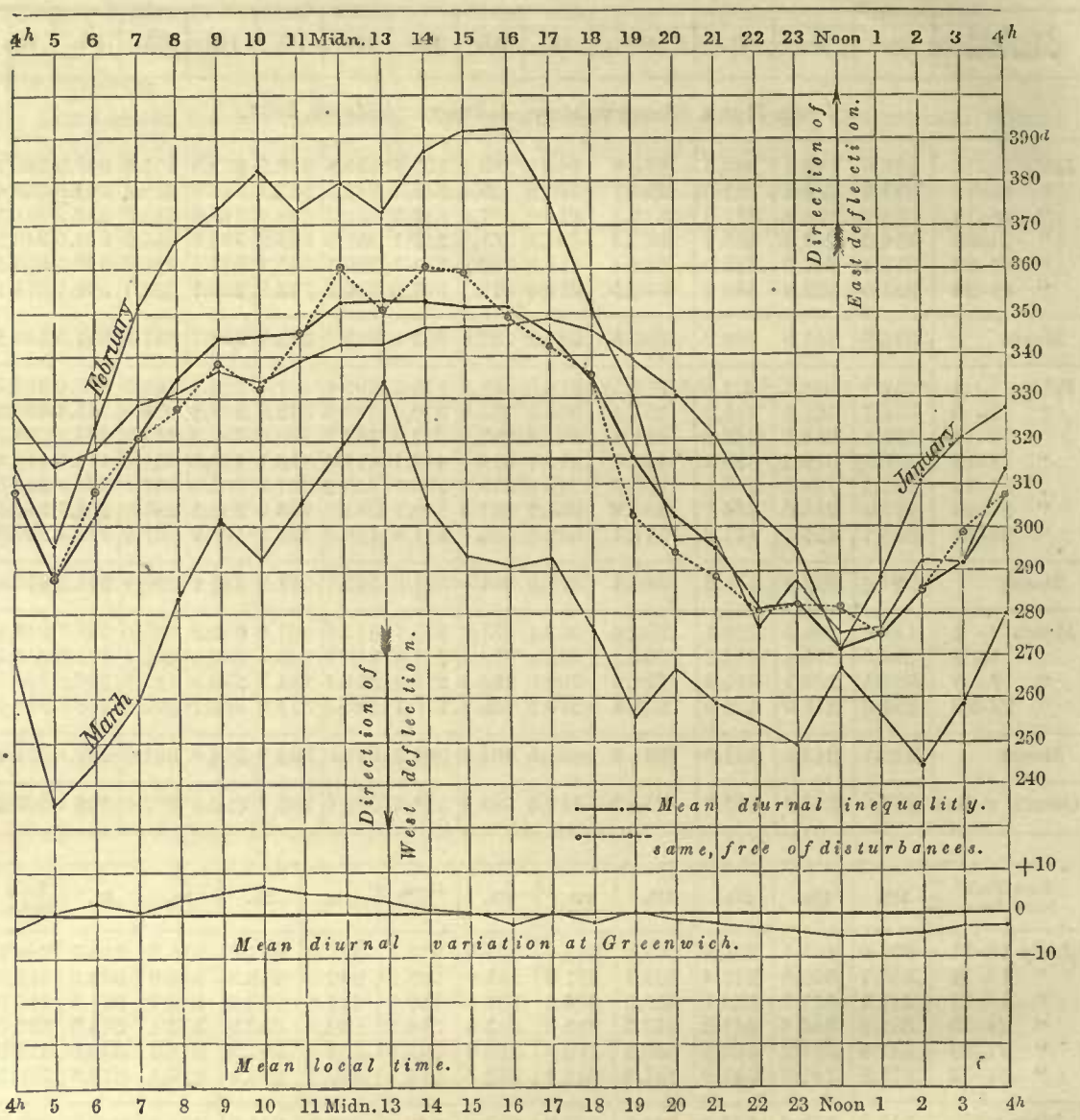
The values in the above table do not refer exactly to the even hour but to 3^m later.

Figures between brackets ( ) are means derived from less that ten readings.

* These four values were observed on the 4th at the hours indicated.

MEAN MONTHLY CURVES OF THE DIURNAL CHANGES OF THE MAGNETIC DECLINATION AT VAN RENSSELAER HARBOR, 1854.

AND SIMULTANEOUS MEAN DIURNAL VARIATION AT GREENWICH.



The irregularities in the daily curves compared on succeeding days are very considerable, as may be seen by glancing the eye over the last column of the preceding table, headed "daily means." No observations on account of disturbances have been excluded from the table, and the following mean diurnal inequality, therefore, contains their full effect. Comparing each hourly mean in the last horizontal line of the above table with the general mean, the following figures represent the resulting diurnal inequality of the declination during the first three months of the year 1854. For the sake of comparison the diurnal inequality observed at Greenwich during the same seventeen days has been made out and is given in the last column.

MEAN DIURNAL INEQUALITY OF DECLINATION DURING SEVENTEEN DAYS IN JANUARY, FEBRUARY, AND MARCH, 1854, AT VAN RENSSELAER HARBOR, AND AT GREENWICH DURING THE SAME DAYS; EXPRESSED IN MINUTES OF ARC.

Local mean time.	Van Rensselaer.	Greenwich.	Local mean time.	Van Rensselaer.	Greenwich.	Local mean time.	Van Rensselaer.	Greenwich.	Local mean time.	Van Rensselaer.	Greenwich.
5h	+24′.3	—0.′5	11h	—21′.8	—4′.5	17h	—23′.1	—0′.3	23h	+29′.6	+3′.5
6	+11.8	—2.5	Midn.	—28.2	—4.1	18	—10.5	+0.6	Noon	+37.8	+5.8
7	— 3.2	—1.6	13	—28.3	—3.1	19	+ 0.8	—0.4	1	+35.0	+5.8
8	—13.5	—3.9	14	—29.0	—0.8	20	+12.2	+0.5	2	+26.3	+5.0
9	—20.8	—4.5	15	—27.8	—0.3	21	+17.4	+1.0	3	+21.2	+3.9
10	—21.0	—5.1	16	—27.8	+0.5	22	+30.6	+2.3	4	+ 7.0	+2.6

A negative sign indicates a deflection to the east, a positive one a deflection to the west of the mean position.

The diurnal inequality at the two stations presents in general the same characteristic features, namely, the principal deflection to the west shortly after noon, and the opposite eastern position about midnight; in regard to the diurnal inequality, therefore, the motion of the magnet at Van Rensselaer Harbor follows in general the same law as recognized in lower geographical latitudes.

The extreme westerly position is attained at noon; after this hour the westerly declination diminishes gradually, with an exception of a period of opposite motion of very limited range between the hours of four and five. The easterly extreme is reached two hours after midnight. Whether the small irregularity just noticed, producing apparently a secondary minimum and maximum, is real or only caused by the accidental deviations of the few observations under discussion, it is not easy to decide with certainty. The motion from 14 hours to 24 hours is performed with great uniformity. Thus, while the diurnal motion agrees with that observed at Lake Athabasca, Fort Simpson, Sitka, Toronto, etc., it shows no trace of that marked deviation observed at Reikiavik, in Iceland, or at Fort Confidence. In 1824 (June), at the Whalefish islands the maximum westerly deviation happened about a quarter past one o'clock P. M.; the time of the maximum eastern deflection was not determined. At Port Bowen the maximum westerly variation appears to have occurred between the hours of 10 A. M. and 1 P. M., the mean result being $11^h\ 49^m$; the greatest deflection of the north end of the needle to the eastward took place between 8 P. M. and 2 A. M., the mean hour being 10 P. M. These observations were made during January, February, March, and April, 1825.

The range of the mean diurnal inequality is 1° 06′.8, when it is at Greenwich during the same time 10′.9.

Analysis of Disturbances of the Declination.—The declination at the commencement and end of the observations appears to have remained nearly the same; the daily and monthly means indicate at first a gradual decrease of westerly declination, which motion, however, is speedily overcome in the month of March. No further attention need be paid to this circumstance in the following discussion of the disturbances, and of their effect upon the diurnal inequality.

The mean disturbance for each of the 24 hours has been obtained by comparing the monthly mean with each hourly reading; let Δ equal this difference, n the

number of hourly readings (equal to 17), and m the mean disturbance, then $m = \pm \sqrt{\frac{\Sigma \Delta^2}{n-1}}$. This quantity is analogous to the mean error of an observation. In the following comparisons we must always bear in mind that the observations for the present discussion are rather limited, and that the comparisons with results at Lake Athabasca and Fort Simpson are of a date nearly ten years earlier. This interval is perhaps favorable to the comparison.

At Van Rensselaer Harbor the mean disturbance force is greater than at either place just named, and pretty regular during two well-marked periods, as shown by the following table:—

TABLE OF THE MEAN DISTURBANCE OF THE DECLINATION AT VAN RENSSELAER HARBOR, TAKEN WITHOUT REGARD TO DIRECTION, FOR EACH OF THE OBSERVATION HOURS, AND EXPRESSED IN MINUTES OF ARC.

Local Mean Time.

5h.	6h.	7h.	8h.	9h.	10h.	11h.	Midn.	13h.	14h.	15h.	16h.
±31′	41	37	47	49	50	46	52	51	47	50	±53′
17h.	**18h.**	**19h.**	**20h.**	**21h.**	**22h.**	**23h.**	**Noon.**	**1h.**	**2h.**	**3h.**	**4h.**
±49′	42	54	48	46	31	46	60[1]	46	39	45	±41′

The disturbing force is least during the day (if such an expression is admissible in this case), from 10 A. M. to 7 P. M., and greater and equally regular during the hours of the night (?), from 8 P. M. to 8 or 9 A. M. At Lake Athabasca the hours of least disturbance are between 9 A. M. and 7 P. M., and at Fort Simpson from 10 A. M. to 7 P. M. Captain Lefroy, in his discussion of the disturbances of the declination remarks: "There are indications in each of the three curves (for Lake Athabasca, Toronto and Sitka) of a small increase in the mean disturbance about noon." At Van Rensselaer Harbor we find the maximum disturbance at this very hour preceded and followed by quite small values; this circumstance certainly deserves our particular attention. Further coincidences of the disturbing force can be noticed at 5 P. M., at which hour at Van Rensselaer, Lake Athabasca, and Sitka the minimum disturbance has been observed. At Fort Simpson, in April and May, 1844, the mean disturbance was but one-fourth of that observed in January, February and March at Van Rensselaer, and the ratio of the minimum to the maximum value was 5.6 and 2.0 at the two places respectively.

By adding the squares of the differences for each hour of the day and month, we find the mean monthly disturbance by the formula $\sqrt{\frac{[\Sigma \Delta^2]}{N-24}}$. The mean disturbance for each month is as follows:—

In January, 1854	±30′
In February, "	±65
In March, "	±40

[1] Principally due to a very large disturbance.

The month of February was, therefore, that of the maximum amount of disturbance. At Lake Athabasca the greatest mean disturbance occurred in January (from observations between October and February inclusive). At Toronto,[1] on the contrary, the months of January and June are those of least disturbance. It is quite possible that at Van Rensselaer the above values are surpassed in other months of the year, yet relatively February contains the greatest mean disturbance during the period of observations.

Hitherto the recognition and separation of the disturbed observations have been effected by an arbitrary process of fixing upon a certain deviation from the mean as the greatest allowable departure, and regarding all observations beyond this limit as disturbances. In the present case, I have sought to introduce a more definite idea by the application of Pierce's criterion for the rejection of doubtful observations,[2] or what is equivalent—for the recognition of the disturbances—they following a different law from the general one. The average mean deviation of the readings composing an hourly mean I find = $\pm$ 46′, and for 17 values $x^2 = 4.55$; hence readings deviating from the mean more than 1° 38′ or 123d are to be recognized as disturbances.

The table of hourly readings contains 23 such values, or one disturbed observation for every 18 ordinary readings. In the five years of hourly observations ending June 30, 1848, at Toronto, the disturbances averaged one in 17 of the whole body. Excluding the above 23 values from the mean, the diurnal inequality freed of the disturbances undergoes no material change, as shown by the following table:—

5h.	6h.	7h.	8h.	9h.	10h.	11h.	Midn.	13h.	14h.	15h.	16h.
+23′.7	+6.0	—3.8	—9.3	—16.4	—12.5	—22.5	—34.7	—27.3	—35.1	—34.1	—26′.0
17h.	18h.	19h.	20h.	21h.	22h.	23h.	Noon.	1h.	2h.	3h.	4h.
—20′.1	—8.0	+9.0	+19.0	+23.3	+30.0	+29.0	+29.2	+34.4	+25.7	+13.6	+6′.9

The maximum west deflection is displaced from noon to one o'clock. The general mean changed from 317.3[d] to 316.5[d], and the range of the mean inequality from 1° 06′.8 to 1° 09′.5. Eleven deflections were towards the east and twelve towards the west. The limited number of observations renders it necessary to conclude the foregoing examination of the disturbances.

Aurora Borealis.—In connection with the disturbances, a short notice of the auroral displays witnessed at the winter quarters will here find an appropriate place. In conformity with the supposed periodicity of this phenomenon, as recognized by Prof. Olmstead, no brilliant and complete auroras have been seen; with an exception of a very few, they may all be placed in his fourth class, to which the most simple forms of appearances have been referred. The aurora of October 24, 1854,

[1] See Vol. III. of the Magnetical and Meteorological Observations at Toronto, Canada. Discussion by Major-General E. Sabine. London, 1857.

[2] See Gould's Astronomical Journal, Nos. 45 and 83.

at 9 P. M. (see first volume of the Narrative), appears to have been one of the more conspicuous displays. A full record of the rest will be found in the 8th volume of the Smithsonian Contributions to Knowledge, in the collection made by Peter Force, Esq. There are 19 in number. The following statement is given in a foot-note: "The processes have no apparent connection with the magnetic dip, and in *no* case did the needle of our unifilar indicate disturbance."

Term-day Observations for Change of Magnetic Declination.—These observations were made at the following dates: January 18–19, February 24–25, March 22–23, April 19–20, May 26–27, and June 21–22, 1854. The readings are given in the following tables:—

TERM-DAY OBSERVATIONS FOR CHANGES OF MAGNETIC DECLINATION AT VAN RENSSELAER HARBOR, 1854.

Göttingen mean time.	0m.	06m.	12m.	18m.	24m.	30m.	36m.	42m.	48m.	54m.	Fern Rock mean time. (to 0m.)
Fern Rock Observatory, January 18 and 19, 1854. Readings taken $2^m\ 14^s$ earlier than indicated.											
10^h	305^d	305^d	305^d	307^d	308^d	312^d	$311^d.8$	$306^d.5$	$309^d.5$	$312^d.5$	$4^h\ 37^m.5$
11	311.2	313	314	315.8	318.5	317	317	319.7	320.5	322.5	5 "
12	320	314.8	315	315.7	317	320	321	320	316	314	6 "
13	311	307	309	311	313	315	317	318	317	315	7 "
14	320	322	319	316	320	320	322	318	320	322	8 "
15	321	323	323.3	322.3	320	319	320	320	325	325	9 "
16	329	329	330	330	327	336	350	366	367	369	10 "
17	362	354	353	347	347	346	346	341	337	334	11 "
18	330	332	335	338	338	340	342	343.5	342	344	12 "
19	344	346.5	345	344	344	345	346	346.5	347	345	13 "
20	346	345	345.5	345	348	347.5	349	351.5	351. 5	349.5	14 "
21	349	354	359	363.5	359.5	351	350	351	350.8	351	15 "
22	356	358	359	361.5	361	355	352.3	357.8	358	360.5	16 "
23	360.5	358	355	351.5	350	349	346	340	332	335	17 "
0	336	333	330.5	326	320	320	323	226	328	337	18 "
1	343	352	350	346	340	348	353	357	349	343	19 "
2	337	332	328	324	332	336	340	343	346	345	20 "
3	342	339	329	320	313	300	292	284	277.5	268	21 "
4	251	244.5	240.5	250	261	254	243	230	235	155	22 "
5	115	90	89	96	88	85	105	129	145	155	23 "
6	163	180	193	220	254	290	291	307	298	270	0 "
7	268	254	240	266	289	297	320	318	320	321	1 "
8	336	336	336	331	337	337	337	330	327	324	2 "
9	314	326	332	338	323	318	316	316	316	314	3 "
10	312	310									4 "
The series commences with readings 304^d, 303^d, and 304^d, at $9^h\ 42^m$, 48^m, and 54^m.											
Fern Rock Observatory, February 24 and 25, 1854. Readings taken $2^m\ 15^s$ earlier than indicated.											
10^h	312^d	322^d	329^d	338^d	$341^d.5$	$319^d.5$	342^d	359^d	377^d	407^d	$4^h\ 37^m.5$
11	408	411	405	418	437	445	445	447	441	439	5 "
12	438	438	440	432	460	482	477	471	480	494	6 "
13	490	493	506	520	516	509	519	531	530	527.5	7 "
14	541	558.5	532	527	518	511	521	532	538	535	8 "
15	532	529	527	528	530.5	542	526	521	516	513	9 "
16	510	508	506	504	493	483	446	470	503	495	10 "
17	490	493	496	498	500	502	500	500	501	503	11 "
18	503	502	502	502	503	500	494	490	492	494	12 "
19	496	495	495	492	488	499	506	498	492	501	13 "
20	514	509	502	506	509	501	491	490	492	498	14 "
21	504	509	517	516	514	512	511	512	512	517	15 "
22	521	529	535	536	529	508	510	516	514	510	16 "
23	511	507	490	491	489	489	488	488	486	485	17 "
0	502	499	496	489	496	500	499	500	484	475	18 "
1	456	448	440	435	442	447	451	457	456	449	19 "
2	445	440	425	412	427	438	449	445	440	417	20 "
3	370	312	284	289	268	298	326	332	360	375	21 "
4	390	400	415	408	405	404	392	396	401	401	22 "
5	404	408	390	375	370	372	—	393	403	402	23 "
6	402	407	390	374	370	358	355	370	381	380	0 "
7	376	377	379	380	382.5	365	370	373	380	395	1 "
8	381	385	372	386	398	406	435	437	438	439	2 "
9	438	438	437	442	446	444	455	448	446	443	3 "
10	450	469	482	497							4 "
The series commences with readings 290^d, 288^d, 282^d, at $9^h\ 42^m$, 48^m, and 54^m,											

Value of a scale division 0′.80.

Increase of scale readings denotes a movement of the north end of the magnet to the east.

Göttingen mean time.	0m.	06m.	12m.	18m.	24m.	30m.	36m.	42m.	48m.	54m.	Fern Rock mean time. (to 0m.)
Fern Rock Observatory, March 22 and 23, 1854. Readings taken 1m 34s earlier than indicated.											
10h	269d	262d	265d	272d	285d	295d	250d	232d	228d	255d	4h 37m.5
11	240	261	243	246	232	228	236	260	259	258	5 "
12	258	256	254	256	258	258	259	260	263	263	6 "
13	262	253	258	264	263	267	265	256	251	247	7 "
14	235	237	239	239	240	244	243	247	245	240	8 "
15	240	238	239	237	234	233	234	237	245	251	9 "
16	268	265	267	279	280	277	272	264	260	269	10 "
17	275	279	277	282	279	280	282	284	283	282	11 "
18	281	280	278	277	275	273	272	270	269	268	12 "
19	269	268	268	268	267	267	268	266.5	264	262	13 "
20	261	261	262	261	261	258	258	259	262	265	14 "
21	269	267	266	264	264.5	262	269	273	278	284	15 "
22	283	282	278.5	275	270.5	263	265	260	260	261	16 "
23	260	257	256	250	253	256	248	250	257	263	17 "
0	272	280	283	285	292	288	289	287	290	294	18 "
1	300	302	291	290	292	283	277	273	271	[1]—	19 "
2	—	—	—	—	—	280	284	278	271	269	20 "
3	267	267	263	255	248	247	252	249	248	251	21 "
4	260	265	274	292	296	295	298	298	297	295	22 "
5	291	290	290	293	292	294.5	291	292	288	290	23 "
6	293	291	291	290	294	295	290	281	276	269	0 "
7	264	252	250	249	242	239	235	242	252	248.5	1 "
8	246	245	243	242	240	239	241	244	250	258	2 "
9	270	282	284	286.5	288	292	297	300	304	302	3 "
10	301	300	299								4 "
Fern Rock Observatory, April 19 and 20, 1854. Readings taken 2m 14s earlier than indicated.											
10h	—	—	—	—	—	—	—	—	—	—	4h 37m.5
11	—	—	—	—	—	—	—	—	—	—	5 "
12	—	—	—	—	—	—	—	—	—	—	6 "
13	—	—	—	—	—	—	—	—	—	—	7 "
14	—	—	—	—	—	—	—	—	—	—	8 "
15	—	—	—	—	—	—	—	—	—	—	9 "
16	—	—	—	272d	271d	275d	273d	272d.5	278d	282d	10 "
17	289d	299d	298d	312	310	305	301	296	299	262	11 "
18	271	287	294	290	289	286	280	268	254	230	12 "
19	236	250	245	242	239	234	229	230	242	256	13 "
20	265	262	260	256	252	247	243	236	231	228	14 "
21	225	224	230	236	229	226	231	233	230	227	15 "
22	226	222	218	215	213	189	187	183	190	187	16 "
23	184	182	194	220	221	223	218	220	222	225	17 "
0	231	236	242	236	238	240	235	224	215	203	18 "
1	194	190	187	184	181	180	178	178	168	164	19 "
2	175	208	236	242	212	205	202	190	190	193	20 "
3	194	196	199	200	210	192	180	175	164	152	21 "
4	140	137	139	148	147	160	164	152	140	121	22 "
5	107	113	116	136	145	132	130	120	90	63	23 "
6	+62	+43	+30	+32	—	—	—4	—7	+4	+8	0 "
7	+30	+23	+16	+12	+16	+11	+5	—2	+25	+58	1 "
8	71	67	73	77	79	81	75	73	76	80	2 "
9	75	74	97	110	128	132	138	147	142	134	3 "
10	126	122	128	132							4 "

Value of a scale division 0′.80.

Increase of scale readings denotes a movement of the north end of the magnet to the east.

[1] Watch stopped.

Fern Rock Observatory, May 26 and 27, 1854.
Readings taken $1^m\ 34^s$ earlier than indicated.

Göttingen mean time.	0m.	06m.	12m.	18m.	24m.	30m.	36m.	42m.	48m.	54m.	Fern Rock mean time. (to 0m.)
10^h	244^d	243^d	258^d	262^d	278^d	280^d	279^d	276^d	292^d	304^d	$4^h\ 37^m.5$
11	330	345	357	365	372	369	365	360	364	368	5 "
12	360	355	345	342	350	348	341	333	330	338	6 "
13	349	356	364	359	354	351	355	360	381	395	7 "
14	403	413	411	408	400	389	395	400.	407	410	8 "
15	414	423	428	436	442	443	442	438	436	433	9 "
16	435	434	440	450	476	490	520	555	570	575	10 "
17	593	600	575	548	533	523	516	506	498	492	11 "
18	485	482	479	477	477	476	475	475	477	480	12 "
19	483	487	493	495	488	495	527	552	568	587	13 "
20	595	612	624	630	633	631	625	620	612	604	14 "
21	599	603	609	612	615	626	633	635	644	650	15 "
22	663	667	665	661	658	659	653	646	640	637	16 "
23	639	641	632	618	595	590	583	572	559	541	17 "
0	543	545	546	546	544	540	537	536	535	537	18 "
1	538	525	523	539	527	520	515	513	480	479	19 "
2	487	493	498	503	506	509	509	533	562	571	20 "
3	573	553	537	517	495	489	486	488	496	510	21 "
4	512	510	507	513	514	512	511	506	497	487	22 "
5	486	485	483	484	480	477	476	476	477	463	23 "
6	449	443	442	440	441	443	447	454	463	470	0 "
7	478	483	487	489	488	483	471	459	457	446	1 "
8	435	447	460	468	475	490	487	478	485	491	2 "
9	493	513	525	530	533	535	534	515	500	—	3 "
10	—										4 "

Observations commence at $9^h\ 24^m$, scale readings 280^d, 271^d, 266^d, 235^d, 231^d, 240^d, corresponding to $9^h\ 24^m$, 30^m, 36^m, 42^m, 48^m, and 54^m respectively.

Fern Rock Observatory, June 21 and 22, 1854.
Readings taken $1^m\ 34^s$ earlier than indicated. (Magnet suspended, I. 7.)[1]

10^h	—	—	—	—	—	—	—	—	—	295^d	$4^h\ 37^m.5$
11	297^d	299^d	300^d	302^d	305^d	309^d	312^d	313^d	313^d	314	5 "
12	315	315	314	314	313	312	310	316	325	333	6 "
13	337	340	344	347	351	352	350	350	351	352	7 "
14	348	346	343	337	333	334	338	348	350	355	8 "
15	354	355	358	364	366	374	374	374	373	367	9 "
16	366	367	366	370	373	377	377	377	378	383	10 "
17	384	385	379	379	379	381	383	384	383	384	11 "
18	387	384	385	382	384	386	386	382	385	387	12 "
19	384	382	383	385	387	386	387	390	392	396	13 "
20	400	402	400	396	394	394	388	376	384	394	14 "
21	390	383	382	381	379	370	364	368	372	370	15 "
22	367	363	358	355	357	361	367	369	367	364	16 "
23	364	363	361	355	350	350	352	355	359	362	17 "
0	363	363	370	369	367	368	370	363	355	351	18 "
1	348	343	337	335	333	329	330	331	331	328	19 "
2	322	318	320	322	325	327	328	328	326	324	20 "
3	322	318	319	322	323	323	322	324	326	331	21 "
4	326	315	334	330	326	326	319	318	318	318	22 "
5	312	316	318	317	323	321	317	310	312	308	23 "
6	306	320	316	316	318	323	304	303	312	290	0 "
7	291	287	286	286	291	283	275	281	283	288	1 "
8	289	290	292	289	291	293	297	298	302	304	2 "
9	304	309	313	312	308	303	295	290	282	273	3 "
10	264	257	245	283	232	230	234	239	242	228	4 "
11	212	207									5 "

Value of a division of the scale 0′.80.
Increase of scale readings denotes a movement of the north end of the magnet to the east.

[1] This magnet I. 7 was undoubtedly used on all previous occasions. Mark reads on circle 338° 22′, circle reads 314° 12′.

The results of the preceding tables have been thrown into curves, to which the corresponding readings at Greenwich and Washington have been added.[1] These readings have all been referred to the same scale, and thus present at a glance the great difference in the magnitude of the diurnal motion as well as that of the disturbances. The Greenwich observations were taken by means of photography; the Washington corresponding observations were also obtained by means of Brooke's automatic photographic registration, and have as yet only been published in the 6th volume of the Astronomical Expedition to Chili, under the direction of Lieut. Gilliss, U. S. N.; Washington, D. C., 1856.

For the Greenwich curves the zero line corresponds to 22° west declination. A remarkable absence of disturbances of any magnitude as well as a small diurnal range of motion at the time of the vernal equinox, is shown by the March curves both for Van Rensselaer and Greenwich.

There appear to be some disturbances common to both places, and if these indications should not be accidental they are of an opposite character, that is, a magnetic east deflection is presenting itself as a magnetic west deflection at the other station, and *vice versa*. For this the reader may examine hours 17 and 5½ of the curve for January 18 and 19, hours from 6 to 8, April 20th, and one or two other less striking cases. The needle at Van Rensselaer Harbor actually points with its north end to the south of the astronomical west, and its meridional component of the direction is pointing in a southern or opposite direction to the same component at Greenwich or Washington.

Absolute Declination.—The magnetic declination at Van Rensselaer Harbor was determined on three occasions in the summer of 1854. Two different magnets were used.

Determination of June 9th. Magnet A 68, mirror facing magnetic north.

Position.	Circle reads. Mark.	P.	Circle reads. Magnetic meridian (south).	P.	Circle reads. Mark.
I.	338° 06′	I.	316° 01′	I.	338° 02′
	06′		00		01
II.	338 00	II.	315 57	II.	338 05
	337 59		56		04
Means	338 02.8		315 58.5		338 03.0
			at 6h 35m Green. t.		

Mean reading on mark	338° 03′
Astronomical bearing (N.)	93 29 E.
Reading of meridian (N.)	244 34
Magnetic meridian (N.)	135 59
Declination	108° 35′

W. (of north) at 1h 52m P. M. local time.

[1] See accompanying plates 1 and 2.

Determination of June 14. Magnet I. 10. Mirror facing magnetic north.

Mark.		Magnetic south meridian.		Mark.	
I.	338° 09′	I.	317° 10′	I.	338° 04′
	08		at 5h 12m Gr. t.		02
II.	338 05		09	II.	338 09
	04	II.	317 02		08
			01		
Means	338 06.5		317 05.5		338 05.8

Mean reading on mark	338° 06′
Astronomical bearing (N.)	93 29 E.
Reading of true meridian	244 37
Reading of magnetic meridian	137 05
Declination	107° 32′

W. at 0h 29m P. M. local time.

The magnet showed considerable agitation during the day.

Determination of June 26. Mirror facing magnetic north.

Magnetic south meridian.		Mark.		Magnetic south meridian.	
I.	315° 49′	I.	338° 24′	I.	315° 52′
	47		23		50
II.	316 18	II.	338 20	II.	315 40
	17		19		38
Means	316 02.7		338 21.5		315 45.0
at 1h 3m P. M. local time.				at 2h 0m P. M. local time	

Mark reads	338° 21′
Astronomical bearing (N.)	93 29 E.
N. meridian (true)	244 52
Magnetic meridian	135 53
Declination	108° 59′

W. at 1h 31m P. M.

Resulting mean declination (for June 16) 108° 22′ W.; if we omit the 2d determination on account of disturbance, and apply a correction for diurnal change to the mean of the first and last determination, we find 108° 12′ W.

SECTION II.

OBSERVATIONS OF THE MAGNETIC INCLINATION.

1853, 1854, AND 1855.

SECTION II.

MAGNETIC INCLINATION.

Instrument and Remarks.—The observations for dip were made by Mr. Sonntag by means of a Barrow dip circle received from Prof. Henry, of the Smithsonian Institution, through the courtesy of Col. Sabine. The inclinometer was supplied with Lloyd needles, for determining the total intensity, but unfortunately the complete record of these observations could not be recovered; the absence of the record for determining the constants necessary for their reduction being wanted, no use could be made of these observations, even for relative intensity at Saikatle and Marshall Bay, and the partial results given in Appendix XV., vol. II. of the Narrative, must, therefore, remain fruitless for the present. There is likewise a deficiency in the record of the dip observations at Van Rensselaer Harbor after February 23, 1854; the results, however, are all preserved in the Appendix just mentioned.

In regard to the index error of the dipping needles, we can only make an approximate comparison. The observations at New York, where the dip has been represented by the formula

$$I = 72°.69 - 0.00491\,(t - 1845) + 0.00114\,(t - 1845)^2,$$

with a probable error of any single observation[1] of $\pm 3'.3$, would apparently produce a correction to needle 1 of $-9'$, and to needle 2 of $-14'$, the changes, however, from one station to another in the immediate vicinity of the city are much greater, and these quantities may, therefore, as well indicate local deviation as index error. The polarity of the needles has been reversed at each station, the effect of this operation upon the resulting dip is somewhat irregular, and will be found exhibited in tabular form.

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[1] See Coast Survey Report of 1856, p. 240. The formula includes dip observations taken between December, 1822, and August, 1855 (exclusive of the observations of the present expedition).

STATION No. I. NEW YORK, AT MR. RUTHERFORD'S OBSERVATORY.
Latitude 40° 43′.8. Longitude 73° 58′.9. W. of G.

May 18, 1853. 4h P. M. Needle No. 2. Poles direct. Magnetic meridian reads 248° 10′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
72° 57′	72° 37′	73° 08′	73° 27′	72° 51′	72° 52′	72° 53′	73° 25′
72 56	72 35	73 05	73 24	72 54	72 54	72 56	73 29
72 56.5	72 36.0	73 06.5	73 25.5	72 52.5	72 53.0	72 54.5	73 27.0
72 46.2		73 16.0		72 52.7		73 10.7	
73 01.1				73 01.7			
73 01.4							

Needle No. 2. Poles reversed.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	b	a	b	a	b	a	b
72° 08′	72° 16′	72° 17′	73° 17′	73° 20′	72° 38′	73° 00′	73° 05′
72 10	72 18	72 30	73 30	73 19	72 36	73 00	73 06
72 09.0	72 17.0	72 23.5	73 23.5	73 19.5	72 37.0	73 00.0	73 05.5
72 13.0		72 53.5		72 58.2		73 02.8	
72 33.2				73 00.5			
72 46.8							

May 18, 1853. 22h 30m. Needle No. 2. Poles reversed. Magnetic meridian reads 248° 10′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
73° 07′	73° 28′	72° 42′	72° 44′	72° 50′	73° 11′	72° 37′	72° 37′
73 03	73 26	72 40	72 47	72 54	73 13	72 40	72 34
73 05.0	73 27.0	72 41.0	72 45.5	72 52.0	73 12.0	72 38.5	72 35.5
73 16.0		72 43.2		73 02.0		72 37.0	
72 59.6				72 49.5			
72 54.6							

Needle No. 2. Poles direct.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	b	a	b	a	b	a	b
72° 52′	72° 51′	72° 49′	72° 54′	73° 37′	73° 51′	72° 58′	73° 20′
72 55	72 55	72 52	72 59	73 34	73 48	72 57	73 17
72 53.5	72 53.0	72 50.5	72 56.5	73 35.5	73 49.5	72 57.5	73 18.5
72 53.2		72 53.5		73 42.5		73 08.0	
72 53.4				73 25.2			
73 09.3							

May 20, 1853. 4h. Needle No. 1. Poles direct.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
71° 37′	72° 00′	75° 55′	76° 22′	73° 11′	73° 02′	73° 41′	74° 04′
71 34	71 59	75 52	76 21	73 13	73 04	73 45	74 06
71 35.5	71 59.5	75 53.5	76 21.5	73 12.0	73 03.0	73 43.0	74 05.0
71 47.5		76 07.5		73 07.5		73 54.0	
73 57.5				73 30.7			
73 44.1							

Needle No. 1. Poles reversed.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
69° 58′	70° 10′	73° 17′	72° 52′	72° 32′	73° 08′	72° 56′	73° 09′
70 00	70 13	73 16	72 55	72 30	73 06	72 53	73 06
69 59.0	70 11.5	73 16.5	72 53.5	72 31.0	73 07.0	72 54.5	73 07.5
70 05.2		73 05.0		72 49.0		73 01.0	
71 35.1				72 55.0			
72 15.1							

May 20, 1853. Needle No. 1. Poles direct.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
71° 48′	72° 03′	74° 18′	74° 48′	72° 38′	72° 33′	74° 26′	74° 27′
71 45	72 01	74 17	74 45	72 40	72 35	74 29	74 31
71 46.5	72 02.0	74 17.5	74 46.5	72 39.0	72 34.0	74 27.5	74 29.0
71 54.2		74 32.0		72 36.5		74 28.2	
73 13.1				73 32.3			
73 22.7							

Needle No. 1. Poles reversed.

CIRCLE EAST.				CIRCLE WEST.			
Face west.		Face east.		Face west.		Face east.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
72° 47′	73° 21′	73° 13′	73° 32′	69° 55′	69° 48′	72° 24′	72° 27′
72 45	73 19	73 11	73 30	69 59	69 51	72 28	72 29
72 46.0	73 20.0	73 12.0	73 31.0	69 57.0	69 49.5	72 26.0	72 28.0
73 03.0		73 21.5		69 53.2		72 27.0	
73 12.2				71 10.1			
72 11.2							

STATION No. II. FISKERNAES, FLAGSTAFF NEAR THE GOVERNOR'S HOUSE.
Latitude 63° 05′.3. Longitude 50° 34′4. W. of G.

June 29, 1853. Needle No. 2. Poles reversed. Meridian reads 106° 01′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
80° 07′	80° 05′	82° 08′	81° 59′	80° 28′	80° 36′	80° 30′	80° 50′
80 11	80 07	82 08	81 58	80 25	80 34	80 28	80 49
80 09.0	80 06.0	82 08.0	81 58.5	80 26.5	80 35.0	80 29.0	80 49.5
80 07.5		82 03.3		80 30.7		80 39.2	
81 05.4				80 34.9			
80 50.2							

Needle No. 2. Poles direct.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
80° 47′	80° 38′	80° 28′	80° 29′	80° 13′	80° 24′	80° 42′	80° 41′
80 46	80 41	80 28	80 29	80 10	80 22	80 40	80 39
80 46.5	80 39.5	80 28.0	80 29.0	80 11.5	80 23.0	80 41.0	80 40.0
80 43.0		80 28.5		80 17.2		80 40.5	
80 35.7				80 28.9			
80 32.3							

STATION No. III. FISKERNAES HARBOR, ON A SMALL ISLAND ON THE NORTH SIDE OF HARBOR.

July 1, 1853. Needle No. 2. Poles direct. Meridian reads 150° 22′.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	b	a	b	a	b	a	b
82° 24′	83° 01′	79° 54′	80° 03′	81° 59′	82° 05′	80° 53′	79° 49′
82 27	83 04	79 57	80 06	81 59	82 03	80 50	79 51
82 25.5	83 02.5	79 55.5	80 04.5	81 59.0	82 04.0	80 51.5	79 50.0
82 44.0		80 00.0		82 01.5		80 20.7	
81 22.0				81 11.1			
81 16.6							

Needle No. 2. Poles reversed.

CIRCLE WEST.				CIRCLE EAST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
81° 07′	81° 23′	79° 52′	80° 00′	80° 49′	80° 52′	79° 54′	79° 54′
81 11	81 23	79 55	80 02	80 46	80 58	79 53	79 53
81 09.0	81 23.0	79 53.5	80 01.0	80 47.5	80 55.0	79 53.5	79 53.5
81 16.0		79 57.2		80 51.2		79 53.5	
80 36.6				80 22.3			
80 29.4							

STATION No. IV. SAIKATLE, ISLAND SOUTH FROM SUKKERTOPPEN.

(Latitude and longitude not determined.)

The magnetic station was on a small bay on the southeast side of the island, and is covered with water at high tide. The Lloyd needles only were used.

STATION No. V. SUKKERTOPPEN, IN THE GARDEN NEAR THE GOVERNOR'S HOUSE.

(Latitude and longitude not determined.)

July 9, 1853. 15^h. Needle No. 2. Poles reversed. Meridian reads 75° 20′.

CIRCLE WEST.				CIRCLE EAST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
80° 30′	80° 43′	81° 15′	81° 48′	80° 46′	80° 30′	81° 20′	81° 20′
80 28	80 46	81 15	81 45	80 46	80 33	81 20	81 21
80 29.0	80 44.5	81 15.0	81 46.5	80 46.0	80 31.5	81 20.0	81 20.5
80 36.7		81 30.7		80 38.8		81 20.2	
81 03.7				80 59.5			
81 01.6							

Needle No. 2. Poles direct.

CIRCLE WEST.				CIRCLE EAST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
81° 30′	82° 25′	80° 17′	80° 40′	80° 53′	80° 42′	79° 31′	79° 04′
81 28	82 24	80 14	80 37	80 57	80 45	79 34	79 05
81 29.0	82 24.5	80 15.5	80 38.5	80 55.0	80 43.5	79 32.5	79 04.5
81 56.7		80 27.0		80 49.2		79 18.5	
81 11.8				80 03.8			
80 37.8							

STATION No. VI. PROVEN, GROUND NEAR THE GOVERNOR'S HOUSE.
Latitude 72° 25′.9. Longitude 55° 25′ (both approximate).

July 19, 1853. Needle No. 2. Poles direct. Magnetic meridian 0° 33′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
82° 35′	82° 45′	83° 16′	83° 19′	82° 38′	82° 41′	83° 44′	83° 44′
82 34	82 44	83 14	83 17	82 40	82 43.	83 47	83 47
82 34.5	82 44.5	83 15.0	83 18.0	82 39.0	82 42.0	83 45.5	83 45.5
82 39.5		83 16.5		82 40.5		83 45.5	
82 58.0				83 13.0			
83 05.5							

Needle No. 2. Poles reversed.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
83° 15′	83° 14′	83° 11′	83° 30′	83° 30′	83° 19′	82° 14′	82° 23′
83 14	83 12	83 10	83 28	83 30	83 21	82 17	82 25
83 14.5	83 13.0	83 10.5	83 29.0	83 30.0	83 20.0	82 15.5	82 24.0
83 13.7		83 19.7		83 25.0		82 19.8	
83 16.7				82 52.4			
83 04.5							

Needle No. 2. Poles direct. Meridian reads 0° 33′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
83° 10′	83° 02′	81° 30′	81° 35′	82° 22′	82° 27′	83° 28′	83° 41′
83 08	83 01	81 30	81 34	82 23	82 29	83 29	83 44
83 09.0	83 01.5	81 30.0	81 34.5	82 22.5	82 28.0	83 28.5	83 42.5
83 05.2		81 32.2		82 25.2		83 35.5	
82 18.7				83 00.3			
82 39.5							

Needle No. 2. Poles reversed.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
83° 13′	83° 20′	82° 57′	82° 52′	83° 03′	83° 19′	82° 30′	82° 32′
83 15	83 19	82 55	82 49	83 05	83 20	82 32	82 34
83 14.0	83 19.5	82 56.0	82 50.5	83 04.0	83 19.5	82 31.0	82 33.0
83 16.7		82 53.3		83 11.7		82 32.0	
83 05.0				82 51.8			
82 58.4							

STATION No. VII. UPERNAVIK, STATION IN GARDEN NEAR THE GOVERNOR'S HOUSE.
(Latitude and longitude not determined.)

July 22, 1853. Needle No. 2. Poles direct. Magnetic meridian reads 239° 18′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
82° 42′	82° 43′	84° 22′	84° 21′	83° 13′	83° 33′	83° 59′	84° 12′
82 39	82 40	84 21	84 18	83 16	83 36	84 01	84 14
82 40.5	82 41.5	84 21.5	84 19.5	83 14.5	83 34.5	84 00.0	84 13.0
82 41.0		84 20.5		83 24.5		84 06.5	
83 30.7				83 45.5			
83 38.1							

Needle No. 2. Poles reversed.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
84° 15′	84° 40′	83° 22′	83° 20′	83° 33′	83° 44′	83° 40′	83° 28′
84 13	84 37	83 20	83 18	83 34	83 45	83 42	83 30
84 14.0	84 38.5	83 21.0	83 19.0	83 33.5	83 44.5	83 41.0	83 29.0
84 26.2		83 20.0		83 39.0		83 35.0	
83 53.1				83 37.0			
83 45.0							

STATION No. VIII. BEDEVILLED REACH, FORCE BAY. STATION HALF A MILE EAST OF ANCHORAGE(?).
Latitude 78° 34′.5. Longitude 71° 33′.6.

August 12, 1853. Needle No. 2. Poles direct. Meridian reads 248° 30′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	b	a	b	a	b	a	b
84° 54′	85° 03′	86° 12′	86° 35′	84° 16′	84° 17′	86° 18′	86° 02′
84 48	84 59	86 17	86 30	84 14	84 14	86 19	86 04
84 51.0	85 01.0	86 14.5	86 32.5	84 15.0	84 15.5	86 18.5	86 03.0
84 56.0		86 23.5		84 15.2		86 10.7	
85 39.7				85 12.9			
85 26.3							

Needle No. 2. Poles reversed.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	b	a	b	a	b	a	b
84° 15′	84° 04′	84° 55′	85° 04′	84° 13′	84° 43′	85° 44′	85° 43′
84 20	84 10	84 55	85 03	84 09	84 38	85 40	85 39
84 17.5	84 07.0	84 55.0	85 03.5	84 11.0	84 40.5	85 42.0	85 41.0
84 12.2		84 59.3		84 25.8		85 41.5	
84 35.8				85 03.6			
84 49.7							

STATION NO. IX. NEAR MARSHALL BAY.

Latitude 78° 52′. Longitude 69° 01′.[1]

The observations on September 3d, 1853, were made with the Lloyd needle, No. 1, Box B. The dip by the statical needle is 85° 26′, and the resulting corrected dip 84° 49′. See Narrative, vol. I. p. 99.

STATION NO. X. VAN RENSSELAER HARBOR, WINTER QUARTERS. MAGNETIC OBSERVATORY ON FERN ROCK.

Latitude 78° 37′. Longitude 70° 40′. W. of G.

January 26, 1854. Needle No. 2. Poles direct. Magnetic meridian reads on circle 9° 02′.

CIRCLE WEST.				CIRCLE EAST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
83° 05′	83° 02′	83° 48′	85° 06′	82° 53′	82° 30′	85° 16′	85° 22′
83 05	83 03	83 47	85 05	82 47	82 26	85 10	85 17
83 05.0	83 02.5	83 47.5	85 05.5	82 50.0	82 28.0	85 13.0	85 19.5
83 03.7		84 26.5		82 39.0		85 16.2	
83 45.1				83 57.6			
83 51.3							

Needle No. 2. Poles reversed.

CIRCLE WEST.				CIRCLE EAST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
84° 48′	85° 22′	84° 09′	84° 40′	86° 20′	86° 05′	84° 27′	85° 20′
84 48	85 23	84 15	84 39	86 15	86 00	84 21	85 16
84 48.0	85 22.5	84 12.0	84 39.5	86 17.5	86 02.5	84 24.0	85 18.0
85 05.2		84 25.8		86 10.0		84 51.0	
84 45.5				85 30.5			
85 08.0							

[1] Erroneously given 67° 01′ in the Narrative, vol. II. p. 431; the date should also be changed as given above.

February 16, 1854: Needle No. 2. Poles direct. Meridian reads 69° 30′.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
85° 38′	86° 02′	84° 41′	84° 30′	85° 24′	85° 38′	83° 51′	83° 44′
85 38	86 02	84 41	84 28	85 23	85 39	83 56	83 44
85 38.0	86 02.0	84 41.0	84 29.0	85 23.5	85 38.5	83 53.5	83 44.0
85 50.0		84 35.0		85 31.0		83 48.7	
85 12.5				84 39.9			
84 56.2							

Needle No. 2. Poles reversed.

CIRCLE WEST.				CIRCLE EAST.			
Face west.		Face east.		Face west.		Face east.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
84° 28′	84° 25′	84° 53′	84° 49′	84° 35′	84° 33′	85° 11′	85° 38′
84 30	84 23	84 52	84 49	84 36	84 33	85 13	85 38
84 29.0	84 24.0	84 52.5	84 49.0	84 35.5	84 33.0	85 12.0	85 38.0
84 26.5		84 50.7		84 34.2		85 25.0	
84 38.6				84 59.6			
84 49.1							

February 23, 1854. Needle No. 2. Poles reversed. Magnetic meridian 67° 35′.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
85° 30′	85° 35′	85° 11′	85° 14′	85° 06′	85° 04′	84° 26′	84° 12′
85 26	85 30	85 06	85 10	85 08	85 07	84 27	84 14
85 28.0	85 32.5	85 08.5	85 12.0	85 07.0	85 05.5	84 26.5	84 13.0
85 30.2		85 10.2		85 06.2		84 19.8	
85 20.2				84 43.0			
85 01.6							

Needle No. 2. Poles direct.

CIRCLE EAST.				CIRCLE WEST.			
Face east.		Face west.		Face east.		Face west.	
a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
84° 27′	84° 08′	85° 01′	85° 21′	84° 28′	84° 12′	85° 06′	85° 13′
84 24	84 04	84 57	85 18	84 29	84 14	85 07	85 15
84 25.5	84 06.0	84 59.0	85 19.5	84 28.5	84 13.0	85 06.5	85 14.0
84 15.7		85 09.3		84 20.7		85 10.2	
84 42.5				84 45.4			
84 44.0							

RECAPITULATION OF RESULTS FOR MAGNETIC INCLINATION.

No. of station.	Locality.	Date.	No. of needle.	DIP.		Difference for change of polarity.	Mean and resulting dip.	
				Pole direct.	Pole reversed.			
I.	New York city	May 18, 1853	2	73° 01′.4	72° 46′.8	+14′.6	72° 54′.1	72° 55′.6
"	" "	" "	2	73 09.3	72 54.6	+14.7	72 61.9	
"	" "	May 20, "	1	73 44.1	72 15.1	+89.0	72 59.6	
"	" "	" "	1	73 22.7	72 11.2	+71.5	72 47.0	
II.	Fiskernaes	June 29, "	2	80 32.3	80 50.2	—17.9	80 41.3	
III.	Fiskernaes Harbor	July 1, "	2	81 16.6	80 29.4	+47.2	80 53.0	
IV.	Saikatle	July 9, "	Ll.	(Approximate.)		—	80 56.0	
V.	Sukkertoppen	July 9, "	2	80 37.8	81 01.6	—23.8	80 49.7	
VI.	Proven	July 19, "	2	83 05.5	83 04.5	+ 1.0	83 05.0	82 57.0
"	"	" "	2	82 39.5	82 58.4	—18.9	82 49.0	
VII.	Upernavik	July 22, "	2	83 38.1	83 45.0	— 6.9	83 41.5	
VIII.	Bedevilled Reach	Aug. 12, "	2	85 26.3	84 49.7	+36.6	85 08.0	
IX.	Marshall Bay	Sept. 3, "	Ll.	(Approximate.)		—	84 49.0	
X.	Fern Rock Observatory, Van Rensselaer Harbor	Jan. 26, 1854	2	83 51.3	85 08.0	—76.7	84 29.7	84 45.8
"	" "	Feb. 16, "	2	84 56.2	84 49.1	+ 7.1	84 52.6	
"	" "	Feb. 23, "	2	84 44.0	85 01.6	—17.6	84 52.8	
"	" "	March 2, "	2	—	—	—	84 49.0	
"	" "	June 10, "	2	—	—	—	84 47.2	
"	" "	" "	2	—	—	—	84 51.0	
"	" "	April 24, 1855	2	(12 sets.)		—	84 48.7	
"	" "	May 20, "	2	—	—	—	84 35.6	

The resulting dip at Van Rensselaer Harbor may be taken as corresponding in time to June, 1854.

SECTION III.

OBSERVATIONS OF MAGNETIC INTENSITY.

1854 AND 1855.

SECTION III.

OBSERVATIONS AND DISCUSSION OF THE MAGNETIC INTENSITY.

THE instrument used (a unifilar magnetometer) has already been described. For the determination of the intensity, the long magnet A. 67 has exclusively been used for oscillations and deflections. The effect of the torsion in the suspension was found so small that it was neglected. The vibrations have been observed in sets of two, one containing the readings of the chronometer when the magnet was moving in the direction of the scale readings, and the other when the magnet was moving in the opposite direction.[1] A mean time pocket chronometer was generally used for noting the time, and its rate was too small to affect sensibly the duration of a single vibration. In the deflections, the magnets were always kept at right angles to one another; the distance of the middle of the deflecting magnet, A. 67, from the suspended magnet, is given by a scale divided into feet and decimals of a foot.[2] The observations were made by Mr. A. Sonntag. At Van Rensselaer Harbor the observations extend over the time from January, 1854, to May, 1855. Two other stations were occupied, one in June, 1855, at Hakluyt Island, the other in July, on the coast between Parker Snow Point and Cape York, at the return of the party.

The necessary constants have been determined at Washington, D. C.

Magnet A. 67 is nearly three inches in length, the two other magnets, I. 7 and I. 10, are somewhat shorter.

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[1] The vibrations given in the Narrative, vol. II., Appendix, No. XV., pp. 431—434, are, therefore, double vibrations, and should have been noted as such.

[2] By some inadvertence, Appendix No. XV. of vol. II. of the Narrative contains the distances expressed in inches; it should have been given in feet and decimals, thus, 13 inches should be 1.3 feet, and 9 inches should read 0.9 feet.

January 17, 1854. **Fern Rock Observatory,** Van Rensselaer Harbor.

A. 67 suspended. Experiments of vibrations. (From right to left.)

No.	Time by pocket chronometer.	No.	Time by pocket chronometer.	Time of 45 double vibrations.
1	$5^h\ 58^m\ 37^s.3$	46	$6^h\ 10^m\ 10^s.8$	$11^m\ 33^s.5$
2	52.9	47	26.3	33.4
3	59 08.0	48	41.4	33.4
4	23.8	49	57.0	33.2
5	38.7	50	11 12.7	34.0
6	54.5	51	28.0	33.5
7	6 00 09.9	52	43.3	33.4
8	25.9	53	58.4	32.5
9	40.2	54	12 14.0	33.8
10	55.8	55	29.6	33.8
				Mean $11^m\ 33^s.45$

Arc at beginning 4° 40′. Temp. 50°. Time of 2 vibrations
" end 1 28 $15^s.410$.

The vibrations from left to right could not be observed.

January 18, 1854. **Fern Rock Observatory.**

Experiments of vibrations. (From right to left.)

No.	Time by pocket chronometer.	No.	Time by pocket chronometer.	Time of 50 double vibrations.
1	$5^h\ 30^m\ 43^s.0$	51	$5^h\ 43^m\ 37^s.5$	$12^m\ 54.5$
2	58.8	52	53.8	55.0
3	31 14.0	53	44 08.8	54.8
4	29.3	54	23.9	54.6
5	44.4	55	39.8	55.4
6	32 00.0	56	54.0	54.0
7	15.3	57	45 10.8	55.5
8	31.5	58	25.8	54.3
9	46.5	59	41.8	55.3
10	33 02.0	60	57.0	55.0
11	18.1	61	46 12.5	54.5
				12 54.81

Arc at beginning 4° 40′. Temp. 68. Time of 2 vibrations
" end 1 12 $15^s.496$.

Jannary 18, 1854. **Fern Rock Observatory.**

Experiments of vibrations. (From left to right.)

No.	Time by pocket chronometer.	No.	Time hy pocket chronometer.	Time of 50 double vibrations.
1	$5^h\ 30^m\ 50^s.8$	51	$5^h\ 43^m\ 46^s.7$	$12^m\ 55^s.9$
2	31 06.7	52	44 02.0	55.3
3	22.0	53	18.4	56.4
4	36.9	54	32.7	55.8
5	52.9	55	49.0	56.1
6	32 08.0	56	45 04.8	56.8
7	23.8	57	20.0	56.2
8	39.2	58	35.3	56.1
9	54.8	59	51.0	56.2
10	33 10.3	60	46 07.0	56.7
11	26.0	61	22.2	56.2
				12 56.15

Arcs and temp. as before. Time of 2 vibrations $15^s.523$.

(Dr. Hayes assisted in these observations.)

February 21, 1854. **Fern Rock Observatory.**

Experiments of vibrations. (From right to left.)

No.	Time by pocket chronometer.	No.	Time by pocket chronometer.	Time of 50 double vibrations.
1	4h 59m 26s.0	51	5h 12m 23s.5	12m 57.5
2	41.8	52	39.4	57.6
3	56.4	53	55.0	58.6
4	5 00 12.6	54	13 10.2	57.6
5	28.2	55	26.2	58.0
6	43.5	56	41.5	58.0
7	58.9	57	57.3	58.4
8	01 14.6	58	14 12.8	58.2
9	30 2	59	28.3	58.1
10	45.6	60	43.5	57.9
11	02 01.3	61	59.2	57.9
				12 57.98

Arc at beginning 5° 52′. Temp. 79°. Time of 2 vibrations
" end 2 24 15s.560.

Experiments of vibrations. (From left to right.)

No.	Time by pocket chronometer.	No.	Time by pocket chronometer.	Time of 50 double vibrations.
1	4h 59m 33s.5	51	5h 12m 31s.8	12m 58s.3
2	48.3	52	47.1	58.8
3	5 00 04.8	53	13 02.8	58.0
4	20.4	54	18.4	58.0
5	35.7	55	34.0	58.3
6	51.2	56	49.5	58.3
7	01 06.9	57	14 05.2	58.3
8	22.5	58	20.8	58.3
9	38.0	59	36.2	58.2
10	53.5	60	51.7	58.2
11	02 09.5	61	15 07.4	57.9
				12 58.24

Ares and temp. as before. Time of 2 vibrations 15s.565.

February 21, 1854. **Fern Rock Observatory.**

Experiments of vibrations. (From right to left.)

No.	Time by pocket chronometer.	No.	Time by pocket chronometer.	Time of 50 double vibrations.
1	6h 20m 47s.5	51	6h 33m 42s.6	12m 55.1
2	21 03.0	52	58.0	55.0
3	19.0	53	34 14.0	55.0
4	34.3	54	29.6	55.3
5	49.5	55	45.0	55.5
6	22 05.5	56	35 00.3	54.8
7	20.9	57	16.8	55.9
8	36.3	58	32.0	55.7
9	51.5	59	47.0	55.5
10	23 07.0	60	36 03.7[1]	56.7
				12 55.45

Arc at beginning 5° 20′. Temp. 55°. Time of 2 vibrations
" end 1 36 15s.509.

[1] Corrected by 10s.

February 21, 1854. **Fern Rock Observatory.**

Experiments of vibrations. (From left to right.)

No.	Time by pocket chronometer.	No.	Time by pocket chronometer.	Time of 50 double vibrations.
1	$6^h\ 20^m\ 55^s.2$	51	$6^h\ 33^m\ 51^s.0$	$12^m\ 55.8$
2	21 11.0	52	34 06.5	55.5
3	27.0	53	22.6	55.6
4	42.0	54	37.5	55.5
5	57.5	55	53.4	55.9
6	22 13.3	56	35 08.6	55.3
7	29.0	57	25.0	56.0
8	43.8	58	39.6	55.8
9	59.2	59	55.5	56.3
10	23 15.3	60	36 12.0	56.7
				12 55.84

Arcs and time as before. Time of 2 vibrations $15^s.517$.

Recapitulation of Results.

January 17, 1854.	Time of 2 vibrations	$15^s.410$	Temp. 50°
" 18, "	" "	15.496	" 68
" 18, "	" "	15.523	" 68
February 21, "	" "	15.560	" 79
" 21, "	" "	15.565	" 79
" 21, "	" "	15.509	" 55
" 21, "	" "	15.517	" 55
	Combination by two means	15.499	63.0
	Time of one vibration	7.749	

January 31, 1854. Experiments of deflections. Distance 1.3 feet. Deflecting magnet A 67.

Magnet.	North pole.	Circle reads.	Mean.	Diff. or 2 u.	Temp.
E.	W.	318° 40′ 41	40′.5	30° 43′.5	68°
"	E.	287 57 57	57.0		73
W.	E.	288 47 47	47.0	30 50.0	75
"	W.	319 37 37	37.0		72.5
				Means 30 46.7	72.1

February 13, 1854. Experiments of deflections. Distance 0.975 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
E.	E.	162° 07′ 06	06′.5	78° 56′.5	50°
"	W.	83 10 10	10.0		61
W.	W.	86 24 24	24.0	78 23.0	65
"	E.	164 47 47	47.0		66
				Means 78 40.0	60.5

February 27, 1854. Experiments of deflections. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
E.	E.	140° 54′.5	54′.5		58°
		54.5		30° 56′.0	
"	W.	109 58	58.5		58
		59			
W.	W.	110 31	31.5		58
		32		30 43.5	
"	E.	141 15	15.0		56
		15			
				30 49.7	57.5

June 7, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 45 double vibrations.
1	3h 04m 34s.2	46	3h 16m 02s.5	11m 28s.3
2	49.4	47	17.8	28 4
3	05 05.0	48	33.0	28.0
4	20.3	49	48.3	28.0
5	35.8	50	17 03.6	27.8
6	51.1	51	19.0	27.9
7	06 06.3	52	34.2	27.9
8	21.8	53	49.4	27.6
9	36.9	54	18 04.8	27.9
10	52.1	55	20.0	27.9
				11 27.97

Arc at beginning 6° 8′. Temp. +33°. Time of 2 vibrations 15s.288.
" end 2 48

Rate of mean time chronometer 2721 (showing nearly Greenwich time), about 2s.0 losing.

June 7, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 45 double vibrations.
1	3h 04m 42s.3	46	3h 16m 10s.2	11m 27s.9
2	57.6'	47	25.5	27.9
3	05 12.7	48	40.8	28.1
4	28.1	49	56.0	27.9
5	43.3	50	17 11.2	27.9
6	58.8	51	26.5	27.7
7	06 13.8	52	41.9	28.1
8	29.2	53	57.4	28.2
9	44.4	54	18 12.5	28.1
10	07 00.0	55	27.8	27.8
				11 27.96

Arcs and temp. as before. Time of 2 vibrations 15s.288.

June 7, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 45 double vibrations.
1	$3^h\ 22^m\ 08^s.0$	46	$3^h\ 33^m\ 37^s.0$	$11^m\ 29^s.0$
2	23.3	47	52.3	29.0
3	38.5	48	34 07.6	29.1
4	53.8	49	23.0	29.2
5	23 09.2	50	38.2	29.0
6	24.5	51	53.7	29.2
7	39.7	52	35 09.0	29.3
8	55.0	53	24.5	29.5
9	24 10.3	54	39.6	29.3
10	25.7	55	54.9	29.2
				11 29.18

Arc at beginning 6° 8′. Temp. 33°. Time of 2 vibrations $15^s.315$.
" end 2 48

June 7, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 45 double vibrations.
1	$3^h\ 22^m\ 16^s.0$	46	$3^h\ 33^m\ 45^s.0$	$11^m\ 29^s.0$
2	31.2	47	34 00.2	29.0
3	46.3	48	15.5	29.2
4	23 01.8	49	30.9	29.1
5	17.0	50	46.3	29.3
6	32.3	51	35 01.5	29.2
7	47.8	52	16.8	29.0
8	24 03.1	53	32.2	29.1
9	18.3	54	47.3	29.0
10	33.3	55	36 02.5	29.2
				11 29.11

Arcs and temp. as before. Time of 2 vibrations $15^s.313$.

June 7, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 54 double vibrations.
1	$8^h\ 12^m\ 39^s.1$	55	$8^h\ 26^m\ 30^s.7$	$13^m\ 51^s.6$
2	54.5	56	46.0	51.5
3	13 09.8	57	27 01.5	51.7
4	25.1	58	17.0	51.9
5	40.3	59	32.2	51.9
6	56.0	60	47.8	51.8
7	14 11.3	61	28 03.2	51.9
8	26.5	62	18.8	52.3
9	42.1	63	34.0	51.9
10	57.5	64	49.3	51.8
				13 51.83

Arc at beginning 6° 40′. Temp. 35. Time of two vibrations $15^s.403$.
" end 2 56

June 7, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 54 double vibrations.
1	$8^h\ 12^m\ 46^s.8$	55	$8^h\ 26^m\ 38^s.5$	$13^m\ 51^s.7$
2	13 02.0	56	54.0	52.0
3	17.2	57	27 09.3	52.1
4	32.6	58	24.8	52.2
5	48.1	59	40.3	52.2
6	14 03.3	60	55.7	52.4
7	18.7	61	28 11.1	52.4
8	34.0	62	26.4	52.4
9	49.5	63	41.9	52.4
10	15 05.0	64	57.4	52.4
				13 52.22

Arcs and time as before. Time of 2 vibrations $15^s.412$.

June 7, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 50 double vibrations.
1	$8^h\ 35^m\ 17^s.1$	51	$8^h\ 48^m\ 07^s.8$	$12^m\ 50^s.7$
2	32.2	52	23.1	50.9
3	48.0	53	38.6	50.6
4	36 03.3	54	54.0	50.7
5	19.0	55	49 09.3	50.3
6	34.3	56	24.8	50.5
7	49.6	57	40.1	50.5
8	37 05.1	58	55.6	50.5
9	20.6	59	50 10.9	50.3
10	36.2	60	26.3	50.1
11	51.5	61	41.6	50.1
				12 50.47

Arc 7° 28′. Temp. 35°. Time of 2 vibrations $15^s.409$.
3 12

June 7, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 50 double vibrations.
1	$8^h\ 35^m\ 24^s.7$	51	$8^h\ 48^m\ 15^s.2$	$12^m\ 50^s.5$
2	40.0	52	30.7	50.7
3	55.2	53	46.0	50.8
4	36 10.8	54	49 01.3	50.5
5	26.2	55	16.8	50.6
6	42.0	56	32.2	50.2
7	57.2	57	47.7	50.5
8	37 12.7	58	50 03.0	50.3
9	28.3	59	18.7	50.4
10	43.8	60	33.8	50.0
11	59.0	61	49.2	50.2
				12 50.43

Ares and temp. as before. Time of 2 vibrations $15^s.409$.

RECAPITULATION OF RESULTS, JUNE 7, 1854.

Set No. 1.	Time of 2 vibrations	15s.288	Temp. 33°
		15.288	" 33
Set No. 2.	" "	15.315	" 33
		15.313	" 33
Set No. 3.	" "	15.403	" 35
		15.412	" 35
Set No. 4.	" "	15.409	" 35
		15.409	" 35
June 7, 1854.	Mean	15.355	+34.0
	Time of 1 vibration . . .	7.678	

June 7, 1854. Experiments of deflections.
Deflecting magnet A. 67. Deflected magnet I. 10. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
W.	E.	374° 16′.3	15′.7		36°.2
		15.0		108° 21′.2	
"	W.	265 55.0	54.5		38.0
		54.0			
W.	W.	260 58.0	56.7		36.0
		55.5		107 33.8	
"	E.	368 31.0	30.5		34.0
		30.0			
				Means 107 57.5	36.0

Experiments of deflections. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
E.	E.	331° 33′.0	32′.0		34°.5
		31.0		30° 58′.5	
"	W.	300 34.0	33.5		34.3
		33.0			
W.	W.	301 01.0	00.5		35.8
		00.0		31 35.5	
"	E.	332 37.0	36.0		35.0
		35.0			
				Means 31 17.0	34.9

These two sets of deflections were observed between the second and third set of the preceding vibrations.

June 8, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$3^h\ 16^m\ 20^s.0$	41	$3^h\ 26^m\ 40^s.4$	$10^m\ 20^s.4$
2	35.5	42	56.0	20.5
3	50.9	43	27 11.5	20.6
4	17 06.5	44	27.2	20.7
5	22.2	45	42.6	20.4
6	37.8	46	58.1	20.3
7	53.3	47	28 13.5	20.2
8	18 08.8	48	29.1	20.3
9	24.3	49	44.6	20.3
10	39.8	50	29 00.5	20.7
11	55.2	51	15.5	20.3
				10 20.43

Arcs 5° 36′. Temp. 35°. Time of 2 vibrations $15^s.511$.
3 20

June 8, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$3^h\ 16^m\ 27^s.3$	41	$3^h\ 26^m\ 48^s.0$	$10^m\ 20^s.7$
2	43.2	42	27 03.5	20.3
3	58.6	43	19.0	20.4
4	17 14.2	44	34.6	20.4
5	29.7	45	50.0	20.3
6	45.3	46	28 05.6	20.3
7	18 00.8	47	21.1	20.3
8	16.2	48	36.5	20.3
9	31.8	49	52.2	20.4
10	47.3	50	29 07.6	20.3
11	19 02.9	51	23.3	20.4
				10 20.37

Arcs and temp. as before. Time of 2 vibrations $15^s.509$.

June 8, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$3^h\ 31^m\ 33^s.3$	41	$3^h\ 41^m\ 53^s.9$	$10^m\ 20^s.6$
2	49.0	42	42 09.2	20.2
3	32 04.5	43	24.7	20.2
4	20.0	44	40.2	20.2
5	35.6	45	55.8	20.2
6	51.2	46	43 11.2	20.0
7	33 06.7	47	26.7	20.0
8	22.1	48	42.1	20.0
9	37.6	49	57.7	20.1
10	53.1	50	44 13.0	19.9
11	34 08.3	51	28.5	20.2
				10 20.15

Arcs 6° 8′. Temp. 35°.2. Time of 2 vibrations $15^s.503$.
and 3 12

June 8, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$3^h\ 31^m\ 40^s.8$	41	$3^h\ 42^m\ 01^s.2$	$10^m\ 20^s.4$
2	56.4	42	16.5	20.1
3	32 11.9	43	32.2	20.3
4	27.3	44	47.5	20.2
5	43.1	45	43 03.0	19.9
6	58.6	46	18.4	19.8
7	33 14.1	47	33.9	19.8
8	29.6	48	49.4	19.8
9	45.1	49	44 04.9	19.8
10	34 00.7	50	20.3	19.6
11	16.2	51	35.8	19.6
				10 19.93

Arcs and temp. as before. Time of 2 vibrations $15^s.498$.

(4 sets of deflections were taken after the above, for which see below.)

June 8, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$8^h\ 31^m\ 54^s.3$	41	$8^h\ 42^m\ 09^s.5$	$10^m\ 15^s.2$
2	32 10.2	42	24.9	14.7
3	25.3	43	40.2	14.9
4	40.8	44	55.5	14.7
5	56.2	45	43 10.9	14.7
6	33 11.4	46	26.2	14.8
7	27.0	47	41.7	14.7
8	42.3	48	56.9	14.6
9	57.4	49	12.3	14.9
10	34 13.1	50	27.5	14.4
11	28.3	51	42.9	14.6
				10 14.75

Arcs 6° 48′. Temp. 35°. Time of 2 vibrations $15^s.369$.
and 2 08

June 8, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$8^h\ 32^m\ 02^s.3$	41	$8^h\ 42^m\ 18^s.3$	$10^m\ 16.0$
2	17.8	42	33.6	15.8
3	33.2	43	49.0	15.8
4	48.7	44	43 04.4	15.7
5	33 04.0	45	19.9	15.9
6	19.3	46	35.2	15.9
7	34.8	47	50.6	15.8
8	50.2	48	44 06.0	15.8
9	34 05.5	49	21.4	15.9
10	21.2	50	36.9	15.7
11	36.8	51	52.3	15.5
				10 15.80

Arcs and temp. as before. Time of 2 vibrations $15^s.395$.

June 8, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 donble vibrations.
1	$8^h\ 48^m\ 52^s.0$	41	$8^h\ 59^m\ 04^s.6$	$10^m\ 12^s.6$
2	49 07.3	42	19.7	12.4
3	23.0	43	35.3	12.3
4	38.2	44	50.5	12.3
5	53.4	45	9 00 05.8	12.4
6	50 08.9	46	21.1	12.2
7	24.3	47	36.3	12.0
8	39.6	48	51.6	12.0
9	54.7	49	1 07.0	12.3
10	51 10.1	50	22.2	12.1
11	25.3	51	37.5	12.2
				10 12.25

Ares 6° 56′. Temp. 35°. Time of 2 vibrations $15^s.306$.
and 3 20

June 8, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 2721.	No.	Time by chronometer 2721.	Time of 40 double vibrations.
1	$8^h\ 48^m\ 59^s.8$	41	$8^h\ 59^m\ 12^s.0$	$10^m\ 12^s.2$
2	49 15.1	42	27.5	12.4
3	30.3	43	42.8	12.5
4	45.8	44	58.0	12.2
5	50 01.1	45	9 00 13.4	12.3
6	16.3	46	28.6	12.3
7	31.8	47	43.9	12.1
8	47.2	48	59.3	12.1
9	51 02.2	49	01 14.6	12.4
10	17.8	50	29.9	12.1
11	33.0	51	45.3	12.3
				10 12.26

Arcs and temp. as before. Time of 2 vibrations $15^s.306$.

Daily rate of chronometer 2721, losing $1^s.0$.

Recapitulation of Results, June 8, 1854.

Set No. 1.	Time of 2 vibrations	$15^s.511$	Temp. 35°
		15.509	" 35
Set No. 2.	" "	15.503	" 35.2
		15.498	" 35.2
Set No. 3.	" "	15.369	" 35
		15.395	" 35
Set No. 4.	" "	15.306	" 35
		15.306	" 35
	Means	15.425	35.0
	Time of 1 vibration . . .	7.712	

The following deflections correspond in time to the middle of the above vibration results.

June 8, 1854. Experiments of deflections.
Deflecting magnet A. 67. Deflected magnet I. 10. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 n.	Temp.
W.	E.	329° 46′	45′.5		36°.7
		45		31° 10′.5	
"	W.	298 36	35.0		37.7
		34			
E.	W.	298 08	07.0		37.0
		06		31 33.5	
"	E.	329 41	40.5		36.2
		40			
				Means 31 22.0	36.9

Experiments of deflections. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 n.	Temp.
E.	E.	365° 52′.5	51′.7		37°.2
		51.0		110° 58′.2	
"	W.	254 54	53.5		36.6
		53			
W.	W.	262 30	29.0		37.0
		28		106 38.0	
"	E.	369 08	07.0		37.0
		06			
				Means 108 48.1	36.9

Experiments of deflections. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 n.	Temp.
W.	E.	369° 08′.0	07′.2		37°.2
		06.5		106° 48′.2	
"	W.	262 20	19.0		37.0
		18			
E.	W.	254 41	40.5		37.6
		40		110 06.7	
"	E.	364 48.0	47.2		36.6
		46.5			
				Means 108 27.4	37.1

Experiments of deflections. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 n.	Temp.
E.	E.	328° 52′	52′.0		36°.0
		52		31° 29′.5	
"	W.	297 23	22.5		35.2
		22			
W.	W.	298 03	02.5		36.3
		02		31 10.5	
"	E.	329 13	13.0		37.0
		13			
				Means 31 20.0	36.1

June 19, 1854. Experiments of deflections.

Deflecting magnet A. 67. Deflected magnet I. 7. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
W.	W.	268° 50′	49′.5		40°.6
		49			
"	E.	376 23	22.5	107° 33′.0	41.6
		22			
E.	E.	373 05	04.5		41.2
		04			
"	W.	267 00	59.5	106 05.0	41.2
		266 59			
				Means 106 49.0	41.1

Experiments of deflections. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
E.	W.	303° 38′	37′.5		40°.8
		37			
"	E.	334 21	20.5	30° 43′.0	41.0
		20			
W.	E.	334 46	46.0		43.5
		46			
"	W.	304 04	03.5	30 42.5	43.0
		03			
				Means 30 42.7	42.1

June 19, 1854. Experiments of vibrations. (Left to right.)

No.	Time.[1]	No.	Time.[1]	Time of 40 double vibrations.
1	4h 33m 20s.1	41	4h 43m 38s.6	10m 18s.5
2	35.3	42	54.0	18.7
3	51.0	43	44 09.5	18.5
4	34 06.5	44	25.0	18.5
5	21.9	45	40.4	18.5
6	37.3	46	55.9	18.6
7	52.8	47	45 11.2	18.4
8	35 08.3	48	26.6	18.3
9	23.8	49	42.1	18.3
10	39.3	50	57.7	18.4
11	54.9	51	46 13.0	18.1
				10 18.44

Arcs 7° 28′. Temp. 43°. Time of 2 vibrations 15s.461.
and 3 44

[1] Number of chronometer not stated.

June 19, 1854. Experiments of vibrations. (Right to left.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	$4^h\ 33^m\ 28^s.2$	41	$4^h\ 43^m\ 46^s.8$	$10^m\ 18^s.6$
2	43.4	42	44 02.3	18.9
3	59.0	43	17.8	18.8
4	34 14.3	44	33.2	18.9
5	29.9	45	48.6	18.7
6	45.3	46	45 04.2	18.9
7	35 00.9	47	19.5	18.6
8	16.3	48	35.1	18.8
9	31.9	49	50.4	18.5
10	47.2	50	46 05.8	18.6
11	36 02.8	51	21.4	18.6
				10 18.72

Arcs and temp. as before. Time of 2 vibrations $15^s.463$.

Experiments of vibrations. (Left to right.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	$4^h\ 50^m\ 26^s.2$	41	$5^h\ 00^m\ 44^s.0$	$10^m\ 17^s.8$
2	41.8	42	59.3	17.5
3	57.3	43	01 14.8	17.5
4	51 12.9	44	30.3	17.4
5	28.2	45	45.9	17.7
6	43.5	46	02 01.3	17.8
7	59.1	47	16.7	17.6
8	52 14.5	48	32.2	17.7
9	29.9	49	47.7	17.8
10	45.4	50	03 03.2	17.8
11	53 01.0	51	18.8	17.8
				10 17.67

Arcs 6° 56′. Temp. 43°. Time of 2 vibrations $15^s.442$.
and 4 00

Experiments of vibrations. (Right to left.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	$4^h\ 50^m\ 34^s.1$	41	$5^h\ 00^m\ 51^s.6$	$10^m\ 17^s.5$
2	49.5	42	01 07.1	17.6
3	51 04.9	43	22.4	17.5
4	20.3	44	37.9	17.6
5	35.9	45	53.4	17.5
6	51.2	46	02 08.9	17.7
7	52 06.9	47	24.3	17.4
8	22.2	48	39.6	17.4
9	37.8	49	55.0	17.2
10	53.1	50	03 10.3	17.2
11	53 08.6	51	25.8	17.2
				10 17.44

Arcs and temp. as before. Time of 2 vibrations $15^s.436$.

June 19, 1854. Experiments of vibrations. (Left to right.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	$5^h\ 13^m\ 12^s.2$	41	$5^h\ 23^m\ 30^s.3$	$10^m\ 18^s.1$
2	27.9	42	45.7	17.8
3	43.3	43	24 01.2	17.9
4	58.9	44	16.8	17.9
5	14 14.2	45	32.3	18.1
6	29.5	46	47.9	18.4
7	45.1	47	25 03.4	18.3
8	15 00.3	48	18.9	18.6
9	16.1	49	34.1	18.0
10	31.3	50	49.7	18.4
11	46.9	51	26 05.1	18.2
				10 18.15

Arcs 6° 48′. Temp. 42°.4. Time of 2 vibrations $15^s.454$.
3 36

Experiments of vibrations. (Right to left.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	$5^h\ 13^m\ 20^s.2$	41	$5^h\ 23^m\ 37^s.6$	$10^m\ 17^s.4$
2	35.7	42	52.9	17.2
3	51.2	43	24 08.3	17.1
4	14 06.5	44	24.0	17.5
5	22.1	45	39.5	17.4
6	37.5	46	54.9	17.4
7	53.2	47	25 10.2	17.0
8	15 08.4	48	25.2	16.8
9	23.7	49	40.8	17.1
10	39.2	50	56.5	17.3
11	54.8	51	26 11.7	16.9
				10 17.19

Arcs and temp. as before. Time of 2 vibrations $15^s.430$.

Experiments of vibrations. (Left to right.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	$5^h\ 33^m\ 23^s.3$	41	$5^h\ 43^m\ 39^s.5$	$10^m\ 16^s.2$
2	38.9	42	54.9	16.0
3	54.2	43	44 10.3	16.1
4	34 09.5	44	25.8	16.3
5	25.2	45	41.3	16.1
6	40.4	46	56.7	16.3
7	55.9	47	45 11.9	16.0
8	35 11.2	48	27.4	16.2
9	26.8	49	42.8	16.0
10	42.2	50	58.2	16.0
11	57.6	51	46 13.6	16.0
				10 16.11

Arcs 7° 04′. Temp. 42°.4. Time of two vibrations $15^s.403$.
3 28

Experiments of vibrations. (Right to left.)

No.	Time.	No.	Time.	Time of 40 double vibrations.
1	5h 33m 31s.2	41	5h 43m 47s.2	10m 16s.0
2	46.5	42	44 02.8	16.3
3	34 02.1	43	18.1	16.0
4	17.4	44	33.5	16.1
5	33.0	45	49.0	16.0
6	48.4	46	45 04.5	16.1
7	35 03.7	47	19.8	16.1
8	19.0	48	35.2	16.2
9	34.3	49	50.6	16.3
10	49.5	50	46 05.9	16.4
11	36 05.2	51	21.3	16.1
				10 16.15

Arcs and temp. as before. Time of 2 vibrations 15s.404.

Recapitulation of Results, June 19, 1854.

Set No. 1.	Time of 2 vibrations	15s.461	Temp. 43°
		15.463	" 43
Set No. 2.	" "	15.442	" 43
		15.436	" 43
Set No. 3.	" "	15.454	" 42.4
		15.430	" 42.4
Set No. 4.	" "	15.403	" 42.4
		15.404	" 42.4
	Means	15.437	42.7
	Time of 1 vibration . .	7.718	

June 19, 1854. Experiments of deflections.
Deflecting magnet A. 67. Deflected magnet I. 7. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 n.	Temp.
W.	W.	298° 54′	53′.5		42°.0
		53		30° 53′.0	
"	E.	329 47	46.5		42.2
		46			
E.	E.	329 20	19.5		43.2
		19		30 50.0	
"	W.	298 30	29.5		42.0
		29			
				Means 30 51.5	42.4

Experiments of deflection. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Mean.	2 u.	Temp.
E.	W.	259° 19′	18′.5		42°.2
		18		106° 11′.5	
"	E.	365 31	30.0		42.0
		29			
W.	E.	369 39	38.5		43.2
		38		106 30.5	
"	W.	263 09	08.0		41.8
		07			
				Means 106 21.0	42.3

June 24, 1854. Experiments of deflections.
Deflecting magnet A. 67. Deflected magnet I. 7. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Means.	2 n.	Temp.
W.	W.	264° 10′	09′.5		38°.0
		09			
"	E.	369 42	41.5	105° 32′.0	38.0
		41			
E.	E.	365 00	59.5		38.0
		364 59			
"	W.	259 50	49.5	105 10.0	38.0
		49			
				Means 105 21.0	38.0

Experiments of deflection. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Means.	2 u.	Temp.
E.	W.	298° 37′	36′.5		38°.5
		36			
"	E.	329 21	21.0	30° 44′.5	38.6
		21			
W.	E.	330 13	12.5		40.3
		12			
"	W.	299 42	41.5	30 31.0	40.0
		41			
				Means 30 37.7	39.4

June 24, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	$4^h\ 21^m\ 34^s.3$	41	$4^h\ 31^m\ 53^s.3$	$10^m\ 19^s.0$
2	49.6	42	32 08.8	19.2
3	22 05.2	43	24.2	19.0
4	20.7	44	39.6	18.9
5	36.3	45	55.0	18.7
6	51.8	46	33 10.4	18.6
7	23 07.3	47	26.3	19.0
8	22.8	48	41.8	19.0
9	38.4	49	57.2	18.8
10	53.8	50	34 12.5	18.7
11	24 09.1	51	28.0	18.9
				10 18.89

Arcs 6° 16′. Temp. 41°.2. Time of 2 vibrations $15^s.472$.
and 3 20

The chronometer nearly shows Greenwich mean time, and its daily rate is less than $0^s.5$ (gaining).

June 24, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	4h 21m 41s.8	41	4h 31m 59s.0	10m 17s.2
2	57.1	42	32 14.3	17.2
3	22 12.6	43	29.2	16.6
4	28.2	44	44.4	16.2
5	43.4	45	59.5	16.1
6	59.0	46	33 14.9	15.9
7	23 14.3	47	30.3	16.0
8	29.8	48	45.8	16.0
9	45.2	49	34 01.0	15.8
10	24 00.8	50	16.3	15.5
11	16.2	51	31.6	15.4
				10 16.17

Arcs and temp. as before. Time of 2 vibrations 15s.404.

June 24, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	4h 40m 31s.1	41	4h 50m 46s.0	10m 14s.9
2	46.5	42	51 01.3	14.8
3	41 02.0	43	16.8	14.8
4	17.4	44	32.0	14.6
5	32.8	45	47.5	14.7
6	48.2	46	52 02.8	14.6
7	42 03.5	47	18.1	14.6
8	18.9	48	33.4	14.5
9	34.3	49	48.8	14.5
10	49.8	50	53 04.1	14.3
11	43 05.1	51	19.4	14.3
				10 14.60

Arcs 5° 52′. Temp. 41°.2. Time of 2 vibrations 15s.365.
and 3 20

Jnne 24, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	4h 40m 38s.8	41	4h 50m 53s.8	10m 15s.0
2	54.2	42	51 09.2	15.0
3	41 09.5	43	24.6	15.1
4	24.9	44	40.0	15.1
5	40.2	45	55.4	15.2
6	55.8	46	52 10.8	15.0
7	42 11.1	48	26.2	15.1
8	26.3	47	41.6	15.3
9	41.9	49	57.0	15.1
10	57.2	50	53 12.3	15.1
11	43 12.6	51	27.8	15.2
				10 15.11

Arcs and temp. as before. Time of 2 vibrations 15s.378.

June 24, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	$5^h\ 03^m\ 29^s.3$	41	$5^h\ 15^m\ 44^s.5$	$10^m\ 15.2$
2	44.9	42	59.5	14.6
3	04 00.3	43	14 15.1	14.8
4	15.6	44	30.4	14.8
5	31.0	45	45.9	14.9
6	46.4	46	15 01.3	14.9
7	05 01.8	47	16.8	15.0
8	17.1	48	32.2	15.1
9	32.3	49	47.7	15.4
10	47.8	50	16 02.9	15.1
11	06 03.2	51	18.2	15.0
				10 14.982

Arcs 6° 16′. Temp. 41°.2. Time of 2 vibrations $15^s.375$.
and 3 28

June 24, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	$5^h\ 03^m\ 37^s.1$	41	$5^h\ 13^m\ 52^s.0$	$10^m\ 14.9$
2	52.4	42	14 07.6	15.2
3	04 07.8	43	23.0	15.2
4	23.2	44	38.3	15.1
5	38.4	45	53.8	15.4
6	53.8	46	15 09.1	15.3
7	05 09.3	47	24.5	15.2
8	24.5	48	39.9	15.4
9	40.0	49	55.2	15.2
10	55.0	50	16 10.6	15.6
11	06 10.8	51	26.0	15.2
				10 15.24

Arcs and temp. as before. Time of 2 vibrations $15^s.381$.

June 24, 1854. Experiments of vibrations. (Left to right.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	$5^h\ 18^m\ 38^s.3$	41	$5^h\ 28^m\ 54^s.8$	$10^m\ 16^s.5$
2	54.0	42	29 10.1	16.1
3	19 09.3	43	25.3	16.0
4	24.9	44	40.8	15.9
5	40.3	45	56.2	15.9
6	55.7	46	30 11.6	15.9
7	20 11.2	47	27.0	15.8
8	26.7	48	42.4	15.7
9	42.2	49	57.8	15.6
10	57.5	50	31 13.1	15.6
11	21 12.9	51	28.7	15.8
				10 15.89

Arcs 6° 48′. Temp. 41°.2. Time of 2 vibrations $15^s.397$.
3 20

June 24, 1854. Experiments of vibrations. (Right to left.)

No.	Time by chronometer 264.	No.	Time by chronometer 264.	Time of 40 double vibrations.
1	$5^h\ 18^m\ 46^s.2$	41	$5^h\ 29^m\ 02^s.7$	$10^m\ 16^s.5$
2	19 01.9	42	18.0	16.1
3	17.2	43	33.6	16.4
4	32.8	44	49.0	16.2
5	48.2	45	30 04.2	16.0
6	20 03.6	46	19.7	16.1
7	19.0	47	35.0	16.0
8	34.3	48	50.4	16.1
9	49.7	49	31 05.8	16.1
10	21 05.1	50	21.5	16.4
11	20.6	51	36.8	16.2
				10 16.19

Ares and temp. as before. Time of 2 vibrations $15^s.405$.

Recapitulation of Results, June 24, 1854.

Set No. 1.	Time of 2 vibrations	$15^s.472$	Temp. 41°.2
		15.404	" 41.2
Set No. 2.	" "	15.365	" 41.2
		15.378	" 41.2
Set No. 3.	" "	15.375	" 41.2
		15.381	" 41.2
Set No. 4.	" "	15.397	" 41.2
		15.405	" 41.2
	Mean	15.397	41.2
	Time of 1 vibration . . .	7.699	

June 24, 1854. Experiments of deflections.
Deflecting magnet A. 67. Deflected magnet I. 7. Distance 1.3 feet.

Magnet.	North pole.	Circle reads.	Means.	2 u.	Temp.
W.	W.	300° 17′	16′.0		44°.2
		15		30° 12′.0	
"	E.	330 29	28.0		43.0
		27			
E.	E.	330 41	40.5		42.2
		40		30 37.0	
"	W.	300 04	03.5		42.4
		03			
				Means 30 24.5	42.9

Experiments of deflections. Distance 0.9 feet.

Magnet.	North pole.	Circle reads.	Means.	2 u.	Temp.
E.	W.	261° 24′	23′.0		41.4
		22		106° 07′.5	
"	E.	367 31	30.5		41.0
		30			
W.	E.	373 07	06.0		42.4
		05		109 04.5	
"	W.	264 02	01.5		41.7
		01			
				Means 107 36.0	41.6

The detail record of the observations of deflections and vibrations at Van Rensselaer Harbor, in May, 1855, and of the vibrations at Hakluyt Island, and near Cape York, in June and July, 1855, could not be found; the results, however, are preserved in Appendix No. XV. of the Narrative (vol. II.), and are herewith subjoined.

SYNOPSIS OF RESULTS OF VIBRATIONS AND DEFLECTIONS, OBSERVED AT VAN RENSSELAER HARBOR DURING THE YEARS 1854 AND '55.

Date.	Temp.'s observed.	Time of 1 vibration.	Mean adopted. T.	Corresponding temp. t_1.	Angle of deflection. u.	Distance in feet. r.
1854.						
January 17	50°.0	7s.705				
" 18	68.0	7.748				
" 18	68.0	7.761				
" 31	72.1					
February 13	60.5		7s.749	63°.0	15° 23′.3	1.3
" 21	79.0	7.780			39 20.0	0.975
" 21	79.0	7.782				
" 21	55.0	7.755				
" 21	55.0	7.758				
" 27	57.5				15 24.8	1.3
June 7	33.0	7.644				
" 7	33.0	7.644				
" 7	33.0	7.657				
" 7	33.0	7.656				
" 7	36.0		7.678	34.0	53 58.7	0.9
" 7	34.9				15 38.5	1.3
" 7	35.0	7.702				
" 7	35.0	7.706				
" 7	35.0	7.705				
" 7	35.0	7.704				
June 8	35.0	7.755				
" 8	35.0	7.754				
" 8	35.2	7.752				
" 8	35.2	7.749				
" 8	36.9				15 41.0	1.3
" 8	36.9		7.712	35.0	54 24.0	0.9
" 8	37.1				54 13.7	0.9
" 8	36.1				15 40.0	1.3
" 8	35.0	7.685				
" 8	35.0	7.697				
" 8	35.0	7.653				
" 8	35.0	7.653				
June 19	41.1				53 24.5	0.9
" 19	42.1				15 21.3	1.3
" 19	43.0	7.730				
" 19	43.0	7.731				
" 19	43.0	7.721				
" 19	43.0	7.718	7.718	42.7		
" 19	42.4	7.727				
" 19	42.4	7.715				
" 19	42.4	7.702				
" 19	42.4	7.702				
" 19	42.4				15 25.7	1.3
" 19	42.3				53 10.5	0.9

Date.	Temp.'s observed.	Time of 1 vibration.	Mean adopted. T.	Corresponding temp. t_1.	Angle of deflection. u.	Distance in feet. r.
1854.						
June 24	38°.0				52° 40′.5	0.9
" 24	39.4				15 18.8	1.3
" 24	41.2	7.736				
" 24	41.2	7.702				
" 24	41.2	7.683				
" 24	41.2	7.689				
" 24	41.2	7.688	7.699	41°.2		
" 24	41.2	7.690				
" 24	41.2	7.698				
" 24	41.2	7.702				
" 24	42.9				15 12.3	1.3
" 24	41.6				53 48.0	0.9
1855.						
May 16	17.0	7.448				
" 16	19.3	7.416				
" 16	17.0		7.405	19.3	14 37.1	1.3
" 16	17.0				50 50.7	0.9
" 16	22.0	7.384				
" 16	19.0	7.371				
May 17	23.0	7.394	7.391	23.0		
" 17	23.0	7.388				
" 17	23.0				49 59.8	0.9
" 17	23.0				14 32.6	1.3
May 18	15.0	7.383	7.384	15.0		
" 18	15.0	7.385				
" 18	27.0				14 23.2	1.3
" 18	27.0				48 00.8	0.9
May 19	28.0	7.407				
" 19	28.5	7.413	7.405	28.2		
" 19	28.0	7.396				
" 19	27.0				49 00.7	0.9
" 19	27.0				14 36.7	1.3

Abstract of Observations of Vibrations at Hakluyt Island.

Approx. lat. 77° 23′. Approx. long. 72° 30′ W. of Gr.

1855. June 21.	33°.3	7ˢ.020		
" 21.	33.3	7.026	7ˢ.026	33°.5
" 21.	33.8	7.033		

Abstract of Observations of Vibrations at a station in lat. 76° 03′ and long. 68° 00′ W. of Gr., on the coast between Parker Snow's Point and Cape York.

1855. July 19.	40°.0	6ˢ.475		
" 19.	41.5	6.489	6ˢ.495	40°.5
" 19.	41.2	6.544		
" 19.	39.5	6.474		

Determination of the Moment of Inertia of Magnet A. 67.

(With stirrup and mirror attached.)

No determination of the moment of inertia of magnet A. 67 having been made by the expedition, it became necessary to determine the same afterwards. The following observations for this purpose were made by myself at the Coast Survey Office, Washington, D. C.

After adjusting the instrument and suspending A. 67, the following experiments of vibrations were made:—

March 18, 1858. Mean time chronometer Kessels 1285.

No. of vibrations.	Mean local time by chronometer 1285.	20 vibrations.
0	9h 31m 10s.7	
20	32 32.4	1m 21s.7
40	33 54.0	21.6
60	35 15.1	21.1
80	36 36.5	21.4
100	37 58.0	21.5
		Mean 1 21.47

Temp. 71°.8. (Rate of chronometer too small to affect the result.) 1 vibration=4s.073.

No of vibrations.	Time by chronometer 1285.	18 vibrations.
0	10h 28m 51s.3	
18	30 04.5	1m 13s.2
36	31 18.0	13.5
54	32 31.0	13.0
72	33 44.8	13.8
90	34 57.9	13.1
		Mean 1 13.32

Arc 234d and 328d Temp. 71°.0.
242 318 1 vibration=4s.073

The mirror was below the magnet in these two sets; in the following four sets it was above.

Magnet suspended with inertia ring Z, of the following dimensions: Outer diameter 2.322 inches; inner diameter 1.837 inches; thickness 0.188 inches at 69°; weight 648.937 grains: hence $K_1 = \frac{1}{2}(r^2 + r_1^2)w = 4.936$ (in feet and grains), $lg\, K_1 = 0.69338$.

Vibrations with ring.

No. of vibrations.	Time by chronometer 1285.	20 vibrations.
0	12h 34m 06s.0	
20	36 32.2	2m 26s.2
40	38 58.8	26.6
60	41 24.1	25.3
80	43 49.6	25.5
100	46 15.4	25.8
		2 25.88

Arc 190d—360d Temp. 75°.
228 —321 1 vibration 7s.294.

No. of vibrations.	Time by chronometer 1285.	20 vibrations.
0	12h 48m 13s.6	
20	50 39.5	2m 25s.9
40	53 05.3	25.8
60	55 31.5	26.2
80	58 00.4	28.9[1]
100	13 00 26.6	26.2
		2 26.02

Arc 229d—321d
239 —301 1 vibration=7s.301

Vibrations without ring.

No. of vibrations.	Time by chronometer 1285.	20 vibrations.
0	1h 17m 29s.9	
20	18 51.2	1m 21s.3
40	20 12.5	21.3
60	21 34.0	21.5
80	22 55.1	21.1
100	24 17.0	21.9
		1 21.42

Arc 298d—230d Temp. 76°.
1 vibration 4s.071.

No. of vibrations.	Time by chronometer 1285.	20 vibrations.
0	1h 26m 50s.7	
20	28 12.1	1m 21s.4
40	29 33.0	20.9
60	30 54.5	21.5
80	32 15.9	21.4
100	33 37.0	21.1
		1 21.26

1 vibration=4s.063.

[1] Omitted, disturbed by a current of air.

Observations for torsion.

Torsion circle.	Scale readings.	Mean.	Diff.
74°	248—304	276	
164	361—234	297	21^d
344	11—428	220	77
74	190—370	280	60
			$31' = 39^d$ for 90°

For torsion with ring use 42

March 19, 1858. Vibrations without ring. (Mirror above.)

No. of vibrations.	Time by chronometer 1285.	20 vibrations.	
0	$9^h\ 23^m\ 31^s.9$		
20	24 53.1	$1^m\ 21^s.2$	Temp. 75°.
40	26 14.3	21.2	
60	27 35.5	21.2	
80	28 56.9	21.4	
100	30 18.0	21.1	
		1 21.22	1 vibration = $4^s.061$.

Vibrations with ring.

No. of vibrations.	Time by chronometer 1285.	20 vibrations.	
0	$9^h\ 50^m\ 17^s.0$		
20	52 43.3	$2^m\ 26^s.3$	
40	55 09.7	26.4	
60	57 35.5	25.8	
80	60 01.1	25.6	
		2 26.02	1 vibration = $7^s.301$.

Recapitulation of Results.

March 18, 1858.	1 vibration, without ring . .	$4^s.073$	—	Temp. 71°.8
" "	" " " . .	4.073	—	" 71.0
" "	" with " . .	—	$7^s.294$	" 75.0
" "	" " " . .	—	7.301	" 75.0
" "	" without " . .	4.071	—	" 76.0
" "	" " " . .	4.063	—	" 76.0
March 19, 1858.	" " " . .	4.061	—	" 75.0
" "	" with " . .	—	7,301	" 75.0
	Mean by combination . .	T=4.069 at 74°.0	T_1=7.299 at 75°.0	

The moment of inertia of the magnet (with appendages) K becomes for the temp. 69° (and corrected for torsion)

$$K = K_1\left(\frac{T^2}{T_1^2 - T^2}\right) = 2.220 \text{ and } lg\ K = 0.34631.$$

Using 0.0000068 for the coefficient of dilatation for 1° Fahr., the above $lg\ K$ for different temperatures becomes:

For 62°, $lg\ K = 0.34628$ and $lg\ \pi^2 K = 1.34058$
" 32, " 0.34609 " $= 1.34039$ (Chas. A. S.)

The value of the induction coefficient

$$P = -\frac{r^2 r_1^5 \sin. u_1 - r_1^2 r^5 \sin. u}{r_1^5 \sin. u_1 - r^5 \sin. u}$$

may be put in the following convenient form—

$$P = -r^2 \frac{\sigma - \varrho^3}{\sigma - \varrho^5} \text{ where } \sigma = \frac{\sin. u^1}{\sin. u} \text{ and } \varrho = \frac{r}{r_1}.$$

We find:	June 7, 1854	$P = -0.007$
	" 8, "	-0.003
	" 8, "	-0.006
	" 19, "	$+0.009$
	" 19, "	-0.003
	" 24, "	-0.001
	" 24, "	$+0.033$
	May 16, 1855	$+0.035$
	" 17, "	$+0.039$
	" 18, "	-0.011
	" 19, "	-0.011

If we take the indiscriminate mean of the above values we find $P = +0.007$, and if we reject the three values marked by brackets, $P = -0.004$; the latter value is probably nearer the truth than the first one, but both are so small that they may be neglected in the computation of the intensity.

In the absence of observations, the temperature coefficient for the magnetic moment or q may be assumed $= 0.0003$, a value found for other magnets of the same magnetic moment and size; with but three exceptions, the temperature corrections are small.

After correcting for difference of temperature, the following results for magnetic moment m and horizontal intensity X have been computed by the formulæ

$$\frac{m}{X} = \tfrac{1}{2} r^3 \sin. u \text{ and } m X = \frac{\pi^2 k}{T^2}.$$

TABLE OF RESULTS OF $log.\frac{m}{X}$, $log.\ m\ X$, OF m THE MAGNETIC MOMENT OF MAGNET A. 67, AND OF THE HORIZONTAL INTENSITY X, AT VAN RENSSELAER HARBOR.

Date.	$lg.\frac{m}{X}$.	$lg.\ m\ X.$	$m.$	$X.$
1854.				
Jan. 31	9.46463	9.56091	0.326	1.117
Feb. 13	9.46795	9.56243	0.327	1.115
" 27	9.46532	9.56282	0.327	1.119
June 7	9.46954	9.56964	0.330	1.122
" 7	9.47155	9.56980	0.331	1.120
" 8	9.47268	9.56583	0.330	1.113
" 8	9.47184	9.56583	0.330	1.114
" 8	9.47091	9.56581	0.330	1.115
" 8	9.47223	9.56593	0.330	1.114
" 19	9.46636	9.56570	0.328	1.121
" 19	9.46371	9.56556	0.327	1.124
" 19	9.46574	9.56552	0.328	1.122
" 19	9.46504	9.56553	9.328	1.123
" 24	9.46218	9.56801	0.327	1.130
" 24	9.46256	9.56782	0.328	1.129
" 24	9.45956	9.56737	0.326	1.133
" 24	9.46855	9.56754	0.330	1.121
1855.				
May 16	9.44285	9.60156	0.332	1.200
" 16	9.45125	9.60156	0.336	1.189
" 17	9.44593	9.60293	0.334	1.198
" 17	9.44065	9.60293	0.332	1.206
" 18	9.43607	9.60219	0.331	1.210
" 18	9.43286	9.60219	0.329	1.215
" 19	9.43956	9.60148	0.332	1.205
" 19	9.44266	9.60148	0.332	1.200
			Mean value of $m = 0.330$ at $t = 36°$.[1]	

RECAPITULATION OF VALUES OF X.

January 31, 1854	$X = 1.117$
February 20, "	1.117
June 15, "	1.121
May 18, 1855	1.203
Mean corresponding to June, 1854 . . .	1.139

Taking the above value 1.139 for the mean horizontal force during the whole period, and multiplying it by sec. 84° 45′.8, the total force at Van Rensselaer Harbor during the same period becomes $\phi = 12.479$.

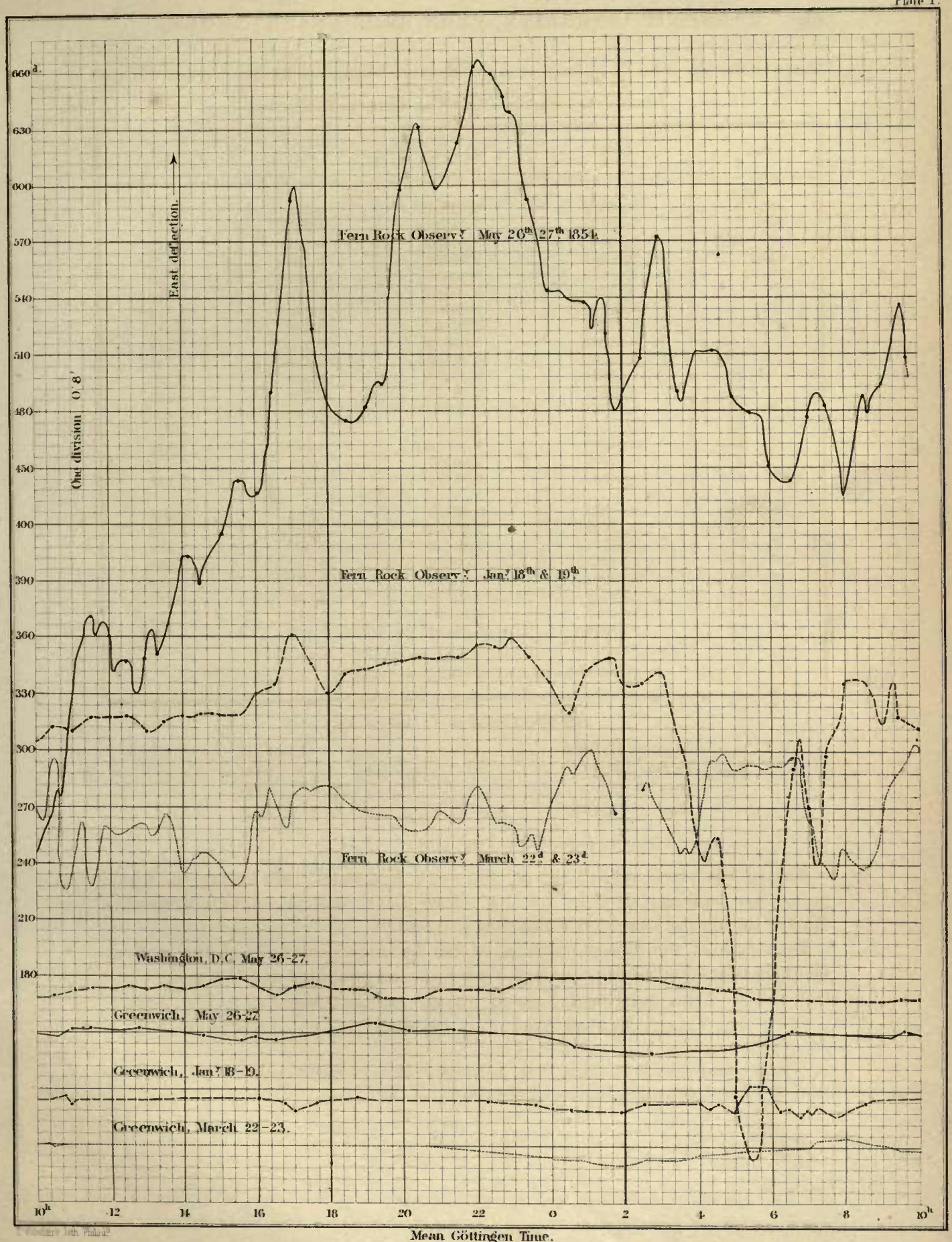
By means of the known value of m the horizontal intensity at the stations Hakluyt Island and coast near Cape York has been computed as follows:—

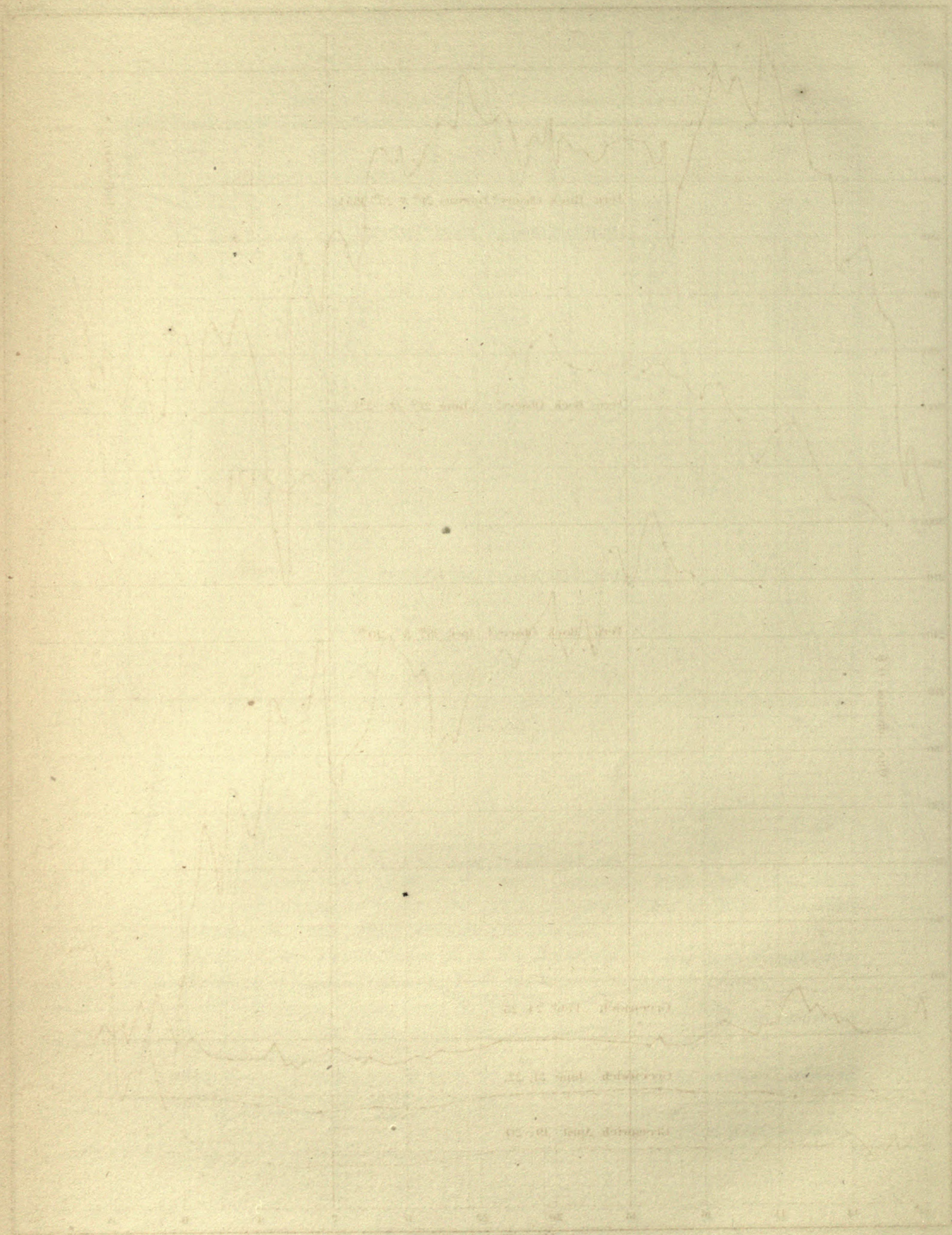
Hakluyt Island, June 21, 1855 . . $X = 1.344$
Coast near Cape York, July 19, 1855 . X 1.573

[1] I redetermined m at Washington, D. C., in March, 1858, and found it equal to 0.311, exhibiting but a small loss of magnetism during nearly four years.

DIURNAL CHANGES OF THE MAGNETIC DECLINATION ON TERM-DAYS.

Plate 1.





DIURNAL CHANGES OF THE MAGNETIC DECLINATION ON TERM-DAYS.