bitants; on the contrary I have reason to infer that they are salutary. In June or July the temperature occasionally rises to the oppressive heat of 92°, but this continues only for a few days at a time, and is terminated by heavy thunder-storms and drenching rains, which speedily cool the atmosphere to 56° or 60°, and give new growth to the drooping vegetables. The temperature in the nights is much lower than during the day, particularly in the months of August and September, and a very heavy fall of dew takes place.

The weather in March is clear and cloudless, and the ice, which in the winter has attained a thickness of sixteen inches, now begins to dissolve, particularly near rocks or stones, or wherever it is affected by radiant heat. Towards the end of the month maples are tapped, and the sugar harvest commences. Flocks of Canada geese and various ducks make their appearance about the same time, and are the harbingers of fine weather. The ice becomes weaker first on the shoals and rocky places, and finally disappears, upon an average, on the 24th of April. The *alnus glutinosa* and various *willows* blossom about the middle of April. The *hepatica triloba* flowers about the 25th.

From the 1st to the 20th of May potatoes are planted, and cucumbers and melons are usually sown between the 25th and the end of the same month. In May, spring wheat, oats and barley are committed to the ground. Various plants, such as *Viola blanda, Xylosteum, Caulophyllum, Erythronium,* &c., blossom in this month, and about the 19th musquitoes begin to be troublesome. In the month of June the temperature rises to 90° in the day, and heavy dews fall in the night. Towards the end of the month garden peas are fully podded, and the male flowers of maize spring up. The *lilium philadelphicum* blossoms at this time.

In July and August the weather is usually very sultry and dry. About the beginning of the former month the *Penstemon pubescens, Rhus typhinum,* garden melons and cucumbers blossom; and towards the middle of August melons grown without artificial warmth are ripe, and the wheat and oat harvest commences. Maize is fit for pulling at the end of the month.

In September numerous flocks of the *turdus migratorius* and other birds arrive from the north, and remain for a time feeding on the berries of various species of *rubus.* Near the end of the month the frost destroys the cucumber and melon vines, and potatoes are dug and stored for winter. The forest assumes a variety of autumnal hues in the beginning of October, and about the middle of the month many flocks of geese and ducks pass to the southward, and their appearance precedes a series of cold weather which strips the leaves from the trees. A fall

of snow usually occurs about the 25th. About the end of the month many *white fish (corregonus albus)* are speared by the Indians.

November is usually calm and pleasant when compared with the more stormy preceding month; and at this period a peculiar state of weather occurs, which is sometimes of three weeks continuance, and is named the Indian summer. It is characterised by a fog or haze rising from the earth or water, through which the sun is seen obscurely, and there is little or no wind.

In December the thermometer sinks a few degrees below zero; the sky is cloudy and much snow falls. The harbour freezes in the beginning of the month. In January the thermometer sinks twenty degrees below zero, but I have once seen it for a few hours as low as 32° (January, 1822). The snow attains a depth of three feet in the woods this month, but the ground under it is not frozen, nor have I observed it to be so at any time during the winter. In February the sky is cloudy, and a great fall of snow takes place, and there is usually a temporary thaw about the end of the month, accompanied by heavy rain and sometimes by thunder. The winter months in other parts of Canada are attended with a cloudless sky, and much less snow than occurs at Penetanguishene, and this difference may, I think, be attributed to the vicinity of the Blue Mountains which skirt Lake Huron, thirty miles to the S.W. of Penetanguishene.

No. III.

OBSERVATIONS ON SOLAR RADIATION,

BY

JOHN RICHARDSON, M.D., F.R.S., &c.

Surgeon and Naturalist to the Expedition.

In the table of observations on solar radiation, the first column under each month, up to the end of April, shows the temperature of the air by the same spirit thermometer, hung in the shade on the north side of the observatory, which was used in forming the register from which the abstract of the Meteorological Journal, Table I., was taken. The succeeding column exhibits the excess of temperature indicated by a spirit thermometer hung on the south side of the observatory where it was exposed to the rays of the sun. The two thermometers had spherical bulbs half an inch in diameter, and their scales corresponded very nearly with each other. The one exposed to the sun was prepared by covering its bulb with silk paper, and a pretty thick coat of China ink mixed with indigo.

When the air was calm, or when the wind blew from any of the northern points of the compass, and the thermometer in the sun was sheltered by the observatory, I considered its excess over the one in the shade to be a measure of the force of solar radiation, which could be readily compared with other observations; but when the wind blew on the blackened thermometer, the heat was abstracted from its bulb with a rapidity proportioned to the strength of the breeze, and these observations being obviously incorrect are marked in the tables with an asterisk. During the winter months, southerly winds were rare, but they became more frequent in the spring; and in the month of May, a mercurial thermometer, having its bulb covered with paper, and blackened in a

similar manner to the spirit one, was inclosed in a square bottle of thin glass, four inches wide, to protect it from the wind. The excess of this thermometer when the sun shone on it, over the mercurial one in the metal cylinders described in page lx. is registered in the second column of the tables of radiation for the months of May, July, and August. During May, there is also a third column for each hour, headed "Exposed," which contains the observations made with the blackened spirit thermometer used in the preceding months, and which still remained suspended on the south side of the observatory; as in the preceding tables the instances in which the wind blew on the latter thermometer are noted by an asterisk. The glass bottle no doubt intercepted a portion of the sun's rays, particularly when they fell obliquely on it; and as the heat it gained was continually abstracted by the wind, the observations were, to a certain extent, inaccurate, but the contrivance was suited to the limited means we possessed at Fort Franklin. It stood three feet from the ground on the top of a detached post, and was exposed to all winds.

In the months of October, November, December, and January, the amount of the solar radiation was noted occasionally only, the cloudy days when there was little sunshine being omitted; but in February, March, and April, the observations were regularly made every hour from sunrise to sunset, and it is the highest for each day which is given in Table I. The remark made in page lx. of the Appendix, on the uncertainty of the hour at which the temperatures were observed in July and August, applies also to the register of solar radiation for these two months.

The intensity of solar radiation shown by the blackened thermometer was generally greatest when the sky was of a deep blue colour, and it was not much affected by scattered clouds, however dense, unless when they passed over the face of the sun. The temperature produced by the sun's rays (except when the exposed thermometer was cooled by southerly winds) generally increased, as might have been expected, gradually from sunrise to noon, and decreased again to sunset, but on an average the radiation was more powerful in the forenoon than at corresponding altitudes of the sun in the afternoon. It was also much stronger in the spring months when the ground was covered with snow, than in the summer months when the altitude of the sun was greater.

The difference of intensity of solar radiation at equal altitudes of the sun is, I believe, dependent upon variations in the clearness of the atmosphere; and perhaps the greater transparency of the air in the spring, before the snow

disappears, may be explained somewhat in the following manner. In the month of March, for instance, the sun in the latitude of Fort Franklin has sufficient power to heat the atmosphere considerably, but the snow then lies unmelted on the ground, and the temperature sinks very low in the night, frequently as low as it does at any time during the winter. The night-cold causes much of the moisture of the atmosphere to be deposited in the form of hoar frost or rime; whilst, on the other hand, the warmth which the air acquires after sunrise renders its solvent power greater than the slow evaporation from snow, cooled most frequently below zero, can satisfy. The consequence is that all the haze or mist floating in the air is completely dissolved shortly after sunrise, and the sky becomes clear to a degree which is unknown there in the summer, or in any season in more southern latitudes*. The greater haziness of the sky after the sun has passed the meridian, probably depends in some degree on the currents of air produced by the heat of the sun mingling portions of the atmosphere at different temperatures.

In cloudy nights, the blackened thermometers, whether exposed to the air, or sheltered by glass, showed generally the same temperature as the one on the north side of the observatory; but when there was a clear blue sky, both the blackened thermometers frequently indicated lower temperatures, sometimes to the amount of four degrees. In the tables of radiation for July and August, the mark *minus* in the second columns for two A. M. and eleven P. M. denotes that the blackened thermometer in the glass bottle showed a lower temperature than the one in the metal cylinders.

As in some degree connected with the subject of radiation, I may notice in this place, that those who travel over the snow in this country, in the spring, experience a sudden sensation of cold in moderately clear weather, just as the upper limb of the sun begins to rise above the horizon. This is probably owing to the first rays of the sun clearing the atmosphere in the way alluded to above, and thereby permitting of greater radiation of heat from objects on the earth's surface to the clear blue sky. It is evident that the rays of the rising sun impinging on the clouds, possess the power of heating the atmosphere, before the luminary is visible from the earth.

In the summer-time, the power of the sun was perceived to be greatest when partial thunder-clouds were floating over a deep blue sky, and after a few large

* Mr. Daniell has pointed out the greater power of the sun's rays in high latitudes; but seems inclined to attribute it to the smaller depth of the atmosphere near the poles.

drops of rain had fallen. When the sun shone out at such times its heat was very oppressive.

The amount of solar radiation shown by Leslie's Photometer was regularly noted in March and May, and occasionally in the other months, but when the temperature of the air was low, and the sun bright, the coloured liquid was frequently driven entirely out of the limb of the instrument to which the scale is attached, and in twelve different instances in the month of March, the whole of the liquid was forced into the colourless bulb. Whether this was owing to the instrument not being calculated for measuring great solar radiation when the temperature of the air was very low, or to a defect in its construction attributable to the maker, I am unable to say; but as the results could only be guessed at, after the liquid had descended below the scale, I have not inserted them in the Tables. In May, the liquid in the Photometer seldom entirely left the stem to which the scale is applied, and in general, in that month, a degree of its scale corresponded to a greater number of degrees of the blackened thermometer than in March.

The effect of the sun in heating the atmosphere in the northern parts of America, and especially in the spring, when the accidental changes of temperature are very small if compared with the morning rise, may be estimated by taking the mean difference for a number of days between the temperature at sunrise, and at two P.M. in the shade. These two periods, in fact, correspond, particularly in the spring months, almost uniformly with the extreme temperatures of the twenty-four hours, and accordingly a comparison of the daily range of temperature in more southern latitudes with that shown by the Meteorological Tables to exist at Fort Franklin, will corroborate some of the preceding statements as to the greater solar radiation in high northern latitudes, consequent, as I have inferred, on the state of the atmosphere*. The heat which the atmosphere acquires in the day-time is not, however, exactly commensurate with the power of the sun's rays indicated by a blackened thermometer, for the air must doubtless frequently acquire heat from the clouds which intercept the sun's rays in their progress to the thermometer. When the whole ground is deeply covered with snow, it is evident that no heat can be communicated from the earth to air whose temperature exceeds 32°.

The highest peak of a chain of hills, distant about forty miles from Bear Lake, was visible in clear weather, and in particular states of the atmosphere a con-

* In the Table of the progress of the seasons at Fort Franklin there is a column which indicates the mean difference between the temperature at sunrise and two P. M. for every ten days.

siderable portion of the range was seen, so that the amount of refraction of the air was in some degree indicated by the extent of hill that appeared over the intervening low grounds. The refraction measured in this way was greatest in a clear sky, when the temperature had been very low in the night, but was rising rapidly in the day, evidently through the influence of solar radiation.

Table V. contains observations made by Captain Back and Lieutenant Kendall on Solar Radiation, with the thermometer sheltered from the wind by glass, from September 1826 to May 1827. And Table VI. contains Observations made at Carlton House during March and April 1826 with a blackened thermometer exposed to the air.

TABLE I. OBSERVATIONS ON SOLAR RADIATION

Day.	October, 1826.		November.		December.		January, 1827.		February.		March.	
	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.
1	....	..	....	..	+ 14·5	28·0	− 42·5	23·0	− 19·0	20·0	+ 5·9	22·0
2	....	..	....	..	+ 11·2	0·8	− 39·7	* 9·0	− 3·0	5·0	− 5·0	20·0
3	....	..	....	..	+ 22·0	22·5	− 18·0	4·5	− 12·1	8·2	− 15·5	30·0
4	....	..	....	..	....	..	− 27·0	* 6·0	− 17·0	18·0	− 10·0	46·0
5	....	..	....	..	− 6·0	4·0	− 24·9	* 4·1	− 21·4	*17·3	− 4·7	27·0
6	....	..	....	..	− 13·0	10·0	− 36·0	4·2	− 19·8	15·8	− 9·1	46·0
7	....	..	+ 5·0	8·0	− 21·1	* 4·5	− 15·0	2·5	− 19·8	6·6	− 29·2	15·0
8	....	..	+ 7·0	* 4·0	− 22·8	14·0	....	..	− 22·5	30·0	+ 3·4	19·0
9	....	..	− 5·5	35·0	− 32·8	20·8	− 20·0	7·0	− 16·0	25·6	− 4·0	15·0
10	....	..	+ 10·5	* 2·5	....	..	....	..	− 17·5	14·0	+ 20·8	15·0
11	+ 31·8	*15·0	+ 2·0	2·6	....	..	− 23·5	12·5	− 20·2	13·5	− 12·6	18·0
12	+ 31·1	2·0	− 8·5	31·0	− 9·4	6·4	− 32·5	27·0	− 26·0	47·0	− 34·2	32·7
13	....	..	− 5·0	23·5	− 6·5	* 2·0	....	..	+ 9·5	8·3	− 24·2	*47·2
14	+ 25·0	23·5	− 9·0	21·5	....	..	− 16·0	3·2	+ 4·1	20·2	− 26·0	48·0
15	+ 26·8	0·2	+ 2·0	20·5	− 5·0	16·0	....	..	+ 27·5	9·5	− 20·0	*42·2
16	....	..	+ 2·5	* 2·5	....	..	− 14·0	4·7	+ 9·9	13·2	− 16·0	39·5
17	....	..	+ 10·2	* 2·0	....	..	....	..	− 4·0	23·4	− 3·6	22·2
18	....	..	....	..	− 15·0	12·5	....	..	− 5·0	11·7	− 8·4	65·0
19	+ 9·5	*1·5	+ 10·5	* 2·3	− 4·2	10·2	....	..	− 15·0	57·9	− 14·0	34·5
20	....	..	+ 8·8	23·2	....	..	....	..	− 15·0	39·9	− 7·0	44·0
21	....	..	+ 4·2	* 0·8	− 16·3	4·1	....	..	− 16·0	40·9	− 13·0	*40·0
22	+ 20·5	9·5	....	..	− 18·0	5·2	− 3·0	14·0	− 18·0	33·8	+ 15·0	36·5
23	+ 18·5	2·5	....	..	− 32·0	22·0	− 10·0	* 3·2	− 12·5	*50·9	− 8·0	38·0
24	....	..	....	..	− 40·5	25·5	....	..	+ 9·8	4·5	− 4·0	*50·0
25	....	..	....	..	− 43·0	5·0	....	..	+ 12·5	26·0	− 4·8	*28·4
26	....	..	− 6·5	10·5	− 39·0	*14·2	− 23·0	*29·0	− 4·0	5·2	+ 1·0	*25·5
27	− 5·8	17·8	− 9·9	*10·9	− 28·0	3·0	− 41·0	41·0	− 9·8	24·3	+ 6·2	*24·8
28	....	..	− 5·0	12·0	− 24·2	16·0	− 38·5	48·0	− 11·0	25·3	+ 9·0	*25·0
29	....	..	+ 9·5	3·5	− 9·0	4·2	− 20·0	*15·0	....	..	+ 13·0	55·0
30	....	..	+ 21·0	17·5	− 17·0	3·0	− 16·2	25·0	....	..	+ 9·8	53·2
31	....	..	....	..	....	..	− 31·5	39·5	....	..	+ 18·8	36·2

AT FORT FRANKLIN, Lat. 65° 12′ N., Lon. 125·12 W., 1825—6.

April.		May.		July.		August.		Day.
Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	Temperature in the shade.	Excess of Temper. in the Sun.	
+ 8·0	43·0	....	..	....	..	+ 52·0	19·0	1
0·0	23·0	....	..	....	..	+ 53·0	32·0	2
+ 13·0	34·3	....	..	....	..	+ 58·0	42·0	3
+ 7·0	26·5	....	..	....	..	+ 57·0	34·0	4
+ 7·3	40·9	+ 35·0	42·5	....	..	+ 64·5	35·5	5
− 1·8	44·8	+ 44·0	49·5	....	..	+ 61·1	37·0	6
− 9·5	30·5	+ 43·0	47·0	....	..	+ 64·0	38·4	7
+ 5·0	27·0	+ 38·0	40·0	....	..	+ 63·0	35·0	8
+ 14·0	14·0	+ 35·0	20·0	+ 51·5	20·5	+ 69·0	35·0	9
+ 34·9	51·0	+ 39·0	29·5	+ 45·0	33·5	+ 74·0	35·5	10
+ 38·0	36·0	+ 45·0	34·0	+ 55·0	15·0	+ 65·7	32·0	11
+ 22·8	8·3	+ 37·5	46·5	+ 50·0	27·5	+ 50·0	4·0	12
+ 20·0	*20·8	+ 39·2	38·8	+ 64·5	31·0	+ 50·0	8·0	13
+ 19·0	* 4·0	+ 47·0	37·0	+ 56·0	3·0	+ 55·5	11·5	14
+ 29·0	*15·3	+ 40·0	41·0	+ 59·5	33·5	+ 56·0	4·0	15
+ 21·0	40·2	+ 47·0	42·0	+ 63·0	35·0	+ 53·3	11·7	16
+ 21·0	42·5	+ 50·0	39·0	+ 66·5	33·5	+ 47·0	16·0	17
+ 39·1	*28·1	+ 35·0	9·0	+ 58·0	33·0	+ 46·0	6·0	18
+ 37·0	20·0	+ 44·0	39·0	+ 58·0	35·5	+ 53·0	16·0	19
+ 23·2	39·8	+ 33·0	17·0	+ 57·0	14·0	+ 50·5	5·5	20
+ 24·8	12·0	+ 39·5	37·9	+ 52·0	14·0	+ 51·0	31·0	21
+ 10·4	*20·6	+ 46·0	37·5	+ 56·0	31·0	+ 48·0	36·0	22
+ 28·0	*20·8	+ 44·0	25·0	+ 61·5	38·5	+ 51·5	26·0	23
+ 30·2	22·4	+ 50·2	49·8	+ 56·0	33·5	+ 53·0	36·0	24
+ 33·0	15·0	+ 52·0	31·0	+ 66·0	34·0	+ 55·5	41·5	25
+ 32·0	*10·8	+ 57·0	39·0	+ 68·5	38·5	+ 59·5	33·5	26
+ 21·5	*23·5	+ 55·0	34·0	+ 64·0	35·5	+ 64·7	38·0	27
+ 21·5	5·5	+ 52·0	38·0	+ 64·0	15·5	+ 55·0	35·5	28
+ 29·5	6·5	+ 57·0	27·5	+ 53·0	20·5	+ 67·0	31·7	29
+ 29·5	*22·7	+ 52·0	32·0	+ 48·0	34·0	+ 53·5	16·0	30
....	..	+ 61·0	32·0	+ 51·5	34·5	+ 60·0	26·5	31

NOTE.—In this Table all the Observations up to the end of April were made with two Spirit Thermometers, one hung in the shade, three feet from the ground, on the north side of the Observatory; the other hung on the south side of the same building, and at an equal height from the ground. The bulb of the latter was coated with silk paper, blackened with a mixture of China-ink and indigo. The second column under each month contains the excess of the Thermometer in the sunshine over the one in the shade.

In May, July, and August, Mercurial Thermometers were used, and the one with the blackened bulb was protected from the wind by a glass bottle, and the other one sheltered from radiant heat by being inclosed in two brass cylinders, as described in page lx of the Notice annexed to the Meteorological Journal.

The greatest excess of the blackened Thermometer observed each day is recorded in this Table, but the Observations are given for each hour in the months of May, July and August, in Tables III and IV.

* The asterisk denotes that the wind blew on the blackened Thermometer.

TABLE II. OBSERVATIONS ON SOLAR

At 5 A.M.			At 8 A.M.			At 9 A.M.			At 10 A.M.			At 11 A.M.			At Noon.		
[Te]mper. in [the] shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.	
[Mer]curial [T]her.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.
7·5	..	* 3·0	+24·5	..	* 0·0	+28·2	..	* 0·4	+29·2	..	* 0·3	+29·8	..	..	+28·5	..	* 0·5
2·0	..	* 1·5	24·2	..	* 3·4	26·5	..	* 0·1	28·0	..	* 0·0	28·0	..	..	28·3	..	* 5·0
8·0	..	2·5	12·0	..	31·9	15·0	..	17·5	18·0	..	12·0	17·0	..	..	16·0	..	..
1·5	2·0	* 1·5	10·0	10·0	* 7·0	13·0	38·5	*13·0	15·0	35·0	*15·5	16·0	42·0	*17·0	17·2	30·8	* 7·8
3·5	4·0	* 1·0	30·0	17·0	* 8·0	31·5	19·5	* 6·5	32·1	25·9	* 7·4	33·0	38·5	*19·0	35·0	42·5	*20·5
2·5	3·0	* 0·0	35·0	37·0	*18·5	37·0	32·5	*20·0	39·0	42·0	*22·2	40·0	44·0	*26·0	42·5	45·5	*23·7
·0	2·5	* 0·0	36·0	37·0	*13·5	39·0	32·0	*22·5	37·0	38·5	*19·0	40·0	41·6	*20·6	42·8	46·2	*22·2
·0	1·0	0·0	33·0	33·0	*24·0	32·5	31·3	*28·3	36·3	30·3	*25·5	38·0	40·0	*32·0	36·0	35·0	*25·0
·5	0·0	0·0	29·0	8·5	6·0	30·2	10·8	7·4	32·0	12·0	8·2	32·0	12·0	9·0	33·2	11·8	9·8
·0	0·0	0·0	29·0	8·0	4·0	30·4	14·6	11·0	32·5	17·5	12·5	34·6	22·9	23·7	39·0	29·5	29·5
5	1·0	2·0	30·0	33·5	*17·5	38·0	33·0	*26·0	39·0	26·0	*12·0	44·0	28·0	24·0	42·0	23·0	* 6·4
0	2·0	0·0	36·0	12·0	* 9·0	38·0	29·0	*16·0	38·6	38·2	*15·2	36·5	40·0	*16·5	36·8	33·2	*10·7
5	21·0	* 0·0	39·2	38·8	42·8	41·0	36·0	*14·5	41·0	33·0	* 9·0	44·0	37·0	*12·5	46·0	38·0	*13·0
)	11·5	1·5	42·2	25·0	12·4	45·0	30·0	25·0	47·2	36·8	22·8	47·0	37·0	28·6	47·0	37·0	35·5
5	5·0	0·0	36·0	17·0	* 3·0	38·0	20·0	* 6·0	36·3	5·0	* 0·0	39·8	29·2	* 5·8	40·0	41·0	*16·5
	22·5	* 1·0	38·9	13·1	* 2·7	41·0	29·0	* 8·5	43·0	40·0	*14·0	45·0	40·0	*16·0	45·0	37·0	*15·0
	12·6	* 1·5	43·0	13·3	* 3·0	43·0	15·0	15·3	48·0	36·0	*17·0	49·5	37·0	*17·0	51·0	33·0	*18·0
	2·5	0·5	38·3	6·2	4·7	37·5	2·5	* 0·0	37·2	4·0	* 0·0	37·0	5·0	* 1·0	36·0	5·0	* 1·0
	5·5	2·0	35·0	24·0	0·2	36·2	29·0	31·0	40·0	28·0	27·5	44·0	39·0	31·4	41·0	31·5	*11·3
	3·0	* 5·0	31·0	8·5	5·2	31·5	8·0	5·8	32·0	15·0	7·0	33·0	17·0	8·5	35·0	15·0	16·0
	10·0	0·7	36·0	15·0	*10·0	38·0	29·5	*11·0	39·5	37·9	*18·0	39·0	32·0	*12·0	39·0	26·0	* 6·0
	5·5	* 0·5	38·0	9·0	* 3·0	42·0	18·0	* 7·0	42·0	22·0	* 9·0	46·0	20·0	*12·0	50·0	13·0	*16·0
	4·0	* 0·0	42·0	8·0	6·0	43·0	8·8	5·2	44·0	10·0	* 6·0	42·0	12·0	* 6·0	44·0	10·2	* 3·2
	12·5	* 0·0	40·0	30·0	*12·0	40·3	29·0	*19·7	43·0	25·5	*17·0	46·2	22·8	*15·8	50·2	49·8	*15·6
	6·0	* 0·0	49·0	24·0	* 9·0	50·0	27·0	*10·0	48·0	29·0	*11·0	46·0	30·0	*12·0	44·0	31·0	*13·5
	22·0	* 0·0	47·4	35·6	*13·4	50·0	28·0	*14·0	51·0	32·0	*16·0	52·0	36·0	*17·0	57·0	39·0	*18·5
	0·0	0·0	46·6	9·0	5·0	46·6	13·4	9·2	49·8	30·0	13·0	55·0	34·0	23·0	57·0	29·0	24·0
	4·0	* 0·4	45·0	36·0	*15·0	45·0	28·0	*10·0	46·0	32·0	*12·0	49·0	36·0	*15·0	52·0	38·0	*17·0
	2·0	* 0·0	48·0	12·0	* 2·0	50·0	20·0	* 8·0	54·0	19·8	* 7·0	57·0	27·5	*10·6	57·5	26·5	*18·5
	6·5	* 0·0	48·5	29·5	*16·7	43·0	23·0	*13·0	46·0	20·0	* 6·0	48·0	28·2	*14·0	46·0	32·0	*20·0
	5·5	* 0·0	58·8	21·7	* 6·2	61·0	32·0	*14·0	45·0	23·0	*10·0	46·0	14·0	* 1·5	49·2	31·3	*11·0
			36·86			38·10			39·02			40·47			41·42	30·74	

NOTE.—The blackened Mercurial Thermometer was sheltered ...

RADIATION IN MAY 1826, AT FORT FRANKLIN.

1 P.M.		At 2 P.M.			At 3 P.M.			At 4 P.M.			At 5 P.M.			At 6 P.M.			
Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		
Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Day.
..	* 2·8	+29·0	..	.	+29·0	..	* 0·0	+29·2	..	* 0·0	+29·4	..	* 2·6	+28·5	..	* 3·2	1
..	..	29·0	..	..	27·4	..	* 6·0	25·0	..	..	23·3	..	..	22·0	..	..	2
..	..	19·0	..	* 6·0	18·0	..	* 5·0	17·0	..	* 8·0	10·5	..	..	14·0	..	..	3
34·0	*10·0	21·0	30·0	* 8·0	22·0	25·0	* 6·0	20·0	20·0	* 4·0	20·5	13·5	* 3·5	20·0	..	..	4
29·5	* 9·5	37·0	34·0	*23·0	36·0	26·0	* 8·0	35·0	26·5	*10·0	34·8	21·8	* 5·0	34·6	17·0	0·0	5
49·5	*29·0	45·0	43·0	*22·2	43·0	40·5	*19·0	44·0	36·0	*14·0	43·2	30·8	* 8·2	42·5	27·5	* 2·5	6
47·0	*20·1	43·8	43·7	*18·2	43·0	38·0	*17·0	44·0	37·0	*15·0	45·6	32·0	*12·0	44·0	46·0	* 1·5	7
32·0	*20·5	33·0	32·0	*16·0	36·6	39·0	*21·6	34·3	38·4	*17·7	34·0	28·0	*14·2	34·3	24·7	* 0·0	8
20·0	16·0	34·0	8·6	7·5	34·0	10·5	8·0	33·0	11·0	8·5	33·0	5·0	3·5	34·5	5·5	3·5	9
29·3	32·3	40·0	24·0	30·0	41·3	25·3	28·0	41·2	23·1	23·8	40·3	19·8	17·3	39·0	10·4	9·0	10
34·0	21·5	45·0	28·0	13·0	46·0	20·0	7·0	43·0	17·0	9·0	44·0	20·2	9·9	44·0	15·0	3·0	11
46·5	*16·0	39·0	40·0	*20·0	40·0	36·5	*16·5	40·0	32·5	*12·0	40·0	30·0	*10·0	40·0	23·7	* 0·5	12
24·5	* 7·5	44·0	33·0	*19·0	41·0	18·5	*10·0	40·7	18·3	* 8·0	40·0	16·0	* 4·0	40·0	14·5	* 4·0	13
30·0	32·0	48·2	34·3	36·3	48·0	36·0	31·7	41·7	29·8	*13·0	42·0	31·0	*10·5	39·4	29·5	* 0·6	14
24·0	* 5·2	41·0	39·0	*13·0	43·0	30·0	*10·0	40·0	22·0	* 5·0	41·0	21·5	* 6·5	41·0	29·0	* 2·0	15
42·0	*15·3	47·5	37·5	35·5	49·5	14·3	13·1	49·2	33·8	*13·3	48·0	31·0	*11·0	47·0	27·0	* 1·8	1
39·0	*19·0	50·1	20·0	* 7·6	51·5	22·5	* 9·5	49·0	13·0	5·0	49·0	..	..	49·0	8·0	* 1·5	1
8·0	* 2·0	34·0	5·0	* 1·0	35·0	9·0	* 2·0	37·2	2·8	2·0	36·6	7·0	* 0·0	36·0	5·0	* 0·0	1
30·0	*19·0	39·5	14·5	* 4·1	38·5	16·5	* 4·0	43·0	12·0	* 7·0	42·7	9·7	* 3·8	40·0	3·0	* 1·0	1
12·0	12·0	35·5	12·0	12·0	36·0	8·6	8·6	36·0	6·0	6·0	36·0	4·0	2·0	36·0	0·0	0·0	2
28·0	* 8·0	40·0	17·0	* 4·0	40·0	20·0	* 0·0	41·0	20·0	* 0·0	38·5	7·0	* 1·5	39·0	4·0	* 0·0	2
22·6	* 8·6	48·0	35·0	*20·6	46·0	37·5	*14·0	46·0	33·0	*14·0	46·0	30·0	*10·6	41·5	19·0	..	2
24·0	* 9·0	43·0	22·0	* 7·4	43·0	17·0	* 4·0	44·0	16·5	* 4·0	44·0	25·0	* 5·5	41·0	13·0	* 1·7	
41·0	*14·0	50·2	32·7	*12·4	50·3	37·1	*11·2	50·0	32·0	*11·3	48·0	29·0	* 6·0	46·0	27·0	* 1·0	
29·0	*11·0	42·0	12·0	* 5·0	52·0	31·0	*15·0	53·6	17·4	* 3·8	50·4	14·6	* 4·6	41·5	2·5	* 1·7	
37·0	*14·0	52·0	25·0	*15·0	48·0	14·0	*16·0	45·6	17·9	* 9·4	53·0	7·0	* 2·0	51·2	2·0	1·0	
27·0	28·0	60·0	24·5	25·0	56·0	25·0	14·5	60·8	24·0	10·5	51·0	29·0	* 3·0	50·4	29·0	0·0	
29·0	*18·8	50·0	32·0	*13·0	47·0	34·0	*11·0	45·0	31·0	*10·0	46·5	27·0	* 6·0	48·0	27·0	1·0	
26·7	*14·0	56·2	16·0	10·0	55·2	6·8	6·0	55·7	5·0	3·0	56·0	3·0	1·8	53·0	1·5	2·4	
31·0	27·5	52·0	32·0	30·0	47·0	17·0	* 6·0	45·0	9·0	* 4·0	46·0	9·0	* 4·0	44·0	6·4	* 1·0	
17·8	* 7·3	43·2	8·8	* 0·8	47·0	8·0	* 0·0	47·0	6·8	* 0·0	47·0	6·0	* 0·0	42·0	3·0	* 0·0	
1·73		41·65			41·61			41·17			40·59			39·45			

The * asterisk denotes that the wind blew on the *exposed* blackened Spirit Thermometer.

TABLE II. OBSERVATIONS ON SOLAR

At 5 A.M.			At 8 A.M.			At 9 A.M.			At 10 A.M.			At 11 A.M.			At Noon.		
Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther in the Sunshine.	
Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed Spirit.
+17·5	..	* 3·0	+24·5	..	* 0·0	+28·2	..	* 0·4	+29·2	..	* 0·3	+29·8	..	..	+28·5	..	* 0·5
22·0	..	* 1·5	24·2	..	* 3·4	26·5	..	* 0·1	28·0	..	* 0·0	28·0	..	..	28·3	..	* 5·0
8·0	..	2·5	12·0	..	31·9	15·0	..	17·5	18·0	..	12·0	17·0	..	..	16·0	..	..
1·5	2·0	* 1·5	10·0	10·0	* 7·0	13·0	38·5	*13·0	15·0	35·0	*15·5	16·0	42·0	*17·0	17·2	30·8	* 7·8
23·5	4·0	* 1·0	30·0	17·0	* 8·0	31·5	19·5	* 6·5	32·1	25·9	* 7·4	33·0	38·5	*19·0	35·0	42·5	*20·5
32·5	3·0	* 0·0	35·0	37·0	*18·5	37·0	32·5	*20·0	39·0	42·0	*22·2	40·0	44·0	*26·0	42·5	45·5	*23·7
33·0	2·5	* 0·0	36·0	37·0	*13·5	39·0	32·0	*22·5	37·0	38·5	*19·0	40·0	41·6	*20·6	42·8	46·2	*22·2
28·0	1·0	0·0	33·0	33·0	*24·0	32·5	31·3	*28·3	36·3	30·3	*25·5	38·0	40·0	*32·0	36·0	35·0	*25·0
24·5	0·0	0·0	29·0	8·5	6·0	30·2	10·8	7·4	32·0	12·0	8·2	32·0	12·0	9·0	33·2	11·8	9·8
28·0	0·0	0·0	29·0	8·0	4·0	30·4	14·6	11·0	32·5	17·5	12·5	34·6	22·9	23·7	39·0	29·5	29·5
17.5	1·0	2·0	30·0	33·5	*17·5	38·0	33·0	*26·0	39·0	26·0	*12·0	44·0	28·0	24·0	42·0	23·0	* 6·4
30·0	2·0	0·0	36·0	12·0	* 9·0	38·0	29·0	*16·0	38·6	38·2	*15·2	36·5	40·0	*16·5	36·8	33·2	*10·7
35·5	21·0	* 0·0	39·2	38·8	42·8	41·0	36·0	*14·5	41·0	33·0	* 9·0	44·0	37·0	*12·5	46·0	38·0	*13·0
36·0	11·5	1·5	42·2	25·0	12·4	45·0	30·0	25·0	47·2	36·8	22·8	47·0	37·0	28·6	47·0	37·0	35·5
·5	5·0	0·0	36·0	17·0	* 3·0	38·0	20·0	* 6·0	36·3	5·0	* 0·0	39·8	29·2	* 5·8	40·0	41·0	*16·5
8·0	22·5	* 1·0	38·9	13·1	* 2·7	41·0	29·0	* 8·5	43·0	40·0	*14·0	45·0	40·0	*16·0	45·0	37·0	*15·0
40·0	12·6	* 1·5	43·0	13·3	* 3·0	43·0	15·0	15·3	48·0	36·0	*17·0	49·5	37·0	*17·0	51·0	33·0	*18·0
37·0	2·5	0·5	38·3	6·2	4·7	37·5	2·5	* 0·0	37·2	4·0	* 0·0	37·0	5·0	* 1·0	36·0	5·0	* 1·0
30·8	5·5	2·0	35·0	24·0	0·2	36·2	29·0	31·0	40·0	28·0	27·5	44·0	39·0	31·4	41·0	31·5	*11·3
29·5	3·0	* 5·0	31·0	8·5	5·2	31·5	8·0	5·8	32·0	15·0	7·0	33·0	17·0	8·5	35·0	15·0	16·0
33·8	10·0	0·7	36·0	15·0	*10·0	38·0	29·5	*11·0	39·5	37·9	*18·0	39·0	32·0	*12·0	39·0	26·0	* 6·0
35·0	5·5	* 0·5	38·0	9·0	* 3·0	42·0	18·0	* 7·0	42·0	22·0	* 9·0	46·0	20·0	*12·0	50·0	13·0	*16·0
35·6	4·0	* 0·0	42·0	8·0	6·0	43·0	8·8	5·2	44·0	10·0	* 6·0	42·0	12·0	* 6·0	44·0	10·2	* 3·2
35·0	12·5	* 0·0	40·0	30·0	*12·0	40·3	29·0	*19·7	43·0	25·5	*17·0	46·2	22·8	*15·8	50·2	49·8	*15·6
6·5	6·0	* 0·0	49·0	24·0	* 9·0	50·0	27·0	*10·0	48·0	29·0	*11·0	46 0	30·0	*12·0	44·0	31·0	*13·5
4·0	22·0	* 0·0	47·4	35·6	*13·4	50·0	28·0	*14·0	51·0	32·0	*16·0	52·0	36·0	*17·0	57·0	39·0	*18·5
2·3	0·0	0·0	46·6	9·0	5·0	46·6	13·4	9·2	49·8	30·0	13·0	55·0	34·0	23·0	57·0	29·0	24·0
9·7	4·0	* 0·4	45 0	36·0	*15·0	45·0	28·0	*10·0	46·0	32·0	*12·0	49·0	36·0	*15·0	52·0	38·0	*17·0
5·0	2·0	* 0·0	48·0	12·0	* 2·0	50·0	20·0	* 8·0	54·0	19·8	* 7·0	57·0	27·5	*10·6	57·5	26·5	*18·5
1·8	6·5	* 0·0	48·5	29·5	*16·7	43·0	23·0	*13·0	46·0	20·0	* 6·0	48·0	28·2	*14·0	46·0	32·0	*20·0
5·7	5·5	* 0·0	58·8	21·7	* 6·2	61·0	32·0	*14·0	45·0	23·0	*10·0	46·0	14·0	* 1·5	49·2	31·3	*11·0
79			36·86			38·10			39·02			40·47			41·42	30·74	

NOTE.—The blackened Mercurial Thermometer was *sheltered* by glass.

RADIATION IN MAY 1826, AT FORT FRANKLIN.

At 1 P.M.		At 2 P.M.			At 3 P.M.			At 4 P.M.			At 5 P.M.			At 6 P.M.			
	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		Temper. in the shade.	Excess of blackened Ther. in the Sunshine.		
	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Mercurial Ther.	Sheltered. Mer.	Exposed. Spirit.	Day.
..	* 2·8	+29·0	..	..	+29·0	..	* 0·0	+29·2	..	* 0·0	+29·4	..	* 2·6	+28·5	..	* 3·2	1
..	..	29·0	..	..	27·4	..	* 6·0	25·0	..	..	23·3	..	..	22·0	..	..	2
..	..	19·0	..	* 6·0	18·0	..	* 5·0	17·0	..	* 8·0	10·5	..	..	14·0	..	..	3
34·0	*10·0	21·0	30·0	* 8·0	22·0	25·0	* 6·0	20·0	20·0	* 4·0	20·5	13·5	* 3·5	20·0	..	..	4
29·5	* 9·5	37·0	34·0	*23·0	36·0	26·0	* 8·0	35·0	26·5	*10·0	34·8	21·8	* 5·0	34·6	17·0	0·0	5
49·5	*29·0	45·0	43·0	*22·2	43·0	40·5	*19·0	44·0	36·0	*14·0	43·2	30·8	* 8·2	42·5	27·5	* 2·5	6
47·0	*20·1	43·8	43·7	*18·2	43·0	38·0	*17·0	44·0	37·0	*15·0	45·6	32·0	*12·0	44·0	46·0	* 1·5	7
32·0	*20·5	33·0	32·0	*16·0	36·6	39·0	*21·6	34·3	38·4	*17·7	34·0	28·0	*14·2	34·3	24·7	* 0·0	8
20·0	16·0	34·0	8·6	7·5	34·0	10·5	8·0	33·0	11·0	8·5	33·0	5·0	3·5	34·5	5·5	3·5	9
29·3	32·3	40·0	24·0	30·0	41·3	25·3	28·0	41·2	23·1	23·8	40·3	19·8	17·3	39·0	10·4	9·0	10
34·0	21·5	45·0	28·0	13·0	46·0	20·0	7·0	43·0	17·0	9·0	44·0	20·2	9·9	44·0	15·0	3·0	11
46·5	*16·0	39·0	40·0	*20·0	40·0	36·5	*16·5	40·0	32·5	*12·0	40·0	30·0	*10·0	40·0	23·7	* 0·5	12
24·5	* 7·5	44·0	33·0	*19·0	41·0	18·6	*10·0	40·7	18·3	* 8·0	40·0	16·0	* 4·0	40·0	14·5	* 4·0	13
30·0	32·0	48·2	34·3	36·3	48·0	36·0	31·7	41·7	29·8	*13·0	42·0	31·0	*10·5	39·4	29·5	* 0·6	14
24·0	* 5·2	41·0	39·0	*13·0	43·0	30·0	*10·0	40·0	22·0	* 5·0	41·0	21·5	* 6·5	41·0	29·0	* 2·0	15
42·0	*15·3	47·5	37·5	35·5	49·5	14·3	13·1	49·2	33·8	*13·3	48·0	31·0	*11·0	47·0	27·0	* 1·8	16
39·0	*19·0	50·1	20·0	* 7·6	51·5	22·5	* 9·5	49·0	13·0	5·0	49·0	..	..	49·0	8·0	* 1·5	17
8·0	* 2·0	34·0	5·0	* 1·0	35·0	9·0	* 2·0	37·2	2·8	2·0	36·6	7·0	* 0·0	36·0	5·0	* 0·0	18
30·0	*19·0	39·5	14·5	* 4·1	38·5	16·5	* 4·0	43·0	12·0	* 7·0	42·7	9·7	* 3·8	40·0	3·0	* 1·0	19
12·0	12·0	35·5	12·0	12·0	36·0	8·6	8·6	36·0	6·0	6·0	36·0	4·0	2·0	36·0	0·0	0·0	20
28·0	* 8·0	40·0	17·0	* 4·0	40·0	20·0	* 0·0	41·0	20·0	* 0·0	38·5	7·0	* 1·5	39·0	4·0	* 0·0	21
22·6	* 8·6	48·0	35·0	*20·6	46·0	37·5	*14·0	46·0	33·0	*14·0	46·0	30·0	*10·6	41·5	19·0	..	22
24·0	* 9·0	43·0	22·0	* 7·4	43·0	17·0	* 4·0	44·0	16·5	* 4·0	44·0	25·0	* 5·5	41·0	13·0	* 1·7	23
41·0	*14·0	50·2	32·7	*12·4	50·3	37·1	*11·2	50·0	32·0	*11·3	48·0	29·0	* 6·0	46·0	27·0	* 1·0	24
29·0	*11·0	42·0	12·0	* 5·0	52·0	31·0	*15·0	53·6	17·4	* 3·8	50·4	14·6	* 4·6	41·5	2·5	* 1·7	25
37·0	*14·0	52·0	25·0	*15·0	48·0	14·0	*16·0	45·6	17·9	* 9·4	53·0	7·0	* 2·0	51·2	2·0	1·0	26
27·0	28·0	60·0	24·5	25·0	56·0	25·0	14·5	60·8	24·0	10·5	51·0	29·0	* 3·0	50·4	29·0	0·0	27
29·0	*18·8	50·0	32·0	*13·0	47·0	34·0	*11·0	45·0	31·0	*10·0	46·5	27·0	* 6·0	48·0	27·0	1·0	28
26·7	*14·0	56·2	16·0	10·0	55·2	6·8	6·0	55·7	5·0	3·0	56·0	3·0	1·8	53·0	1·5	2·4	29
31·0	27·5	52·0	32·0	30·0	47·0	17·0	* 6·0	45·0	9·0	* 4·0	46·0	9·0	* 4·0	44·0	6·4	* 1·0	30
17·8	* 7·3	43·2	8·8	* 0·8	47·0	8·0	* 0·0	47·0	6·8	* 0·0	47·0	6·0	* 0·0	42·0	3·0	* 0·0	31
1·73		41·65			41·61			41·17			40·59			39·45			

The * asterisk denotes that the wind blew on the *exposed* blackened Spirit Thermometer.

TABLE III.

OBSERVATIONS ON SOLAR RADIATION, IN JULY, 1826, AT FORT FRANKLIN.

Day.	At 2 A.M.		At 8 A.M.		At 11 A.M.		At 2 P.M.		At 5 P.M.		At 8 P.M.		At 11 P.M.	
	Temper. in the Shade.		Temper. in the Shade.	Excess of Temper. in the Sun.	Temper. in the Shade.	Excess of Temper. in the Sun.	Temper. in the Shade.	Excess of Temper. in the Sun	Temper. in the Shade	Excess of Temper. in the Sun.	Temper. in the Shade.	Excess of Temper. in the Sun.	Temper, in the Shade.	
1														
2														
3														
4														
5														
6														
7														
8														
9	..	..	..	..	51·5	20·5	48·5	12·8	..	..	41·3	3·4	35·0	1·0
10	+30·0	1·0	44·0	24·0	45·0	..	45·0	33·5	..	..	46·0	3·5	42·5	0·5
11	40·5	0·5	55·0	15·0	56·0	14·5	57·0	14·5	55·0	14·0	54·0	14·0	47·0	−2·0
12	38·3	0·3	52·0	13·0	58·0	32·0	80·0	19·0	50·0	27·5	49·0	1·0	43·0	−2·0
13	37·0	−2·0	48·0	4·0	61·0	30·0	64·5	31·0	62·0	21·5	58·0	5·3	55·5	0·0
14	55·5	0·0	57·0	2·0	55·0	3·0	55·0	4·0	57·0	2·0	55·0	1·0	53·5	0·0
15	51·0	1·0	59·5	15·0	62·0	29·0	59·5	33·5	53·5	14·5	50·0	0·0	42·0	−0·5
16	40·0	−1·0	57·0	24·0	63·0	35·0	65·5	29·5	56·0	30·0	49·5	2·0	45·0	−2·0
17	41·0	0·0	56·0	15·0	66·5	33·5	68·0	17·0	58·0	15·0	53·5	1·5	44·5	−2·0
18	46·0	−6·0	55·0	21·0	60·0	11·5	58·0	33·0	58·7	10·3	51·5	1·5	42·5	0·5
19	40·0	−0·5	58·0	35·5	64·0	34·5	57·0	34·5	58·0	29·5	50·0	2·0	48·0	−1·0
20	42·0	−1·0	57·0	14·0	64·0	16·0	56·0	2·0	56·0	0·5	53·0	−0·5	49·5	−1·5
21	49·5	−1·0	52·0	14·0	54·0	7·0	54·0	6·0	52·5	3·0	49·5	1·5	48·0	0·0
22	45·5	0·5	52·0	13·0	54·5	18·5	56·0	31·0	53·0	29·0	48·0	23·0	44·0	−1·0
23	44·0	−1·0	57·5	29·5	61·5	38·5	62·0	34·5	52·0	28·0	45·5	2·5	42·5	0·5
24	43·0	−1·7	56·0	33·5	57·0	29·0	70·0	28·3	54·0	27·0	53·0	4·7	47·0	−1·0
25	45·3	−0·3	66·0	34·0	64·0	34·0	62·0	33·0	58·0	27·0	55·0	3·0	46·5	−0·5
26	48·1	0·5	67·0	33·0	68·5	38·5	73·0	34.0	70·0	27·5	59·0	−1·0	49·0	−1·0
27	49·0	0·0	62·0	20·5	64·0	35·5	65·0	27·0	67·0	5·0	64·0	4·5	58·0	−0·5
28	60·0	0·0	65·0	11·0	62·5	3·5	64·0	15·5	60·0	6·0	54·7	1·3	50·0	0·0
29	48·0	0·0	55·0	11·0	59·0	19·5	53·0	20·5	51·0	6·0	45·5	0·0	43·5	−0·2
30	43·5	−0·5	47·0	5·0	50·5	13·5	48·0	34·0	46·0	14·0	44·0	4·0	42·0	−1·0
31	34·0	−2·0	51·5	34·5	49·5	25·5	54·0	30·5	50·0	13·5	46·0	1·3	39·0	−1·0

TABLE IV.

OBSERVATIONS ON SOLAR RADIATION IN AUGUST, 1826, AT FORT FRANKLIN.

Date.	At 2 A.M.		At 8 A.M.		At 11 A.M.		At 2 P.M.		At 5 P.M.		At 8 P.M.		At 11 P.M.	
	Temper. in the Shade.		Temper. in the Shade.	Excess of Temper. in the Sun.	Temper. in the Shade.	Excess of Temper. in the Sun	Temper. in the Shade.	Excess of Temper. in the Sun	Temper. in the Shade.	Excess of Temper. in the Sun.	Temper. in the Shade.	Excess of Temper. in the Sun.	Temper. in the Shade.	
1	46·0	−1·0	51·0	16·0	52·0	19·0	51·7	7·3	48·0	8·0	47·0	1·0	39·5	−0·5
2	38·0	−1·0	48·0	30·0	57·0	29·0	53·0	32·0	46·0	22·0	44·0	6·0	34·0	−1·0
3	33·5	−1·5	51·0	32·0	54·0	22·0	58·0	42·0	54·0	8·0	51·5	1·5	51·0	0·0
4	44·0	−1·0	53·0	33·0	57·0	34·0	56·0	33·5	53·5	21·0	52·0	1·0	49·0	−1·0
5	47·0	−1·0	53·5	32·5	64·5	35·5	63·0	31·0	60·0	29·0	58·0	−1·0	51·0	−1·0
6	48·0	−1·0	61·0	37·0	68·0	37·0	68·0	34·7	56·5	25·0	50·5	1·5	47·0	−1·0
7	42·5	−0·5	55·0	32·0	64·0	38·4	59·0	27·0	57·0	1·0	52·0	0·0	46·0	−1·0
8	44·0	−1·0	57·0	32·0	63·0	35·0	63·0	30·5	56·5	7·5	53·5	1·0	62·0	−0·5
9	62·0	0·5	67·5	32·5	69·0	35·0	63·0	29·5	55·0	11·0	50·5	0·0	64·0	−2·0
10	61·5	0·5	66·0	31·0	74·0	35·5	63·0	21·0	60·5	9·5	49·5	−0·5	60·0	−2·0
11	50·5	−1·5	63·0	26·5	65·7	32·0	71·0	26·0	66·0	6·0	61·5	0·0	57·0	0·0
12	55·5	0·0	51·0	1·0	50·5	2·0	50·0	2·0	50·0	4·0	50·0	0·0	49·0	−1·0
13	48·5	−1·0	49·5	3·5	50·0	8·0	53·0	7·0	53·0	6·0	52·0	2·5	48·5	−1·5
14	48·0	0·0	51·5	11·0	55·5	11·5	57·0	7·0	52·0	1·0	48·0	0·3	47·5	−0·3
15	46·5	−0·5	52·0	3·0	53·0	3·0	56·0	4·0	54·5	2·0	51·0	0·0	48·0	−1·5
16	50·0	−1·0	51·0	4·0	53·3	11·7	47·0	11·0	46·5	4·0	46·0	0·0	45·5	−0·5
17	43·0	0·0	45·0	4·5	47·0	16·0	45·0	7·0	44·5	8·5	41·5	0·0	42·0	−1·0
18	42·5	−1·5	43·5	3·0	46·0	6·0	43·5	4·5	47·0	3·0	45·0	0·0	44·5	0·0
19	43·5	−0·5	45·0	4·0	48·5	9·5	53·0	16·0	52·0	11·0	51·5	0·0	49·5	0·0
20	48·0	0·0	50·5	3·0	50·5	5·5	51·0	5·0	48·0	2·5	46·0	0·0	45·0	−0·5
21	44·0	0·0	46·0	12·5	50·7	11·7	51·0	31·0	48·0	22·0	41·0	−0·5	35·0	−0·5
22	35·0	0·0	46·5	15·0	48·0	36·0	47·0	33·0	44·0	4·5	42·0	0·0	42·0	0·0
23	43·3	0·0	48·0	7·5	52·0	23·0	51·5	26·0	51·0	25·0	45·0	−0·5	43·0	−1·0
24	42·0	−1·0	44·0	22·0	53·0	36·0	58·0	15·0	55·5	17·0	50·0	0·0	50·0	0·0
25	48·5	−0·5	50·0	33·0	55·5	41·5	60·0	40·0	57·5	34·0	51·0	23·5	48·5	−0·5
26	46·0	−1·0	55·0	33·5	59·5	33·5	58·0	26·0	48·0	12·0	42·5	−0·5	39·0	−0·5
27	37·5	−0·5	54·5	32·0	60·0	26·0	64·7	38·0	51·5	34·5	45·5	0·0	39·0	−1·0
28	40·0	−0·5	44·0	0·0	56·5	12·0	55·0	35·5	50·0	27·5	42·5	19·0	42·0	−1·2
29	42·0	−2·0	48·0	30·5	67·0	31·7	65·5	31·0	60·0	14·0	55·5	−1·5	53·0	−1·0
30	52·5	−0·8	53·5	3·0	57·0	12·0	68·0	8·0	53·5	16·0	51·0	−0·5	40·0	−1·0
31	40·5	−1·0	50·5	2·0	60·0	26·5	60·5	10·5	53·0	18·0	48·5	0·0	46·0	0·0
	45·61	−0·65	51·78	18·17	56·83	23·08	56·88	21·68	52·63	13·37	48·89	..	46·95	..

TABLE V. TABLE OF SOLAR RADIATION, extracted from a Register kept by CAPTAIN [illegible] by a blackened Thermometer exposed to the Sun's rays, but sheltered [illegible]

Day.	Sept. 1826.		November.		December.		Jan. 1827.		February.	
	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.
1	+ 54·0	9·5	– 1·0	17·0	+ 8·6	21·4	– 25·5	1·5	– 35·0	25·0
2	+ 36·0	5·0	– 2·0	28·0	+ 8·5	4·5	– 21·0	1·5	– 25·8	33·8
3	+ 36·0	5·0	– 8·0	8·5	– 0·2	4·5	– 43·2	9·0	– 35·5	27·0
4	+ 43·0	32·0	– 10·2	4·7	– 6·8	13·0	– 40·3	20·2	– 42·0	49·0
5	+ 54·8	33·2	– 5·0	13·0	+ 2·0	2·8	– 32·8	3·8	– 43·5	46·5
6	+ 60·8	30·2	– 6·8	9·8	+ 2·0	11·5	– 22·2	3·2	– 43·8	47·0
7	+ 65·0	29·5	– 12·0	2·0	+ 2·0	24·0	– 15·5	3·2	– 45·0	40·0
8	+ 41·5	37·1	– 5·0	5·0	+ 20·5	15·5	– 25·0	10·8	– 40·0	39·0
9	+ 47·0	38·0	– 6·0	6·8	+ 14·0	20·5	– 21·5	22·0	– 36·0	6·0
10	+ 44·5	41·3	– 15·2	22·7	+ 17·0	3·5	– 21·6	2·4	– 30·0	6·5
11	+ 54·5	33·7	– 17·0	30·5	+ 5·2	3·8	– 35·5	17·5	– 19·8	21·3
12	+ 35·0	9·0	0·0	4·0	– 7·0	4·4	– 23·2	9·4	– 23·0	51·0
13	+ 41·8	21·2	– 7·0	4·0	– 9·0	8·0	– 25·8	23·3	– 11·0	6·8
14	+ 51·8	32·4	– 9·0	4·8	– 9·0	5·8	– 23·0	34·0	– 12·6	48·6
15	+ 46·0	40·0	– 19·8	3·8	– 9·8	2·3	– 10·0	4·0	– 5·2	39·4
16	+ 44·8	8·0	– 13·8	7·8	– 21·5	4·0	– 25·0	10·8	– 4·5	48·5
17	+ 33·0	10·0	– 3·5	7·5	– 23·5	7·5	– 18·2	5·7	– 6·2	8·7
18	+ 29·0	0·0	– 1·0	4·0	– 18·5	3·0	– 37·8	5·8	– 1·5	46·5
19	+ 31·0	42·0	– 14·2	29·2	– 27·5	3·0	– 15·2	4·0	+ 14·0	44·2
20	+ 34·2	33·3	– 14·6	6·0	– 19·0	2·5	– 26·0	36·0	+ 12·8	7·0
21	..	..	+ 3·0	3·0	– 40·5	10·5	– 13·0	12·0	– 6·2	35·7
22	+ 52·0	28·3	+ 5·5	3·3	– 23·0	2·2	– 1·2	31·5	– 13·0	17·5
23	+ 57·0	28·0	– 6·3	9·8	– 40·2	8·5	– 11·0	30·5	– 22·0	27·0
24	+ 51·0	21·0	+ 4·8	3·8	– 24·5	2·2	– 8·2	8·2	– 27·0	49·0
25	+ 53·2	35·8	– 1·0	9·0	– 14·0	4·0	– 6·2	9·2	– 22·0	39·5
26	..	..	+ 8·0	5·8	– 10·0	11·5	– 17·0	5·2	– 17·0	51·5
27	..	..	+ 6·5	33·5	– 10·0	3·0	– 22·2	38·3	– 10·2	52·2
28	..	..	+ 6·0	21·0	– 6·0	3·0	– 32·0	16·5	– 17·2	53·2
29	..	..	+ 20·0	12·0	– 14·5	7·0	– 27·0	36·5		
30	..	..	+ 17·5	3·0	– 9·0	2·2	– 23·0	24·0		
31	..	..	..	..	– 11·9	2·0	– 33·0	34·0		

LIEUTENANT KENDALL, at Fort Franklin in 1826—7; showing the Greatest Excess of Temperature indicated in the Wind, over that by a Thermometer shaded by Metal Cylinders.

March.		April.		May.		Day.
Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	
− 20·0	51·0	− 2·5	70·0	+ 56·8	37·2	1
− 17·2	36·4	− 0·5	63·5	+ 54·5	36·0	2
− 16·0	48·9	+ 4·0	28·5	+ 59·0	39·5	3
− 15·0	44·0	0·0	35·6	+ 50·5	27·0	4
− 4·5	46·5	+ 1·5	59·5	+ 37·3	31·7	5
+ 3·0	45·8	− 5·2	58·0	+ 37·0	23·0	6
+ 3·5	53·5	− 4·2	66·2	+ 40·0	17·0	7
+ 4·5	51·0	− 8·2	58·2	+ 24·2	22·8	8
+ 21·0	45·0	+ 7·5	62·5	+ 14·2	37·3	9
+ 11·2	24·0	+ 8·6	48·4	+ 21·0	45·0	10
+ 17·0	68·0	+ 16·4	54·8	+ 23·8	50·2	11
+ 15·5	60·0	+ 11·2	58·8	+ 34·2	38·2	12
+ 4·0	49·0	+ 19·0	60·0	+ 35·2	31·0	13
+ 2·0	43·0	+ 16·2	63·1	+ 28·0	26·5	14
+ 6·0	20·0	+ 13·7	61·3	+ 49·5	31·7	15
+ 2·0	47·5	+ 4·2	48·8	+ 52·5	37·5	16
+ 2·5	49·0	+ 0·8	57·2			17
+ 5·4	51·2	+ 11·0	61·0			18
+ 6·5	56·0	+ 22·0	42·0			19
+ 7·5	24·0	+ 21·0	38·8			20
+ 3·8	18·2	+ 23·0	56·0			21
+ 5·2	45·3	+ 25·5	57·5			22
+ 2·0	29·5	+ 28·2	51·8			23
− 5·0	53·0	+ 33·0	54·8			24
− 8·2	60·5	+ 34·2	45·8			25
− 1·0	28·0	+ 37·0	48·5			26
− 10·0	55·0	+ 39·5	47·5			27
− 1·8	21·3	+ 49·5	52·7			28
+ 11·0	46·0	+ 39·5	42·5			29
+ 9·0	64·5	+ 39·5	42·0			30
− 12·5	65·0					31

NOTE.—The Observations recorded in this Table were made by Captain Back and Lieut. Kendall, with the apparatus used by me in May, and by Mr. Dease in July and August of the preceding year,—namely, a Thermometer having its bulb covered with thin paper, blackened with China ink and indigo, and sheltered from the wind by a thin glass bottle: and a Thermometer protected from radiation by two metal cylinders. From November to the end of April the Thermometers used were filled with spirit, and in that respect differed from those used the preceding spring which were Mercurial ones; but on the 29th of April the Spirit Thermometer in the sunshine was replaced by a Mercurial one.

The hours of observation were 8, 10, 11, A.M., and 1, 2, 4, P.M.; and after the middle of February an Observation was also regularly made at noon. The greatest excess of the Temperature in the Sun, noted at any of these hours, is inserted in the Table with the Temperature opposite to it, which was indicated at the time by the Thermometer in the metal cylinders.

TABLE VI. OBSERVATIONS on SOLAR RADIATION, made at Noon, 1827, at CARLTON HOUSE, Lat. 52° 51′ N., Lon. 106° 13′ W.

Day.	February.		March.		April.		
	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	Temperature in the Shade.	Excess of Temper. in the Sun.	
1			+ 4	50	+ 33	20	
2			+ 10	..	+ 28	30	
3			+ 20	46	+ 25	39	
4			+ 20	..	+ 32	20	
5			+ 15	40	+ 35	37	
6			+ 16	44	+ 27	38	
7			+ 4	24	+ 24	35	
8			+ 11	60	+ 46	22	
9			+ 32	41	+ 47		
10			+ 20	35	+ 40	30	
11			+ 10	42	+ 47	41	
12			+ 6	50	+ 42	26	
13			+ 12	32	+ 44		
14			+ 20	7	+ 43	39	
15			+ 23	24	+ 45		
16			+ 32	16	+ 43	50	
17			+ 8	43	+ 33		
18			+ 23	45	+ 30		
19			+ 24	..	+ 26		
20	+ 23	*36	+ 32	33	+ 24	40	
21	+ 31	6	+ 28	32	+ 35		
22	..	..	+ 28	34	+ 37	35	
23	+ 4	43	+ 34	6	+ 42		
24	+ 4	10	+ 28	..	+ 41	33	
25	− 4	48	+ 26	33	+ 45	41	
26	− 5	42	+ 32	15	+ 50		
27	− 25	57	+ 25	31	+ 50	41	
28	+ 5	46	+ 24	39	+ 50		
29	....	..	+ 27	..	+ 54		
30	....	..	+ 33	29	+ 59		
31	....	..	+ 38	35			

These Observations were made with the same Spirit Thermometers that were used for ascertaining the Solar Radiation at Fort Franklin, from September to the end of April. The one exposed to the Sun was hung against a piece of rough deal, and had its bulb covered with thin paper, and blackened with a mixture of China ink and indigo. It was in a sheltered spot, but was not protected from the wind by glass.

The Observations were discontinued in the beginning of May, because the Spirit in the Thermometer, which was in the sunshine, then rose to the summit of the scale.

No. IV.

OBSERVATIONS ON THE VELOCITY OF SOUND AT DIFFERENT TEMPERATURES.

By Lieutenant E. N. Kendall, R.N.

Date.	Angle between the direction of the Wind and that of the sound.	Velocity of the Wind.	Temper.	Distance from the Gun in feet.	Seconds elapsed.	Velocity of Sound deduced in feet.	REMARKS.
1825 October				1521	1·40	1086	
					1·35	1126	
					1·35	1126	
					1·35	1126	
				Mean	1·36	1118	
				3042	2·71	1122	
					2·71	1122	
				Mean	2·71	1122	
				3960	3·52	1122	
				4563	4.08	1118	
					4·09	1113	
					4·13	1105	
					4·08	1118	
31 8 to 9 P.M.	The wind nearly opposed the direction from whence the sound was transmitted.	Wind only perceptible at times.	28° to 27°	Mean	4·09	1114	The evening was calm, and occasional heavy clouds passed slowly across the heavens. The Aurora Borealis was faintly visible, and many meteors were seen during the observations. It is proper to observe that, though the thermometer used, indicated 28 degrees at the commencement of the observations, and 27 at their termination, two others showed the temperatures respectively, from 29·4 to 28·4, and from 29·0 to 28·0.
				5280	4·80	1100	
					4·83	1093	
					4·78	1105	
					4·75	1112	
					4·80	1110	
					4·81	1098	
				Mean	4·79	1102	
				6085	5·51	1104	
					5·51	1104	
					5·51	1104	
					5·51	1104	
					5·51	1104	
					5·50	1106	
				Means	5·50·9	1104·3	

OBSERVATIONS on the VELOCITY of SOUND at DIFFERENT TEMPERATURES.

Date.	Angle between the direction of the Wind and that of the sound.	Velocity of the Wind.	Temper.	Distance from the Gun in feet.	Seconds elapsed.	Velocity of Sound deduced in feet.	REMARKS.
1825 Nov. 3 4 P.M. to 5·30	125°	Only perceptible at times	From +10 to + 3°	3960	3·61	1094	Scarcely any wind was stirring; the evening was remarkably clear, and the stars shone with great brilliancy; the mean of three observations were taken at the first and second stations, and of two at the third. Bells were tried this evening, but probably the men did not catch the sound quick enough, as the velocity inferred was under 900 feet. I stood by the man at the northern extreme of the base, and the man at the southern was directed to keep his musket elevated, and to fire at the instant when the report of the other musket reached him. A mean of three observations gave 9·80 seconds, and consequently agreed with the other; proving, at the same time, that the results were not affected by wind.
				2640	2·41	1095	
				5280	4·90	1078	
					Mean	1089	
5	About 38° the wind would therefore appear to accelerate the transmission of sound.	Sufficient to blow the smoke at an angle of 45. It would probably propel a ship 3 or 4 knots.	From −20 to − 10	5280	4·85	1088	The day was fine, a hazy fog covered the lake over the open water, but the wind blew in a contrary direction, and the atmosphere near the place of observation was clear. This observation is not included in the following Table of results, because the effect of the wind was not determined.
14 5 P.M.	The wind shifted during the observation, but was so light that it could scarcely be determined from whence it blew.	Smoke rising from 10 to 5 degrees from the perpendicular.	− 2 to −4	5280	4·90	1078	The circumstances were remarkably favourable. The sky overcast, but the atmosphere dry, and a man's voice could be distinctly heard at the distance of a statute mile. The atmospherical refraction had been very great all day.
				5280	4·88	1082	
				5280	4·90	1078	
					Mean	1079	
Dec. 23	130	A gentle breeze to which a ship could carry Royals on a wind.	− 36	5274	5·15	1024	The first three observations were made when the wind was adverse; the sound was by no means so distinct as the three last, when it was nearly in the direction of the sound. The breeze was equal at both sets, the mean may therefore be considered as the motion of sound, at a temperature of −35·8, and the half difference the quantity due to the
				5274	5·18	1016·2	
				5274	5·20	1014·2	
		Mean	when	retarded	by wind	1018·1	

OBSERVATIONS on the VELOCITY of SOUND at DIFFERENT TEMPERATURES.

Date.	Angle between the direction of the Wind and that of the sound.	Velocity of the Wind.	Temper.	Distance from the Gun in feet.	Seconds elapsed.	Velocity of Sound deduced in feet.	REMARKS.
1825 Dec. 23	45		−35°·8	5274	5·01	1052·69	effect of the wind in accelerating and retarding its transmission. The evening was beautifully clear, not a cloud visible, but, in consequence of the fog from the river, the opposite side of the lake four miles distant was enveloped in haze.
				5274	5·00	1054·80	
				5274	5·01	1052·69	
		Mean when accelerated			by wind	1053·39	
		Mean when retarded			by wind	1018·78	
		Mean velocity at the Temperature			of −35°·8	1036·08	
					Difference	34·61	
				Effect of	the wind	17·30	
24	Wind directly opposing the transmission of sound.	A gentle gale; smoke 15° from the perpendicular.	− 41	5280	5·20	1015·2	The night was remarkably fine, no cloud visible; but a halo with four paraselenæ on its circumference surrounded the moon, and a mist hung over the southern horizon. The same difference was observed in the intensity of the sound as was remarked last night. After the six observations the extreme cold caused the watch to stop; it however recovered itself on being removed into its usual temperature. Small icy spiculæ were falling, and on looking at the moon, that body appeared to have an irregular motion, oscillating from side to side, and moving up and down, sometimes quickly, and at others more slowly. The mirage had been very great during the day; but I may here remark, that in this quarter this phenomenon appears to be influenced more by barometrical or hygrometrical changes, than by those of temperature.
				5280	5·20	1015·2	
				5280	5·20	1015·2	
		Mean with the wind opposing sound				1015·2	
	Wind directly favouring the transmission of sound.		− 41	5280	5·05	1045·5	
				5280	5·05	1045·5	
				5280	5·05	1045·5	
						3136·5	
		Mean with the wind favouring sound				1045·5	
		Mean with the wind opposing sound				1015·2	
		Mean velocity at the Temperature of −41°				1030·3	
					Difference	30·3	
	Effect of the wind in accelerating and retarding sound					15·1	

TABULAR VIEW OF THE FOREGOING RESULTS.

Temperatures, Fahrenheit.		Temperatures, Centigrade.		Velocity of Sound in a Second.	Difference of degrees of Fahr.	Difference of feet inches.	Number of feet portioned to a degree Fahrenheit.
Range of the Thermom.	Mean.	Range of the Thermom.	Mean.				
+ 28°·0 to + 27°·0	+ 27°·5	− 2°·22 to + 2°·78	− 2°·50	1112			
					21·0	24·3	1·15
+ 10·0 to +3·0	+ 6·5	− 12·22 to − 16·12	14·17	1089			
					9·5	11·0	1·15
− 2·0 to − 4·0	− 3·0	− 18·89 to − 20·00	19·44	1079			
					32·7	41·9	1·28
− 36·0 to 35·5	− 35·7	− 37·78 to − 37·50	37·64	1036·1			
					5·3	5·8	1·09
− 41·0	− 41·0	40·56	40·56	1030·3			
							Mean 1·167

From comparison of these results it appears that the transmission of sound is retarded 1·167 feet, for every degree of decrease of Fahrenheit's thermometer, when below the freezing point, and, consequently, that the mean velocity at the freezing point would be 1118·5 feet per second. No results have been obtained when the thermometer stood above the freezing point. The want of a barometer and hygrometer that could be depended on, precluded the possibility of ascertaining whether the transmission of sound is influenced by barometric or hygrometric changes in the atmosphere, and the flatness of the country round Fort Franklin also prevented the comparison of observations at different altitudes. All the instrument cases belonging to the Expedition, and everything in the construction of which wood and metal were combined, were split, not from their unequal contraction and expansion from great changes of temperature, for they remained in a room which scarcely ever altered its temperature fifteen degrees; but, as may be fairly inferred, from the dryness of the atmosphere.

REMARKS ON THE PRECEDING OBSERVATIONS.

The late able investigations of M. Arago and Dr. Gregory into the circumstances which operate on the transmission of sound through the atmosphere, rendered it an object of interest to determine whether the laws they ascertained for the climate of Europe, would apply equally to observations made in the low temperatures of the northern altitudes, as well as to ascertain any new facts that would tend to elucidate the inquiries which those already known naturally suggested.

If the observations here recorded do not answer these queries, it is in some degree to be attributed to the difficulty and length of the journey of the Expedition through the wilds of North America; in the progress of which the delicate pneumatic atmospherical instruments, most requisite for those purposes, were broken or rendered useless. They present, however, fewer anomalies than could have been expected from observations where the thermometer was the only atmospherical instrument used.

The watch used in these experiments was made by Mr. Massey of Liverpool, (the inventor of the patent logs and leads,) who, with great liberality, intrusted it to my care for the purpose. It was a stop-watch, with divisions showing tenths of seconds, and by practice it could readily be read off to 100th. This instrument, though frequently exposed for more than an hour together to the low temperatures, only stopped once, and then, on its being placed in its accustomed temperature, it recovered its usual rate of going, which was remarkably regular. The force of the wind could only be approximated, in consequence of the want of an anemometer, but the deviation of the smoke from the perpendicular was generally noted.

From the want of barometrical observations the height of the place of observation above the level of the sea could only be inferred from estimation. It was computed in the following manner: the mean current of Mackenzie's River is three miles an hour, and the distance from Great Slave Lake, from whence it flows, to the Polar Sea, is 1044 miles; the Ganges has a current of the same velocity, and a course rather longer, viz. 1300 miles, and the winding descent of that river is estimated by Major Rennell at four inches in the mile; allowing half an inch as the quantity due to the difference of length between the two rivers, the descent of Mackenzie's River would be 391 feet from Great Slave Lake, or 220 feet from the mouth of the river flowing from Great Bear Lake, and no falls obstruct its course; Bear Lake river has some long rapids, and its mean descent may be estimated at six inches per mile, which amounts to 43 feet; this, added to the descents from its mouth, gives 263 feet, for the height of Great Bear Lake above the level of the Polar Sea.

A small lake contiguous to the Fort, communicating with Great Bear Lake, was selected for the purpose of measuring a straight line a mile in length, on the newly formed and even surface of the ice. The snow which had fallen on it being removed previous to the commencement of the operations, the straight line was preserved by marks at short intervals, and the

whole distance divided into quarters, both of a geographic and statute mile; but lest any confusion should have been produced by this arrangement, the distance from the musket has been always expressed in feet. A straight fir pole, that had been exposed for a long time to the action of the frost and air, and was not so liable to contraction and expansion as a metallic substance, was used for the measurement of the distance, and, on comparing it with the measure after the operations were completed, no variation was visible in its length of fifteen feet. The gun used was a common trading gun of 5-8ths bore and loaded with the usual charge of powder.

I was compelled to discontinue the observations on the velocity of sound early in the winter, owing to Mr. Massey's watch being required to be used as a chronometer, and therefore it was improper to expose it to changes of temperature; I had otherwise intended to have made a much more extensive series.

No. V.

OBSERVATIONS

FOR

LATITUDE, LONGITUDE, AND MAGNETIC VARIATIONS.

REMARKS ON TABLE I.

The following Table I. contains the results of observations for latitude, longitude, and magnetic variation, made during our progress through America, and along the sea-coast West and East of the Mackenzie. The altitudes were taken with the sextant and artificial horizon; and when the observations were not made by myself, the observer's initials are added.

The Expedition was supplied with three chronometers from the Royal Observatory at Greenwich, No. 3093 by French, Nos. 516 and 541 by Murray; and with their rates and errors for mean Greenwich time. My late friend Mr. Daniel Moore once more lent me his excellent chronometer No. 1733, Baird; as he had done on my two preceding voyages. Up to the time of our arrival at New York these watches preserved their rates steadily, but being much shaken by our travelling on carriages over indifferent roads from thence to Lake Huron, we found their rates considerably altered on our reaching Penetanguishene. Two of them, however, having increased their rates in nearly the same ratio as the other two had decreased theirs, the mean longitude shown by them was 80° 00′ 52″ West, which corresponded with the situation assigned to Penetanguishene by Captain Owen and Lieutenant Bayfield. New rates to be used in the subsequent voyage were there obtained by equal altitudes, and by a series of morning and evening observations on eight successive days. We only remained two days at Fort William (Lake Superior), and had not the opportunity of ascertaining whether the chronometers were preserving steady

rates. The longitude of that place, deduced from the mean of the four, was 89° 16′ 30″ W.; but since my return to England I have learned that the commissions for settling the boundary line have laid it down in longitude 89° 22′ 40″ W.

Its longitude by No. 1733, which we considered as the standard, was 89 °22′ 03″ W. During our stay there, No. 3093 stopped without any apparent cause, and being, in consequence, useless, it was left in charge of Lieutenant Bayfield. The party divided at this place; Dr. Richardson and I preceding the rest in the journey to Fort Chipewyan. I retained the chronometer No. 1733, Nos. 516 and 541 being left with Lieutenant Back and Mr. Kendall to enable them to carry on the survey until they should gain the route of the former Expedition.

In our progress through the interior the chronometers were suspended round our necks, inside the dresses, and the greatest care was taken to preserve them as much as possible from being shaken in travelling over the portages. This could not be altogether effected, though from the following notices it will appear that they preserved their rates much better than might have been expected, especially Nos. 1733 and 516. At the French portage the longitude observed by Mr. Kendall differed 1′ 30″ from mine, at the Fort in Rainy river 1′ 35″, and at Fort Alexander near Lake Winipeg, his longitude by 516 exactly agreed with that shown by 1733. In the passage from Fort William to the latter place No. 541 altered its rate, and a new one was procured there by dividing the difference between its longitude and that shown by the others, by the number of days since their departure from Fort William. We joined the track of the former Expedition at the Grand Rapid, Saskatchawan river; cloudy weather prevented my obtaining any observations there, but Mr. Kendall did, and his results place its west end in longitude 99° 27′ 44″, which we laid down in 99° 28′ 03″ by the mean of three chronometers in 1819. At Cumberland House the mean results gave longitude 102° 21′ 46″ W., which, on our former visit, was placed in 102° 16′ 40″ W., and at Isle à la Crosse Fort 107° 54′ 36″, instead of 107° 16′ 40″ W. as settled in 1820. These differences, however, being small when considered as actual distance, and these results having been obtained from single observations, but those on the former voyage by the mean of several sets, I did not think it necessary to alter the position of these places in the map. I was confirmed in this determination by finding on arrival at Fort Chipewyan, whose position had been ascertained by a series of lunar observations in 1820, that the mean of the chronometers only differed 40″ in longitude from that in which it had then been placed. The rates and errors for 1733 and 516 obtained at Fort Chipewyan were continued through the remainder of our journey during the year 1825, but

a new rate was procured at Fort Norman for No. 541, previous to its being sent for the use of Dr. Richardson in his survey of Bear Lake. The greatest difference in the longitudes of 516 and 1733 in the descent from Fort Norman to Garry Island, and up to the time of our arrival at Fort Franklin, was 1′ 23″. The longitude of the Fort by the mean of the chronometers was 123° 5′ W. Its position, however, was afterwards determined by lunar observations taken in the autumn of 1825, and the spring of 1826, viz.

	°	′	″
Mean of thirty-two sets of observations ☉ East, and West ☽, by Captain Franklin.	123	11	38
Mean of twenty-eight sets ☉ East, and West ☽, by Mr. Kendall.....	133	13	54
Mean Longitude of Fort Franklin	132	12	44

The longitudes observed by Dr. Richardson and Mr. Kendall in their surveys of Bear Lake were reduced to this meridian before the map of the discoveries was constructed. In the course of the winter 1825—6, the chronometer No. 541 was rendered useless by the main-spring breaking. Every care was taken to ascertain the rates of the two remaining watches, before the commencement of our sea voyage in 1826. Several transits of Arcturus over the meridian were observed, and for the six weeks preceding our departure, morning and evening observations of the sun's upper and lower limbs were obtained when the weather permitted. Their errors for mean Greenwich time were deduced from the longitude 123° 12′ 44″ W. The longitudes of the different points on the western coast was established from the mean results of these chronometers. They kept well together, not varying more than two miles in longitude for the first month, and the difference between them during the whole voyage was never greater than six miles.

An examination of the column of variation will show that, between the longitudes of 90° and 110° W., or where the magnetic pole is placed by the computations of Professors Barlow and Hansteen, the greatest number of curves of variation were crossed by a course at right angles to the magnetic meridian, and that but slight differences of the variation were observed in steering on a true meridian line. Beyond the longitude of 110 West, greater differences in variation were on the contrary found, when the places of observation were north and south of each other, or when we were travelling on a meridian line. In navigating the Polar Sea to the westward of the Mackenzie in the mean latitude of 69½° North, the variation was found to decrease, though slightly, until we had passed the longitude of 145° West; and Dr. Richardson observed that the variation increased as he went to the eastward, until he ceased to steer to the North of East, in longitude 121°, and his course was directed more to the South.

TABLE I. RESULTS of the OBSERVATIONS for LATITUDE, LONGITUDE, and VARIATION.

Date.	Latitude North.	Longitude by Chronometer West.	Variation East.	Place of Observation.	Date.	Latitude North.	Longitude by Chronometer West.	Variation East.	Place of Observation.
1825	° ′ ″	° ′ ″	° ′ ″		1825	° ′ ″	° ′ ″	° ′ ″	
March	40 42 7	74 1 15	1 30 48 W.	New York.	May 26	... ...	92 58 14 K.	... ...	Rainy Lake.
Apr. 11	44 22 55	79 53 41 K.	... ... East.	Nattawassaga Portage.	23	48 36 18	93 28 33	10 42 33 / 10 58 *	H. B. Co. Fort, in Rainy River.
...	44 48 42	80 00 52	0 56 16	Penetanguishene, Lake Huron.	24	... ...	94 43 40	... ...	Near mouth of Rainy River.
28	46 10 26	82 39 14	16 *	An island at west outlet of the Missassaga River.	31	... ...	94 37 31 K.	10 38 9 K.	Sandy Island East end of Lake of the Woods.
May 2	... ...	84 23 7	2 32 47	Sault de St. Marie Portage, east side.	June 1	... ...	94 38 16 K.	12 13 39 K.	Lake of the Woods.
...	46 30 57 K.	84 23 54 K.		West side of Portage.	...	49 21 19 K.	... ...	12 58 * K.	Lake of the Woods.
12	48 23 40 K.	89 16 8	7 17 28	Fort William, Lake Superior.	3	... ...	95 24 07 K.	... ...	Winipeg River.
14	48 24 52	... ...	9 43 * R.	Mountain Portage, east end.	...	50 18 5 K.	... ...	... ...	Jacob's Falls.
18	... ...	89 34 30 K.	11 2 48 K.	Dog Portage, N.E. end.	May 27	... ...	95 36 59	13 51 5 R.	Woody Point, Slave Fall.
...	48 49 49	... ...	... ...	Dog Lake, north end.	June 5	50 24 4 K.	... ...	... ...	Bonnet Portage.
19	... ...	89 50 13 K.	11 30 59 K.	Jourdan Portage.	...	50 36 49 K.	96 21 25 F. and K.	15 15 41 K.	Fort Alexander, near Lake Winipeg.
17	48 57 33	90 00 50 K.	5 58 * R.	Meadow Portage, middle.	...	50 41 2	96 25 46	13 16 59 R.	Lake Winipeg.
...	... ...	90 2 12 F.K.	... ...	West end of the same Portage.	12	50 42 29 K.	96 31 38 K.	14 25 30 K.	Point Metass. Lake Winipeg.
20	48 54 59 K.	... ...	5 58 *	Savannah Portage, N.E. end.	1	... ...	96 34 24	... ...	Point Observation, Lake Winipeg.
...	... ...	90 3 15 K.	... ...	S.W. end of the same Portage.	...	51 13 11	... ...	13 47 *	Commencement of the Ox Straits.
21	48 54 26 K.	... ...	... ...	On the Savannah River.	2	51 37 15	96 45 42	14 45 59 R.	Nearly opposite the Dog's Head.
...	... ...	90 15 38 K.	9 23 53 K.	Near the mouth of the Savannah River.	3	51 45 3	97 3 27	... ...	Sandy Island, three miles N.W. of Dog's Head.
22	48 42 57 K.	... ...	... ...	Ridge Portage.	15	52 9 32 K.	97 41 32 K.	... ..	A Point of Lake Winipeg.
...	... ...	90 42 55 K.	... ...	Barrel Portage, N.E. side.	18	... ...	98 37 06 K.	14 33 35 K.	A Point of Lake Winipeg.
17	... ..	91 6 47	... ...	French Portage, east end.	20	53 1 8 K.	98 34 29 K.	19 52 29 K.	Extreme of Long Point, Lake Winipeg.
23	... ...	91 8 24 K.	... ...	West end of the same Portage.	..	... ...	... ...	17 58 38 K.	Horse Islands.
...	48 39 4 K.	... ...	... ...	Perch Lake.	22	... ...	99 27 44 K.	... ...	Grand Rapid Portage, Saskatchawan River.
20	48 36 14	... ...	6 38 * R.	Portage of the Two Rivers, West end.	...	... ...	99 28 2 R.	... ...	The same laid down in 1819.
23	... ...	91 25 7 K.	... ...	Portage of the Dead.	...	53 57 33 K.	102 21 46 K.	19 14 21 F. R. K.	Cumberland House.
20	... ...	91 45 5	... ...	Portage of the Great Rocks.	...	53 56 40 F.	102 16 40 F.	17 17 29 F.	The same laid down in 1819.
21	48 20 30	... ...	... ...	An island two miles and a half from Upper Portage of River of the Cross.	June 17	54 20 10	... ...	20 19 * R.	Mouth of Sturgeon River.
21	... ...	92 22 57	... ...	Lower Portage of River of the Cross.	20	55 22 42	... ...	... ...	Rock 5½ miles below the Frog Portage.
25	48 19 4 K.	... ...	... ...	Lake Vermilion.	20	... ...	103 19 33	.. ...	West end Frog Portage.
...	... ...	92 33 34 K.	... ...	Nemican or Sturgeon Lake.	22	... ...	104 47 46	... ...	Great Devil Portage, East End.

The Asterisks denote the variation by ⊙'s bearing at noon. The initials point out the observers when the observations were not made by myself. The order of the places on the route has been followed, and not the dates of the observations.

RESULTS of the OBSERVATIONS for LATITUDE, LONGITUDE, and VARIATION.

Date.	Latitude North.	Longitude by Chronometer West.	Variation East.	Place of Observation.
1825	° ′ ″	° ′ ″	° ′ ″	
June25	55 57 35	... ...	... ...	Lower Portage Lake Primeau.
...	... ...	106 44 36	... ...	Narrows between Sandy and Snake Lakes.
27	55 25 25	107 54 36 F and K.	23 19 20 R.K.	Isle à la Crosse Fort.
...	... ...	107 52 55 F.	22 15 48 F.B.	Do. laid down in 1820.
July 5	56 26 30	109 52 54	23 3 3 R.	1st Stage Methye Portage.
9	56 40 17	109 57 54	... ...	East side of Little Lake, Methye Portage,
11	56 42 51	109 59 8	27 54 27	West end Methye Portage.
...	58 42 32	111 19 00	25 29 37 F and B.	Fort Chipewyan.
...	58 42 37	111 18 20	22 49 32 F and B.	Do. laid down in 1820.
30	61 10 26	113 45 00	29 15 9 K.	Fort Resolution, Great Slave Lake.
31	61 00 55	... ...	... ...	Great Slave Lake.
...	... ...	114 18 27	28 20 43 K.	Isle of the Dead, Great Slave Lake.
Aug. 1	60 52 50	... ...	... ...	Sandy River, Great Slave Lake.
A.M.	... ...	114 57 10	... ...	Near Burnt Point.
P.M.	... ...	115 47 46	33 13 21 K.	Entrance into the Mackenzie River.
A.M. 2	... ...	116 11 32	32 35 38 K.	Mackenzie River.
P.M. 2	... ...	116 35 27	... ...	West end of Big Island, North 1¼ mile.
A.M. 3	... ...	117 42 12	34 28 27 K.	Opposite the Isles of the Rapid.
...	61 26 32	... ...	... ...	Point in the Little Lake.
P.M. 4	... ...	118 53 54	... ...	Mackenzie River.
4	... ...	119 47 26	... ...	Mouth of Fish River.
...	61 26 31	... ...	... ...	Point of Mackenzie River.
6	... ...	123 31 2	37 41 49 K.	Elbow in the Mackenzie below Fort Simpson. River bends to the North.
..	62 49 22	... ...	... ...	Below the bend.
7	64 40 38 K.	124 44 47	39 57 52 F and K.	Fort Norman in June 1826.
A.M. 9	... ...	128 23 35	... ...	Island above the 1st Rapid, Mackenzie River.
..	65 44 22	... ...	42 13 *	Below the Rapid.
P.M.	66 10 44	128 52 32	44 05 3 K.	Just above the Ramparts.
10	... ...	129 26 37	46 25 15 K.	Mackenzie River.
...	66 45 12	... ...	... ...	Do. Do.

These Observations were made by Dr. Richardson with the Chronometer No. 541, during his survey of the northern parts of Bear Lake.

Date.	Latitude North.	Longitude by Chronometer West.	Variation East.	Place of Observation.
1825	° ′ ″	° ′ ″	° ′ ″	
Aug. 11	67 28 21	130 51 48	47 28 41 K.	Fort Good Hope.
12	... ...	133 15 28	48 32 45 K.	Commencement of the Narrows.
...	67 27 53	... ...	47 28 *	Narrows, Mackenzie River.
13	... ...	134 20 30	51 4 21 K.	Expansion of the River.
...	68 15 50	... ...	52 13 * K	Middle Channel.
15	69 3 45 K.	135 47 33	... ...	Moose Deer Encampment, Mouth of the Mackenzie River.
18	69 7 14	135 50 33	48 43 * K.	Remarkable Hummock.
17	69 28 52	135 40 55	51 42 11 K.	Garry Island, S.W. end.
Various times.	65 11 56	123 5 0 / 123 12 44 (by lun. obs.)	39 9 00 / 38 49 41	By Az. Comp. Ft. Franklin. / By mean of 4 months Obs. on the Diurnal Variation.
14	... ...	122 30 21	... ..	Point 9, Great Bear Lake.
16	... ...	121 59 56	... ..	Point 27. Do. Do.
17	... ...	120 54 04	36 0 42	Point 41. Do. Do.
...	66 4 04	... ...	... ...	Point 45. Do. Do.
18	... ...	121 22 36	41 11 10 / 42 27 27	Point 51. Do. Do.
20	... ...	120 59 20	... ...	Point 78. Do. Do.
21	... ...	... ...	43 37 39	Point 92. Do. Do.
22	66 56 39	... ...	46 58 *	Point 100. Do. Do.
24	66 52 38	118 34 42	47 25 56	Below Rapid on Dease R.
26	... ...	119 41 15	44 57 7 / 46 10 22 Amp.Az.	Point O. near Cape McDonald.
...	66 31 31	... ...	... ...	An Island, Point Q.
27	66 21 41	119 59 18	44 3 43	An Island, Point Y.
28	66 15 40	... ...	... ...	Centre of the Lake.
1826				
Apr. 10	65 2 51	... ...	38 48 *	Point 2, south shore, Bear Lake.
11	65 59 15	... ...	39 0 *	Point 4, near Manitou Cove.
13	64 58 5	121 7 51	... ...	Sa-choh-Etha Portage.
14	64 58 22	120 48 7	... ...	Fishery M'Vicar's Bay.
16	65 1 21	120 13 27	42 28 *	M'Vicar's Bay.
17	65 7 25	119 46 33	40 28 *	M'Vicar's Bay.
18	65 18 51	119 13 39	... ...	M'Vicar's Bay.
19	65 30 43	... ...	... ..	S.E. Point, Bear Island.

These Observations were made by Mr. Kendall and Dr. Richardson's survey of the S.E. parts of Bear Lake.

* The Longitudes by Dr. Richardson were deduced to Fort Franklin, supposing it to be in 123° 5′ W. as shown by the Chronometers on our first arrival, but after its position was ascertained by lunars to be in 123° 12′ 44′ W.; an addition of 7′ 44″ was made to each longitude for the construction of the map.

RESULTS of the OBSERVATIONS for LATITUDE, LONGITUDE, and VARIATION.

These Observations were made by Mr. Kendall on his and Dr. Richardson's survey of the S.E. parts of Bear Lake.

Date.	Latitude North.	Longitude by Chronometer West.	Variation East.	Place of Observation.
1826	° ′ ″	° ′ ″	° ′ ″	
Apr. 20	65 34 24	... ...	... ...	N.W. Point, Bear Island.
20	... ...	119 29 22	... ...	Portage opposite Bear Island.
22	65 46 49	119 13 53	44 54 16	Point Leith.
25	65 34 32	... ...	42 30 *	Near the bluff of Sa-choh-Etha.
27	65 30 26	... ...	42 08 *	West shore of Sa-choh-Etha.
28	65 26 D. R.	120 43 D. R.	40 47 49	Point 47, of Sa-choh-Etha.
28	65 20 54	... ...	... ...	West shore Sa-choh-Etha.
June 27	64 40 38	124 44 47	39 57 52 K.	Fort Norman.
28	64 55 4	... ..	... ...	Mackenzie River, 4½ miles above Bear Lake River.
29	65 40 35	... ...	... ...	Mackenzie River, near East Mountain of Rapid.
30	66 15 0	128 31 28	39 54 16	Mouth of Hare-skin River.
July 1	67 28 21	130 54 38	... ...	Fort Good Hope.
3	67 27 10	133 35 14	45 36 37 B.	Just below Red River.
4	67 51 22	... ...	... ...	West branch of Mackenzie River.
7	68 52 5	136 18 15	... ...	Near West outlet of Mackenzie.
9	69 1 24	137 24 40	46 40 40 B.	Sea Coast, West of Mackenzie River.
12	69 3 52	... ...	... ...	Do. Do. Do.
15	69 18 45	138 10 30	46 15 40 B.	Mouth of Babbage River.
17	69 28 13	... ...	... ...	Near Point Stokes.
18	69 33 38	139 3 10	... ...	South Point, Herschel Island.
19	69 36 18	139 42 28	46 3 24 B.	Nearly opposite Mount Conybeare.
23	69 36 27	140 12 2	45 6 10 B.	Small River.
24	69 36 26	140 19 33	... ...	
27	69 38 26	140 46 22	... ...	
30	69 38 23	140 51 D. R.	45 43 23 B.	Between Clarence River and Point Demarcation
Aug. 1.	69 43 30	141 29 45	... ...	Icy Reef.
4	70 5 11	143 54 55	45 36 04 B.	Barter Island.
5	70 7 14	145 29 45	... ...	Reef between Canning River and Point Brownlow
6	70 11 22	145 49 57	42 55 52 B.	Flaxman Island, North side.
8	70 16 27	147 38 04	43 15 12 B.	Foggy Island.
17	70 25 53	148 52 00	41 20 *	Return Reef.
Sept. 4	67 42 12	... ...	... ...	Forks of Mackenzie, near Peel River.
July 8	69 28 59 K.	... ...	49 26 58	Refuge Cove. Sea Coast East of the Mackenzie.

Date.	Latitude North.	Longitude by Chronometer West.	Variation East.	Place of Observation.
1826	° ′ ″	° ′ ″	° ′ ″	
July 9	69 37 50	... ...	50 43 *	Point Toker.
10	69 42 37	131 57 37	... ...	Bay near Point Warren.
15	70 11 36	... ...	50 50 *	Near Cape Brown.
16	70 8 1	... ...	49 0 *	Island in Liverpool Bay.
17	69 54 48	... ...	53 0 *	Near Point Sir P. Maitland.
18	70 30 46	... ...	... ...	Cape Bathurst.
19	70 19 5	... ...	50 0 *	Point Trail.
21	69 37 57	... ...	... ...	Three miles south of Burnet River.
22	69 42 54	... ...	52 0 *	Limestone Point, Wright's Bay.
22	69 58 D. R.	124 0 D. R.	55 46 45	Perforated Rock, near Cape Parry.
24	69 49 7	123 33 32	56 33 *	Burrow Island.
...	69 42 D. R.	123 17 D. R.	54 00 18	Clapperton Island,
25	69 43 D. R.	122 46 30	55 54 00	Bay near Cape Lyon.
...	69 46 25	122 50 55	... ...	Cape Lyon.
28	69 44 22	... ...	53 0 *	Near Point Deas Thompson.
29	69 29 17	... ...	... ...	Near Point De Witt Clinton.
31	69 20 1	... ...	... ...	Point Tinney.
...	69 17 D. R.	119 28 D. R.	51 28	Between Points Tinney and Croker.
Aug. 1	69 13 15	... ...	... ...	Point Clifton.
2	68 55 47	... ...	... ...	Near Harding River.
3	68 52 44	... ...	52 0 *	Stapylton Bay.
4	68 58 23	... ...	52 30 *	Cape Sir W. Hope.
5	68 53 18	... ...	50 0 *	Near Point Cockburn.
6	68 36 30	... ...	... ...	Small Islands.
7	68 13 25	... ...	... ...	Point Locker, Coronation Gulf.
8	67 58 26	115 18 D. R.	... ...	Cape Kendall.
...	67 47 50	115 36 49	48 0 0	Mouth of Coppermine River.
11	67 32 58	... ...	... ...	Escape Rapid, Coppermine River.
12	67 18 59	... ...	... ...	Foot of Copper Mountains.
13	67 13 21	... ...	... ...	Do. Do.
14	67 10 18	... ...	... ...	Barren Grounds.
17	66 58	... ...	... ...	Do. Do.

REMARKS ON TABLE II. CONTAINING THE DIP OF THE NEEDLE.

We were provided with a Meyer's Dipping Needle of six inches diameter, made by Dollond, on the plan suggested by Captain Sabine, in *Phil. Trans.* 1822. Art. I., and with two other needles of the ordinary construction. In the following Table the letters C and M imply whether the dip was obtained by Meyer's needle, or by the common needles; and the agreement between the results by Meyer's needle and by the common needles at those stations where they were both used, show that the latter were very nicely balanced. The dips observed on this Expedition, at the stations that we visited on the former voyage, were about four degrees less. I have already mentioned, in the Appendix of my former Narrative, the reasons I had for doubting the correctness of the instrument then used; and on this occasion, I have only to add, that I have every reason to confide in the results now obtained.

Accidental circumstances prevented us from obtaining satisfactory observations on the Magnetic Force.

TABLE II.

CONTAINING the DIP of the NEEDLE, and the POSITION of the MAGNETIC POLE, computed by PROFESSOR BARLOW.

Date.	Latitude North.	Longitude West.	Dip North.	Variation East.	Needle.	Obsr.	Place of Observation.	Computed Position of Magnetic Pole.	
								Lat. N.	Long. W.
1825.	° ′ ″	° ′ ″	° ′ ″	° ′ ″				° ′	° ′
March	40 42 7	74 1 15	73 27 3	1 30 48 W.	M.	F.	New York.	71 24	76 28
Apr. 18	44 48 42	80 00 52	76 16 0	0 56 16 E.	M.	F.	Penetanguishene.	70 34	78 46
May 11	48 23 40	89 16 08	78 22 0	7 17 28 E.	M.	F.	Fort William.	70 37	81 08
			78 18 5		C.	F. K.			
„ 20	48 54 00	90 3 15	78 39 5	5 58 0 E.	C.	B. K.	Savannah Portage, S.W. end.	71 8	83 18
„ 27	48 36 18	93 28 33	77 18 5	10 42 43	C.	B.	Fort in Rainy River.	71 56	79 14
June 6	50 36 49	96 21 25	78 47 8	15 15 41	C.	B. K.	Fort Alexander, Winipeg River.	70 43	79 17
„ 20	53 1 8	98 34 39	79 50 5	19 52 29	C,	K.	Long Point, Lake Winipeg.		
„ 28	53 56 40	102 16 40	80 21 7	19 14 21	C.	B. K.	Cumberland House.	70 56	83 22
July 11	55 25 25	107 51 36	79 55 0	23 19 14	C.	B. K.	Isle à la Crosse. Much thunder and lightning during these Obs.	71 53	82 37
„ 24	58 42 32	111 18 20	81 26 8	25 29 37	C.	F. K.	Fort Chipewyan.	72 48	86 24
Aug. 5	62 11 00	121 38 00	81 53 8	37 42 00	C.	K.	Fort Simpson, Mackenzie River.	72 8	88 35
Sept. 19	65 11 56	123 12 44	82 57 0	38 59 20	M.	F.	Fort Franklin, Great Bear Lake.		
			82 49 1		C.	F. K.			
			83 1 9		C.	F. K.			
			82 56 1	Mean.					
1826.									
June 15	65 11 56	123 12 44	83 3 27	39 00 00	M.	F.	Fort Franklin.	69 16	98 8
			82 57 24		C.	F. K.			
			83 00 25	Mean.					
July 3	67 27 10	133 35 34	82 36 1	45 36 37	C.	K.	Near Red River, Mackenzie River.	73 20	92 58
„ 10	69 1 24	137 24 40	82 22 3	46 40 40	C.	F. B.	Sea Coast, West of the Mackenzie River.	73 57	95 22
„ 28	69 38 23	140 51 00	83 27 4	45 43 00	C.	F. B.	Sea Coast.		
Aug. 9	70 16 27	147 38 04	82 26 8	43 15 12	M.	F.	Foggy Island.	77 51	91 6
			82 25 4		C.	F. B.			
Sept. 29	65 11 56	123 12 44	82 44 2	39 00 00	M.	F.	Fort Franklin.		
			83 10 3		C.	F. K.			
			82 57 7	Mean.					

TABLE III.

SHOWING the INCREASE of VARIATION BETWEEN 1819, 1820, and 1825.

Latitude North.	Longitude West.	Variation East, observed on the first Expedition.	Variation East, observed on the second Expedition.	Increase of East Variation for the Interval.	Annual Increase.	Place of Observation.
° ′ ″	° ′ ″	° ′ ″	° ′ ″	° ′ ″	′	
53 56 40	102 16 40	17 17 29 in Oct. 1819	19 14 21 in June 1825	1 56 52	20.5	Cumberland House.
55 25 25	107 54 36	22 15 48 in March 1820	23 19 20 in July 1825	1 3 32	17.7	Isle à la Crosse Fort.
56 42 51	109 59 8	25 2 30 in July 1820	27 54 27 in July 1825	2 51 57	34.4	West side Methye Portage.
58 42 37	111 18 20	22 49 32 in May 1820	25 29 37 in July 1825	2 40 5	30.8	Fort Chipewyan.
61 10 30	113 45 00	25 40 47 in July 1820	29 15 9 in July 1825	3 34 22	42.8	Fort Resolution and Moose Deer Island, Slave Lake. These observations were made about three miles apart.
67 47 50	115 36 49	46 25 52 in July 1821	48 0 0 in Aug. 1826	1 34 8	18.4	Mouth of the Coppermine River.
65 11 56	113 12 44	39 9 36 in Sept. 1825	39 13 32 in Sept. 1826	. .	3.56	Fort Franklin.

At the mouth of the Mackenzie an increase of 15° in the variation was observed since the visit of Sir A. Mackenzie in 1789, an average of 25 minutes a year.

No. VI.

OBSERVATIONS

RELATIVE TO THE

DAILY VARIATION OF THE HORIZONTAL MAGNETIC NEEDLE.

The daily variation of the Horizontal Needle having been recently supposed to be intimately connected with the theory of terrestrial magnetism, I was desirous of attending to it as much as possible during our residence in winter-quarters. Our observations, therefore, commenced very soon after our arrival, viz., on the 6th of October, 1825, and were continued every day from that time to the 30th of April, 1826, and again from the 1st of October, 1826, to the 30th of April, 1827*, during which period they were registered hourly from 8 A.M. to 12 P.M. The instrument was placed in the observatory, at such a distance from the dwelling-houses as to be quite free from any radiation of heat, or other disturbing causes, which their proximity might have occasioned. The stand on which it was fixed was constructed in the following manner :—A post, six feet six inches long, was planted three feet deep in the earth, and the upper part surrounded by a square frame of deal, four feet in diameter, which was rammed full of mud and sand, and when the earth became frozen the sand was as firm as a rock.

The Needle was of a lozenge shape, and six inches long; some of the observations were made with it when suspended, and others when resting on the pivot, as noticed in the following table. The graduated circle of the instrument being divided to ten minutes of degrees, could be read to the nearest minute with a magnifying glass. The Needle was protected from currents of air by a closely fitted glass cover.

Two gold leaf electrometers and a thermometer were placed within the observatory, at four feet six inches from the ground, and were, as well as the

* The register for October, 1825, not comprehending the whole of the month, that for April, 1826, comprising only my own observations, and those for the months of February, March, and April, 1827, having been made by two observers only, I have confined the abstract to the eight complete months.

direction of the wind and the state of the weather, examined at the same times with the Needle.

The extent of the tables of observations preventing their being given in detail, I have, therefore, at the suggestion of Professor Barlow, made the abridgement contained in the following Table No. I. This table, however, conveys a very inadequate idea of the daily fluctuations of the Needle, which can only be seen by referring to the daily registers, and in order to afford the opportunity to any person who may wish to do so, I have lodged the whole at the Admiralty.

The daily fluctuations for one month will be observed in Table II., which contains the whole register of my observations for October, 1826, when the Needle was placed under a reduced directive power by opposing magnets. This method of increasing the amount of the daily variation was first suggested by Professor Barlow, in the *Philosophical Transactions*, part 2, for 1823. I was, however, indebted to Professor Christie for the directions which I followed in making the observations.

I have endeavoured to show, by subsequent tables, that many of the deviations of the Needle are attributable to the appearance of the Aurora Borealis, and I think it not improbable that many of the fluctuations during the day may be due to the same cause, though, owing to the day-light, the coruscations were invisible; because we scarcely ever observed any material change in the position of the Needle during the day, without a correspondent alteration in the state of the atmosphere, which was supposed by the whole party to be in some measure connected with the Aurora Borealis.

It will be observed that the readings from October, 1826, exceed those in the first series; but, whether this be due to any error in replacing the instrument, or to an actual change of the variation, I have no means now of determining.

5	N38 42E	N38 42E	N38 35E	N38 32E	N38 29E	N38 23E	N38 25E	N38 25E	N38 23E	N38 28E	N38 27E	N38 25E	N38 28E	N38 33E	N38 28E	N38 32E	N38 25E	Suspended
5	38 44	38 45	38 38	38 42	38 43	38 37	38 39	38 39	38 36	38 39	38 38	38 38	38 34	38 39	38 35	38 38	38 39	Suspended to 14th, then on Pivot.
6	38 56	38 53	38 55	38 54	38 52	38 54	38 53	38 49	38 52	38 52	38 52	38 52	38 52	38 49	38 51	38 49	38 49	On Pivot
6	38 48	38 43	38 46	38 44	38 43	38 42	38 41	38 40	38 40	38 41	38 40	38 39	38 40	38 41	38 39	38 39	38 42	Ditto.
6	38 52	38 52	38 54	38 54	38 50	38 52	38 51	38 49	38 51	38 49	38 50	38 48	38 49	38 48	38 47	38 49	38 48	Ditto.
6	40 06	40 05	40 04	40 01	40 03	39 58	39 56	39 56	39 57	39 52	39 53	39 55	39 53	39 54	39 54	39 50	39 51	Suspended

REMARKS ON TABLE I.

It appears from the preceding table that the Needle had its greatest easterly bearing at 8 A.M., and its least easterly or greatest westerly at midnight, the mean daily difference being eight minutes, which is certainly much less than might have been expected, considering our proximity to the Magnetic Pole, as indicated by the dip of the Needle being 83°. The mean between the two extremes is 39° 11′, which is the bearing between noon and 1 P.M.

The position of the Magnetic Pole, as computed from our observations by Professor Barlow, is in 69° 16′ north latitude, and 98° 8′ west longitude, and by the observations of Capt. Parry in lat. 70° 43′ north, long. 98° 54′ west, its mean place being in lat. 70° 0′ north, long. 98° 31′ west, which is between Port Bowen and Fort Franklin; the former being situated in lat. 73° 14′ north, long. 88° 54′ west, and the latter in 65° 12′ north, long. 123° 12′ west. It appears, therefore, that for the same months, at the interval of only one year, Capt. Parry and myself were making hourly observations on two Needles, the north ends of which pointed almost directly towards each other, though our actual distance did not exceed 855 geographical miles; and while the Needle of Port Bowen was increasing its westerly direction, ours was increasing its easterly, and the contrary,—the variation being west at Port Bowen and east at Fort Franklin; a beautiful and satisfactory proof of the solar influence on the daily variation.

TABLE II.—OBSERVATIONS on the HORIZONTAL NEEDLE, under a Directive Power, reduced by opposing Magnets, for October, 1826, by Capt. Franklin.

The Magnets were placed after the manner suggested by Professor Christie, of the Royal Military Academy, Woolwich. The Asterisks denote when the Aurora Borealis was visible.

Days.	8 A.M.	9 A.M.	12 A.M.	3 P.M.	6 P.M.	9 P.M.	12 P.M.
1	N 39° 27′ E	N 39° 23′ E	N 39° 33′ E	N 39° 08′ E	N 38° 52′ E	N 39° 12′ E	N 39° 10′ E
2	39 11	39 45	39 42	39 42	39 35	39 33	39 33
3	39 51	40 25	40 23	40 10	38 45	38 48*	39 15
4	39 12	39 18	39 18	39 15	39 12	39 15*	37 30*
5	39 44	39 44	39 34	39 40	39 35	39 33*	39 35*
6	39 35	39 35	39 35	39 35	39 35	39 35	39 35*
7	39 35	39 35	39 33	39 32	39 35	39 34	39 35
8	39 35	39 35	39 33	39 35	39 35	39 35	39 35
9	39 34	39 33	39 33	39 33	39 33	39 33	39 33
10	39 48	39 50	39 47	39 47	39 45	39 48	39 28
11	38 40	38 48	38 48	38 48	39 50	39 50	39 48
12	38 48	38 50	38 50	38 48	38 52	38 52	38 52
13	40 55	40 56	40 50	40 35	40 32	40 05	37 35*
14	40 25	40 25	39 43	39 43	39 45	39 35	35 10
15	39 15	39 20	39 18	39 15	39 15	39 50*	38 50
16	38 50	38 51	38 50	38 50	38 51	38 52	39 11
17	40 00	40 30	40 05	39 05	39 05	38 48	37 35
18	45 35	41 53	39 35	39 15	38 58	39 12	40 25
19	42 22	40 45	39 50	39 05	39 03	39 45*	36 15*
20	42 25	41 10	39 50	39 33	39 30	39 50	40 08
21	39 40	39 45	39 35	39 35	39 38	39 40	39 35
22	38 50	38 48	38 55	38 50	38 55	38 57	38 55
23	39 40	40 55	40 05	39 55	39 53	39 55	39 20
24	40 33	40 33	39 38	39 35	39 35	39 35	37 25
25	41 13	41 12	40 05	39 42	39 18	39 20	39 20
26	39 35	39 35	39 35	39 35	39 30	39 30*	39 30
27	40 40	40 38	40 30	40 23	40 17	38 05	38 33
28	40 10	40 05	40 00	39 55	39 48	39 45	39 38
29	40 28	39 50	39 30	39 08	39 15	39 12	39 10
30	39 16	39 15	39 20	39 15	39 15	39 15	39 15
31	39 43	40 15	39 13	39 20	.. ..	.. ..	.. ..
Mean	40 05	39 58	39 38	39 29	39 26	39 24	38 55

The Mean at Twelve P.M. in this Table is the least, in other respects it agrees with the preceding Tables.

REMARKS ON TABLE II.

The minimum of variation is in this table at midnight, as in the others, but it differs from them in showing a progressive decrease to the latter hour, and in not exhibiting the fluctuations we perceive in Table I. between 3 P.M. and 10 P.M. As to the amount of deviation shown in the daily columns as well as in the means, it is considerably greater, as was to be expected, when the directive power was reduced by the opposing magnets.

No. VII.

ON THE AURORA BOREALIS.

The results of the observations on this phenomenon made during the present Expedition, coinciding with the remarks on the same subject given at much length in the Appendix to my former Narrative, I shall here confine myself to the mention of a few brief deductions from a careful examination of our registers at Bear Lake.

The observations were made without intermission for six successive months, in the years 1825-26, and again in 1826-27, but as their insertion would occupy too much space I have endeavoured to illustrate the general effect of the Aurora Borealis on the magnetic needle, by first giving, in Table I. the observations at length, for five days, when the coruscations were extremely active, accompanied by the remarks made at the time; and secondly, in Table II. by showing the deflections of the needle which occurred during a series of observations when the Aurora was in motion.

My opinion recorded in my former Narrative *, that the different positions of the Aurora have a considerable influence upon the direction of the Magnetic Needle, has been repeatedly confirmed during our residence at Bear Lake. It was also remarked, that, from whatever point the flow of light, or, in other words, the motion of the Aurora proceeded, if that motion was rapid, the nearest end of the needle was drawn towards that point almost simultaneously with the commencement of the motion. This fact, I think, will be apparent from an examination of the following tables, and more particularly of the registers for the five days in Table I. The exceptions to this course, which are very few, are pointed out by asterisks in the tables.

A careful review of the daily registers of the appearance of the Aurora has led me to form the following general conclusions: 1st, that brilliant and active coruscations of the Aurora Borealis cause a deflection of the needle almost

* Appendix, p. 551.

invariably, if they appear through a hazy atmosphere, and if the prismatic colours are exhibited in the beams or arches. When, on the contrary, the atmosphere is clear, and the Aurora presents a steady dense light, of a yellow colour, and without motion, the needle is often unaffected by its appearance.

2nd. That the Aurora is generally most active when it seems to have emerged from a cloud near the earth.

3rd. When the Aurora is very active, a haziness is very generally perceptible about the coruscations though the other parts of the sky may be free from haze or cloud.

4th. That the nearest end of the needle is drawn towards the point from whence the motion of the Aurora proceeds, and that its deflections are greatest when the motion is most rapid. The effect being the same whether the motion flows along a low arch or one that crosses the zenith.

5th. That a low state of temperature seems favourable for the production of brilliant and active coruscations; it being seldom that we witnessed any that were much agitated, or that the prismatic tints were very apparent when the temperature was above zero.

6th. That the coruscations were less frequently visible between the first quarter day, and the full moon, than in any other period of the lunation, and that they were most numerous between the third quarter and the new moon*.

7th. That the appearance of the Aurora was registered at Bear Lake in 1825-26, 343 times, without any sound having been heard to attend its motions.

8th. The height of the Aurora was not determined by actual observation, but its having been seen on several occasions to illuminate the under surface of some dense clouds, is conclusive that its elevation could not have been very great. When Dr. Richardson and Mr. Kendall made their excursion on Bear Lake, in the spring of 1826, the former saw the Aurora very brilliant and active, displaying the prismatic colours in a cloudless sky (on 23d April); while Mr. Kendall, who was watching at the time, by agreement, for its appearance, did not see any coruscation, though he was only twenty miles distant from Dr. Richardson.

9th. The gold leaf Electrometer which was kept in the observatory was never affected by the appearance of the Aurora.

10th. On four occasions the coruscations of the Aurora were seen very distinctly before the daylight had disappeared, and we often perceived the

* The proportion of coruscations seen at these periods, from the month of October, 1825, to April, 1826, was 38 to 125. The moonlight being strong between the first quarter and the full moon at those hours when we more particularly watched for the Aurora, may, perhaps, account for our not having seen its coruscations so often during this part of the lunation.

clouds in the day-time disposed in streams and arches, such as the Aurora assumes.

The opinions I have ventured to advance above, are at variance with the conclusions drawn by Captains Parry and Foster, from their observations at Port Bowen,—those officers inferring that the Aurora does not influence the motion of the needle; but the discrepancy may be perhaps explained by the difference in activity and altitude of the Aurora at the two places. I have stated that the needle is most affected when the Aurora is very active and displays the prismatic colours. Captains Parry and Foster have informed me that the Aurora seen at Port Bowen was generally at a low altitude, without much motion in its parts, and never exhibiting the vivid prismatic colours, or the rapid streams of light, which are so frequently recorded in our registers of its appearance at Fort Enterprise and Fort Franklin. At both these places we as often witnessed the coruscations crossing the zenith as at any other altitude, and under such a variety of forms and in such rapid motion as to baffle description.

From the difference in the appearance and activity of the Aurora at Port Bowen, and Forts Enterprise and Franklin, an inference may be deduced that the parallel of 65°N. is more favourable for observing this phenomenon and its effect on the needle, than a higher northern latitude.

The observations contained in Table I. were made by Lieut. Back, Mr. Kendall, and myself; the two latter being stationed to read off the arc at each end of the needle, while the former remained with Dr. Richardson on the outside of the Observatory to note and inform us of the changes in the coruscations. The height of the arches was estimated by the eye, and their bearing by reference to the dwelling-houses and other marks which had been previously determined. The bearings of the Aurora in this, and the following table, are reckoned from the true meridian; and for the information of the general reader it may be stated that the position of the needle was about 3½ points of the compass to the east of the true north.

TABLE I.

Date.	Interval.	North end of the Needle at the previous register.	North end of the Needle during these Coruscations.	Deflections during these coruscations to the East.	Deflections during these coruscations to the West.	Appearance and position of the Aurora.
Oct. 1825. 26th.	Between 10h. 10m. and 10h .30m. P.M.	N 38° 9′ E No Aurora visible.	N 39° 18′ E			An arch of 20° elevation extending from W.N.W. to E.N.E. by the north. The motion of the light rushed at the first from the former to the latter point, and then backwards and forwards, and ultimately passed off to the southward.
			39·25			
			40·00	2°·41′		
			40·50			
			40·00			
			39·30	..	1°·20′	Needle stationary a few seconds.
			38·40*	..	50	A beam shot along the arch from W. by N. to East.
			38·15	..	25	Beam from north across the zenith to south horizon.
			39·30	1·15		Motion of light from W.N.W. along the arch.
			38·25		1·05	Motion from N.W. to N.E. at an elevation of 8°.
			38·05	1·00		Beam from north to the zenith.
			37·25			
			37·50			Needle stationary; the Aurora having disappeared.

REMARKS ON THE 26TH.

Temp. Obs., 11° 2
Air . + 10 2
Wind moderate, N.W., clear in the upper part of the sky. Hazy near the horizon.

THESE coruscations were extremely brilliant, and in continual motion. The principal feature was a broad band of light that extended along the northern part of the sky from W.N.W. to E.N.E. at an elevation of 20°, from which beams of a less intense light were frequently projected across the zenith from north to south, or in the contrary direction; and they sometimes reached the opposite horizon before they disappeared. The band as well as the beams seemed to be composed of an infinite number of slender rays which were highly inclined, and exhibited the prismatic colours, the strongest tints being red, yellow, and green. The whole of these coruscations appeared to be interposed between the spectator and a thin filmy mass of cloud.

TABLE I.—*continued.*

Date.	Interval.	North end of the Needle at the previous register.	North end of the Needle during these Coruscations.	Deflections during these Coruscations to the East.	Deflections during these Coruscations to the West.	Appearance and position of the Aurora.
Oct. 1825.	From midnight to ten minutes after that hour.	N 38.4 E Aurora then Visible.	N 37.50 E	. .	39	A stream of light extending from E.N.E. to the north, at an elevation of 15°. The motion of its parts very rapid.
			37.25 *			
			36.50	. .	35	A beam from north to the zenith; on reaching that part, it instantly spread across the zenith, and its extremities were pointed S.W. by W. and E.N.E.
			37.30	40		
27th.			36.15	. .	1.15	Another beam from north which spread across the zenith, as the former had done, having its points directed W. by S. and E. by N.
			36.50	35		The whole coruscation then disappeared, and the needle gradually recovered its usual position.
			38.8	. .	1.18	Temperature Observatory, — 16°, wind west, light.
						Air . . . . . — 15°, clear sky. Hazy in the parts near the coruscations.

REMARKS ON THE 27TH.

It should be observed that there were two distinct issues of light from E.N.E. along the above-mentioned stream, which, on reaching the north point, rushed towards the zenith, and in both instances similar arches were formed across the zenith. The needle betrayed the same course of deviation in both cases. The motion of the light was extremely rapid.

TABLE I.—*continued.*

Date.	Interval.	North end of the Needle at the previous register.	North end of the Needle during these Coruscations.	Deflections during these Coruscations to the East.	Deflections during these Coruscations to the West.	Appearance and position of the Aurora.
1825		° ′ N 37.54 E.	° ′ N 38.15 E	° ′	° ′	
Nov.	Between 10h. 30m., and 10h. 45m., P.M.		38.6	. .	. .	Motion rapid from S.S.E. to N.N.W. across the zenith.
2			37.45		.30	
			38.35	.50	. .	Arch the same, direction of motion not noted.
			36.12	. .	2.23	Arch across zenith from south to north. Motion rapid.
			37.20	1.08		Arch across zenith from N.N.W. to South.
			36.20		1.00	
			37.45 *	1.25	. .	Motion N.N.W. to South.
			37.40	.20	. .	Aurora gradually disappearing, needle stationary at the last position.
			38.00			
						Temperature Observatory,—1° 3′, nearly calm. Air . . . . . —zero, clear.

REMARKS ON THE 2ND.

THE Aurora this night was extremely brilliant and active, and exhibited the prismatic tints. The coruscations commenced with a highly illuminated arch, spreading from S.E. to N.W. across the zenith, in which part it formed a corona, from whence slender rays were projected perpendicularly downwards, giving to the coruscation the appearance of a globe, with the meridians marked upon it. This Aurora originally sprang from a mass of cloud bearing S.S.E., which gradually changed its position to the eastward, and on its reaching the east point a band of light resembling the fringe of a curtain rushed forth, and extended round the northern horizon at an elevation of 8°. The corona disappeared at the time this latter change took place, and arches were projected in rapid succession from S.S.E. to N.N.W., south to north, and N.N.W. to south; all of them displaying the most brilliant colours. The needle betrayed its greatest deviation during the projection of these last-mentioned arches, and was, in fact, kept in a state of vacillation for about five minutes, approaching towards, or receding from, the true north, according to the apparent motion of the rays of light.

TABLE I.—*continued.*

Date	Interval.	North end of the Needle at the previous register.	North end of the Needle during these Coruscations.	Deflections during these Coruscations to the East.	Deflections during these Coruscations to the West.	Remarks and appearances of Aurora.
1825		N 37.27 E	N 41.00 E	3.33		A bright beam darted from an elevated arch towards the horizon at the N.N.W. point.
Dec.		Aurora	38.15	..	2.45	
7th.	Between 11h. and 11h. 25m. P.M.	visible	39.15			A stream from E.S.E. to N.W., with a rapid vibratory motion in its parts.
			39.50			
			41.15	2.00		
			41.00	..	.15	
			40.50	..	.10	Coruscations in the form of a horse-shoe, motion following that shape.
			40.45	..	.05	
			40.45			See subsequent remarks.
			39.12	..	.33	
			38.05	..	1.07	
						Temperature Observatory,—25°, wind N.W., light
						Air . . . . . —27°, clear.
						Haze perceptible near the coruscations.

REMARKS ON THE 7TH.

THE Aurora this night was very generally diffused, and extremely active and brilliant. The most remarkable part of the coruscation was three perfect arches, at the several altitudes of 40°, 50°, and 90°, having the same points in the horizon. From the lowest of these arches a beam flashed towards the horizon to N.N.W., which produced a change in the needle of 2° 45′, as above noted. When these arches became faint, a mass of light rushed from E.S.E., and in its progress to the N.W., in an horizontal direction, the rays of light, of which the stream was composed, were seen vibrating backwards and forwards between the two extremes in the most rapid manner. During this commotion, which lasted ten minutes, the needle deviated between 39° 15′ and 41° 15′. It afterwards continued stationary for three minutes at 40° 45′, though the Aurora was violently agitated; but the motion of the light was then nearly circular, or in the form of a horseshoe, and confined to the zenith. The colour of the light was faint red. In a few seconds afterwards, the whole body of the light, being concentrated in the W.N.W. point, darted in an instant across the zenith to E.S.E., exhibiting, in its progress, a similar agitation in its rays to that already described. The coruscation then branched off to the north, forming a broad band of light about 20° high, reassumed the horse-shoe form at the latter point, and its rays undulated through every part of this figure like the waves of the sea, or a rolling volume of smoke. During these last-mentiond changes, the needle retraced its course, as shown in the three last notices, and remained stationary 38° 05′, while the Aurora formed a zone that encircled the horizon at an elevation of 30°, in which shape it remained a few minutes and then disappeared.

TABLE I.—*continued.*

Date.	Interval.	North end of the Needle at the previous register.	North end of the Needle during these Coruscations.	Deflections during each Coruscation to the East.	Deflections during each Coruscation to the West.	Appearance and position of the Aurora.
1825		N. 39° 2′ E.	N. 38° 48′ E.	° ′	° ′ .14	Motion from N.W.b.N. along a band of light stretching to the eastward, elevated 15°, and about 2° broad.
Dec.		Aurora	38·15			
8th		visible.	38·16	. .		The colours very vivid—motion rapid.
			38· 3			
			37·32		1.16	Needle stationary for five minutes at this position.
			37·45		. .	Motion returning from the eastward along the band to N.W.b.N.
			37·48	.16		
			37.48	. .	. .	The needle stationary at this position for five minutes, during which interval the light was rushing from each extreme of the band, meeting in the N.b.E. point. There was but little display of colour.
	Between midnight and 25 minutes after that hour.		37·38	. .	.10	The motion from the N.W. prevailed.
			36·35	. .	1.03	A stream of light, about 20° broad, darted across the zenith from N.W.b.N. to S.S.E.
			37·35	1.00	. .	A beam darted from the zenith to N.W.b.N., followed by the whole mass that had ascended from this point.
			38·03			
			38·25	.50	. .	
			38·05	. .	·20	Motion along the first-mentioned band, from N.W.b.N. to the Eastward.
			37·15	. .	·50	A stream from N.W.b.N. to the zenith.
			37·40	.25	. .	A beam from zenith to N.b.E.
			37·35	. .	.5	Needle stationary for some minutes, the motion rolling from opposite directions of the arch that extended from N.W.b.N. to East, and clashing in the centre.
			38·03	.28	. .	Motion from N.W.b.N., in nearly a horizontal direction to W.S.W.
			38· 8	. .	. .	Stationary for 5 minutes.
			37· 8	. .	1.00	A stream of an irregular shape darted from N.W.b.N. to S.S.E. across the zenith.
			35·15	. .	1.53	
			36· 5	.50	. .	Aurora generally diffused in filmy streams, without motion.
			36·48	.43	. .	Motion from E.S.E. to N.W.b.N., in a band similar to that first described.
9th	h. m. At 1·20 A.M.	. . .	38·03	1.15	. .	The Aurora appeared in an arch from N.E. to North, but motionless. Temperature of Observatory, −26° 3, nearly calm. Air −30 5, clear.

General Remarks.

The changes in the coruscations were so various and rapid, as to render their description impossible. The band of light first mentioned, as extending horizontally from N.W.b.N. to the eastward, remained nearly the whole time.

TABLE II.—SHOWING THE DEFLECTIONS OF THE NEEDLE WHEN UNDER THE INFLUENCE OF THE AURORA BOREALIS *.

The initials denote the Observer.

Month. 1825.	Hour.	Observer.	Previous Reading North end of Needle.	New Reading North end of Needle.	Deflection of the Needle to the East.	Deflection of the Needle to the West.	Direction of the Motion of the Aurora.	Temp. of Observatory.	Wind and Weather.
			° ′	° ′	°	°		°	
Needle suspended. Oct. 25	9 P.M.	F.	N. 38 20 E.	N. 38 28 E.	8	..	A flash from East while I was looking at the instrument.	+19·5	Calm, clear.
29	7 P.M.	B.	37 55	37 47	..	8	Flashes from N.N.W.	+11·5	S.S.E., strong, clear.
Nov. 4	between 10h & 10h 20′ P.M.	B.	38 08	38 48	40	..	From E.N.E. along a stream extending to N.W.	−17·5	
..	..	..	.. ..	38 20					
..	..	..	.. ..	38 00	..	58	Beams darting upwards between N.N.E. and N.N.W.	−17·5	Calm, clear.
..	..	..	.. ..	37 50					
..	..	..	. ..	38 25	35	..	From E.N.E. in two streams, 30° high.	..	
..	..	..	.. ..	38 00	..	25	Towards the zenith from N.N.W.	..	
5	between 10h & 10h 10′ P.M.	B.	37 54	37 58	4	..	From E.S.E. to N.N.W.	−18·5	Calm, clear.
				37*50	..	4			
..	11 P.M.	K.	37 50	37 28	..	22	From N.N.W. to E.N.E. arch 40° high.	−19	North, light, clear.
7	10 P.M.	B.	37 25	37 30	5	..	Flashes from E.S.E.	zero	N.N.W., clear.
13	5 P.M.	F.	37 42	37 47	5	..	Beam from North to zenith.	−15·5	
..	between 12h & 12h 10′ P.M.	B.	37 43	37 50	7	..	Aurora very vivid, darting instantaneously across zenith, alternately from the W.b.N. and E.S.E. points.	−20·5	Calm, clear.
				37 35	..	15			
27	9 P.M.	F.	38 22	38 43	21	..	From East to North.	− 7·5	E.N.E., fresh, hazy.
28	10 P.M.	B.	38 23	38 54	31	..	From W.N.W. to E.b.S. rapidly across zenith.	− 9	East by North, fresh, hazy.
Dec. 1	12 10 P.M.	B.	38 16	38 20	4	..	Beams darting first to the zenith, from a band extending from N. W. to E. b. N. and then back again.	+ 2·5	Calm, clear.
				38 18	..	2			
2	1 A.M.	F.	.. ..	38 25	7	..	Aurora stationary.	+ 1	Ditto.
The Needle was suspended to the middle of this month, and afterwards on the pivot. ..	between 10h & 10h 20′ P.M.	B.	38 05	37 48	..	17	A beam shot from N.N.E.		
..	..	..	.. ..	38 00	12	..	Aurora stationary.	+17·5	Calm, very gloomy weather.
..	..	..	.. ..	37 55	..	5	Another beam shot from N.N.E.		
..	..	..	.. ..	37 52	..	3	Another beam from N.N.E.		
4	Midnight	F.	38 13	38 5	..	8	From N.N.W. to East.	+ 1·5	N.W. gale, gloomy weather.
6	11 P.M.	K.	38 19	38 18*	..	1	From E.S.E. to N.N.W.	− 9.	Calm, clear.
12	9 P.M.	K.	38 58	39 8	10	..	From E.N.E. to N.b.W.	− 7·3	East, light, cloudy.

* This Table has been confined to the notice of those coruscations only when the motion of the Aurora was perceptible.

TABLE II.—*continued.*

	Month. 1825.	Hour.	Observer.	Previous Reading North end of Needle.	New Reading North end of Needle.	Deflection of the Needle to the East.	Deflection of the Needle to the West.	Direction of the Motion of Aurora.	Temp. of Observatory.	Wind and Weather.
				° ′	° ′	° ′	° ′		° ′	
Needle on Pivot.	Dec. 17	9 P.M.	F.	N. 39 30 E.	N. 38 45 E.	..	45	From North. These deflections were made in a few seconds.	−19·5	N.N.W., moderate, clear.
	..	..	..	.. ..	38 52	7				
	..	..	..	.. ..	38 48	..	4			
	..	10 P.M.	B.	38 30	38 32	2	..	Mass of light from East.	−19·0	Ditto, ditto, ditto.
	23	Midnight	F.	38 42	38 38	..	4	Flash from N.W. to zenith, then disappeared.	−38·5	West, moderate, clear.
	..	..	..	.. ..	38 41	3	..			
	1826 Jan. 4	11 40 P.M.	B.	38 20	38 20	None	None	Rapid motion from East to West, across zenith.	−24·5	Calm, hazy.
	8	Midnight	R.	38 27	38 36	11		From zenith to north horizon.	−29.0	N.W., light, clear.
	..	..	..	.. ..	38	..				
	29	between 12h & 12h 10′ P.M.	F.	38 50	38 59	9	..	Motion rapid, alternately from East and West points.	−25·0	East, clear.
					49		10			
	Feb. 3	1 A.M.	F.	38 55	37 52	..	1 03	A beam darted across zenith from South to North.	−22·5	Calm, very hazy.
	..	Midnight	B.	38 39	37 26	..	1 13	A beam shot from N.W. to S.E. across zenith.	−22·	N.W., fresh, very gloomy weather.
	8	11¼ P.M.	K.	38 40	38 48	8	..	Motion from E.N.E. to N.W.	−31·0	N.E., moderate, clear.
	..	Midnight	F.	.. ..	38 42	..	6	Motion from S.E.	−32·2	Ditto, ditto.
	9	10 P.M.	B.	38 37	38 35	..	2	Motion rapid, from S.W.	−22·2	Nearly calm, clear.
	..	..	..	.. ..	30	..	5			
	10	11 P.M.	K.	38 44	38 58	14	..	From E.N.E. to N.N.W.	−20	N.W., fresh, hazy.
	11	10 P.M.	B.	38 45	38 35	..	10	Beams darting to the South from zenith.	−29·7	Nearly calm, clear.
	..	11¼ P.M.	K.	.. ..	37 15	..	1 20	Very rapid, from N.W. to N.E. prismatic colours.	−30·	Ditto, ditto.
	..	Midnight	F.	.. ..	38 45	1 30	..	No motion, Needle stationary.	−29·8	Ditto, ditto.
	19	10 P.M.	B.	38 38	38 31					
	..	..	..	.. ..	25	..	13	Motion rapid, from N.W. to E.b.S. Prismatic colours.	−22	Calm, cloudy.
	March 2	Midnight	F.	38 40	38 30	..	10	From N.W. to S.E.	−17·5	N.W., moderate, very clear.
	3	11 P.M.	K.	38 39	38 41	2	..	From E.S.E.	..	Ditto, ditto.
	..	Midnight	F.	.. ..	38 48*	7	..	From N.W. in lower part of a much diffused Aurora.	−28·5	Ditto, ditto,
	7	8 P.M.	K.	38 38	38 27	..	11	From N.W.b.N.	+20	N.W., strong, clear.
	..	9 P.M.	F.	.. ..	38 29*	2	..	From N.W.b.N.	+17·6	Ditto, ditto
	..	11 P.M.	K.	.. ..	38 18	..	11	From North to S.E. behind clouds	+17·8	N.W., gale, hazy.
	..	Midnight	F.	.. ..	38 29	11		Very little Aurora, Needle stationary.	+16.8	Ditto, ditto.
	8	11 P.M.	K.	38 40	38 35	..	5	Motion from the extremes of a band N.W. and E.S.E. meeting in the centre.	−14	Calm, clear.

TABLE II.—*continued.*

Month. 1826.	Hour.	Observer.	Previous Reading North end of Needle.	New Reading North end of Needle.	Deflection of the Needle to the East.	Deflection of the Needle to the West.	Direction of the Motion of Aurora.	Temp. of Observatory.	Wind and Weather.
			° ′	° ′	° ′	° ′		° ′	
March 8	Midnight	F.	N38 40 E.	N.38 36 E.	..				
..	..	..	.. ..	32	..	4	Rapid motion from N.W.	−14·2	Calm, clear, hazy near Aurora.
..	..	..	.. ..	38	6	..	From E.N.E.		
9	11 P.M.	K.	39 01	39 14	13	..	From E.b.S. to zenith.	+ 1·5	Calm, gloomy.
10	11⅓ P.M.	K.	38 40	38 47	7	..	From S.E. across zenith.	−10·5	N.W., strong, clear.
..	Midnight	F.	.. ..	38 35	..	12	Beam darted from S.S.E. across zenith.	−11·	N.W., gale, hazy.
..	..	..	.. ..	37	2	..	Aurora disappeared.		
11	7 P.M.	B.	38 35	38 43	8	..	Bright flash from E.b.S.	−21·5	Calm, clear.
..	..	..	.. ..	38 40	..	3	Disappeared.		
..	11 P.M.	K.	.. ..	38 43	3	..	Aurora stationary.		
..	Midnight	F.	.. ..	39 15	32	..	Rapid motion from E.b.S. to N.W.	−34·0	Calm, clear.
13	11¼ P.M.	K.	38 39	38 46	7	..	Motion from E.S.E.	−32·8	Nearly calm, clear.
..	Midnight	F.	.. ..	38 40	..	6	Aurora diffused over the sky, without motion.	−34·5	Ditto, ditto.
14	Midnight	R. B.	38 34	38 30	..	9	Mass of rays shot towards zenith from S.E.	−21·5	Calm, clear.
..	..	..	.. ..	38 25					
15	4 A.M.	F.	.. ..	39 15	50	..	Motion very rapid, from E.S.E.		
..	11 P.M.	K.	38 41	38 49	8	..	Motion from East.	−19·5	Calm, clear.
..	Midnight	F.	.. ..	38 44					
..	..	..	.. ..	38 42	..	7	From N.W. faint.	−21·2	Ditto.
26	11 P.M.	K.	38 44	38 45	1	..	Aurora much diffused, motion from N.W.		
..	Midnight	F.	.. ..	38 43	..	2	Motion from North.	−5·5	Very clear.
28	11 P.M.	K.	38 48	38 53	5	..	Motion from E.b.S.	+5·8	East, gloomy.
..	Midnight	F.	.. ..	38 48	..	5	Aurora spread over the sky. No motion.	+6·0	Gloomy, small snow.
29	11¼ P.M.	K.	39 30	39 20	..	10	Motion from S.E.	−3·5	Calm, clear.
	h.								
April 3	11 50 P.M.	B.	39 8	39 42	34	..	Motion rapid, from E.b.S. across zenith.	−1·	Calm, very hazy.
6	10 P.M.	B.	39 10	39 2	..	8	Motion from N.W.	−15·5	N.W., clear.
..	Midnight	F.	.. ..	39 2	None	None	Aurora spread over the sky, without motion.	−17·8	N.W., moderate, clear.
13	11 P.M.	F.	38 57	38 54	..	3	Motion rapid, from N.W.b.N. across zenith.	+10·5	S.E., moderate, clear.
..	..	..	.. ..	49	..	5			
..	Midnight	F.	.. ..	38 58	9	..	Motion rapid from E.b.S.	+10·8	Ditto.
23	11 P.M.	F.	38 55	39 00	5	..	Motion rapid, from East.	+27·1	East by North, moderate, very clear.

Needle on Pivot.

Needle on Pivot.

TABLE II—*continued.*

	Month. 1826.	Hour,	Observer.	Previous Reading North end of Needle.	New Reading North end of Needle.	Deflection of the Needle to the East.	Deflection of the Needle to the West.	Direction of the Motion of Aurora.	Temp. of Observatory.	Wind and Weather.
Needle suspended between opposing Magnets.	Oct. 4	Midnight	F.	N 39° 15′ E	N 37° 30′ E	..	1° 45′	Motion very rapid, from N.N.E. to S.E.	+31	Calm, clear.
	13	Midnight	F.	40 05	37 35	..	2 30	Aurora gleaming through dense clouds, N.N.E.	+26.5	S.E., moderate, very hazy.
	19	between 12h & 12h 5′ P.M.	F.	39 45	38 15*		1 30	In quick motion, from W.N.W. to S.E.		
	..	..	F.	.. ..	39 35	1 20		Motion rapid at S.W.	+14	N.W. light, cloudy.
	..	..	F.	.. ..	36 15		3 20	Coruscation having arrived at S.E. point vanished.		
	30	9 P.M.	F.	39 15	39 15	None	None	Aurora very bright, without motion.	+ 6.5	Calm, very clear.
Needle suspended without the opposing Magnets.	Nov 1	10 P.M.	B.	39 45	40 11	26	..	Motion from East.	—1	Calm, clear.
	..	Midnight	F.	.. ..	39 48	..	23	Bright across zenith, motion from N.W.	— 3.5	N.W., light, clear.
	4	Midnight	F.	39 42	40 15	23	..	From East to N.W. rapid, light very brilliant.	—14.5	Calm, clear.
	10	Midnight	F.	39 40	39 05	..	35	From N.W. motion rapid.	—17	N.W., light, hazy.
	11	5 P.M.	K.	39 55	39 50	..	5	From North.	—15	W.N.W., clear.
	16	11 P.M.	K.	39 57	39 20	..	37	Aurora generally diffused, motion from North.	—9	East, clear.
	..	Midnight	F.	.. ..	39 17	..	3	Aurora ditto, motion slow from North.	— 6.5	East, clear.
	19	10 P.M.	B.	39 57	39 52	..	5	From N.W. little motion.	..	
	..	Midnight	F.	.. ..	39 49*	..	3	From N.E. ditto.	..	
	20	8 A.M.	F.	.. ..	41 36	1 47	..	Aurora had been very active during the night. Motion from N.E.	..	
	..	Midnight	F.	39 48	40 00*	12	..	Gleaming through dense clouds, N.b.E.	— 8.5	East, dark clouds.
	22	Midnight	F.	39 56	39 58	2	..	From E.S.E. little motion, though bright light.	— 2.5	W.N.W., light, very clear.
	24	11 P.M.	K.	39 47	39 43*	..	4	Generally diffused, little motion from E.S.E.	+ 2.2	
	..	Midnight	F.	.. ..	39 40	..	3	From S.E. active.	— 2.	Nearly calm, very clear.
	Dec. 4	11 P.M.	K.	40 00	39 32	..	28	From N.W. active.	— 3.2	N.W., hazy.
	19	11 P.M.	K.	39 57	39 58	1	..	Rays shot from zenith to E.b.N.	—17.3	
Needle suspended without Magnets.	22	12h 0′ to 12h 3′ P.M.	F.	39 55	39 52	..	..			
	..	..	..	.. ..	40 06	14	..	Motion rapid, from West to the South.	—25.3	W. by S., moderate, cloudy, and hzay.
	..	..	..	.. ..	40 15	9	..			
	26	11 P.M.	K.	39 50	39 00	..	50	From N.N.W. rapid, gleaming through clouds.	— 4.0	N.W., very gloomy.
	..	Midnight	F.	. ..	38 55	..	5	From N.W. Aurora seen through clouds.	— 4.2	Ditto, ditto.
	1827. Jan. 3	Midnight	F.	39 58	39 33	..	25	Motion quick from N.N.W.	—33.5	N.W., light, clear.
Needle suspended without Magnets.	31	11 P.M.	K.	39 46	39 45	..	1	Motion rapid from the extremes of three arches, 20° 30° and 90° high at S.E. and N.W. points meeting in the centre.	—33	N.W., light, clear.
	..	Midnight	F.	.. ..	39 05	..	40	Motion rapid from N.W. Aurora generally diffused.	—35	Ditto, ditto, ditto.

TABLE II.—*continued.*

Month. 1827.	Hour.	Observer.	Previous Reading North end of Needle.	New Reading North end of Needle.	Deflection of the Needle to the East.	Deflection of the Needle to the West.	Direction of the Motion of the Aurora.	Temp. of Observatory.	Wind and Weather.
			° ′	° ′	°	° ′		°	
Feb. 3	8 P.M.	K.	N. 39 22 E.	N. 39 20 E.	..	2	Alternate motion, from S.E. and N.W. meeting in the centre.	−31.5	W.N.W., moderate, clear.
..	10 P.M.	B.	.. ..	39 15	..	5	Active from N.N.W.	−28.5	Ditto.
..	11 P.M.	K.	.. ..	39 18*	3	..	From N.W.	..	
..	Midnight	F.	.. ..	39 13	..	5	Generally diffused.	−31.5	Ditto.
4	11 P.M.	K.	39 16	39 18	2	..	Rapid motion from zenith to North horizon.	−36.	East, light, clear.
..	Midnight	F.	.. ..	39 16	..	2	Motion from W.N.W.	−36.7	Ditto.
6	Midnight	F.	38 50	38 48	..	2	From N.W.	−42.2	N.W., light, clear.
7	Midnight	F.	38 45	38 40	..	5	From S.E.	−42.5	W.N.W., light, clear.
23	10 P.M.	B.	38 15	38 13	..	2	From N.W.b.N.	−31.5	N.W., very clear.
25	Midnight	K.	38 15	38 15	None	None	From S.E.	−15.	East, strong, clear.

Needle on Pivot.

It is evident from the preceding Tables, that the Deflections of the Needle caused by the Aurora, were greater when it was suspended than when it rested on the pivot; and greatest when suspended between opposing magnets, as in the month of October, 1826.

ERRATA.

Page.	Line.	
13	9	*for* conflagations, *read* conflagrations.
19		*for* 91, *read* 19.
44	2	from the bottom, *for* aspin, *read* aspen.
72	5	from the bottom, *for* parhelia, *r.* parheliæ.
85	7	*for* Tuesday, *read* Thursday.
102	20	*for* immovable, *read* immoveable.
196	3	*for* object smore, *read* objects more.
225	6	*for* Kayack, *read* Kaiyack.
,,	23	*for* Kayacks, *read* Kaiyacks.
242	14	*for* Godwin, *read* Goodwin.
267.		Heading of the Chapter, line 4, *for* Boileau, *read* Beaulieu.
278	12	*for* Boileau, *read* Beaulieu
279	8	do. do. do. do.
,,	26	do. do. do. do.
280	20	do. do. do. do.
296	25	*for* parahelion *read* parhelion.
307	8	*for* no, *read* on.

IN THE PLATES.

No. 21, facing p. 193, *for* drawn by Captain Back, *read* by Lieut. E. N. Kendall.

No. 27, facing p. 256, *for* drawn by Captain Back, *read* by Lieutenant E. N. Kendall; and *for* Richar's, *read* Richard's Island.