TABLE XIII.—TERRESTRIAL

DATE.	Time of Day.	Barometer.	Thermometer in Shade.	Height above the Sea.	Observed Elevation or Depression of the Horizon.	Tabular Dip.	Tabular Dip in	SITUATION.
1822.	H.		°		′ ″	′ ″	′ ″	
April 1	1 P.M.	29.05	− 3	..	Depr. 19 52	. .	Defᵗ. 16 18	At the Observatory, Winter Island.
„ „	„ „	. . .	. .	..	„ 21 12	. .	„ 17 38	„
„ „	„ „	. . .	. .	..	„ . . .	. .	„ . . .	„
„ „	5 „	29.07	− 6	..	„ 16 24	. .	„ 12 50	„
„ „	„ „	. . .	. .	..	„ 15 34	. .	„ 12 0	„
„ 9	2½ „	29.68	+ 8	14	„ 1 21	3 34	Exce^ss 2 13	„
„ „	„ „	. . .	. .	..	„ 0 1	. .	„ 3 33	„
„ „	„ „	. . .	. .	..	„ . . .	. .	„ . . .	„
„ 16	9¾ A.M.	29 64	+24	80	„ 8 34	8 32	Defᵗ. 0 2	From a hill on Winter Island.
„ „	0¼ P.M	29.62	+26	..	„ 7 52	. .	Exce^ss 0 40	„
„ „	4 57′ „	29.58	+22	..	„ 7 37	. .	„ 0 55	„
„ 17	10 A.M.	29.51	+13	..	„ 7 59	. .	„ 0 33	„
„ „	1 P.M.	29.58	+24	..	„ 12 49	. .	Defᵗ. 4 17	„
„ 18	9¼ A.M.	29.69	+20	..	„ 7 18	. .	Exce^ss 1 14	„
„ „	1 P.M.	29.72	+23	..	„ 15 15	. .	Defᵗ. 6 43	„
„ „	5½ „	29.76	+27	..	„ 7 46	. .	Exce^ss 0 46	„
„ 19	9¾ A.M.	29.67	+17	..	„ 9 13	. .	Defᵗ. 0 41	„
„ „	1 P.M.	29.73	+33½	..	„ 6 27	. .	Exce^ss 0 5	„

REFRACTIONS—*continued.*

REMARKS, &c.

Lieutenant Palmer over sea horizon, compared with my own, with artificial horizon, three observations.

My own observations over sea horizon, compared with Lieut. Palmer's, with artificial horizon, do.

A white vapour over the horizon which was tolerably defined, no water in sight, the sun bright, and weather clear and fine

Altitudes by Lieut. Palmer over the sea horizon, compared with my own, with the artificial horizon

Ditto Ditto Ditto

A considerable quantity of open water seen, but none between the horizon (which was a well-defined line of ice,) and place of observation. Weather, moderate and cloudy, light breezes from S W

By a comparison of the observations of Lieut Palmer, with those made with the artificial horizon, by myself

Ditto. With artificial horizon, and my own over the sea

The horizon jagged with ice, ⊙ bright and clear, no haze on the horizon nor water in sight Thermometer in ⊙ + 8°

By a mean of five altitudes of the ⊙'s lower limb over the ice horizon, and compared with the computed. Fine calm morning, horizon distinct and well-defined, very little water in sight

White flying clouds with fresh breeze from W and fine weather, much open water between the horizon and place of observation Thermometer in ⊙ + 34°

In the same way as the above, horizon rather hazy but well-defined, no open water, the land appeared much refracted, although these observations agree with the tables nearly

In the same way as the above, much haze upon the horizon, but tolerably distinct, no water in sight Thermometer in ⊙ + 34°.

In the same way; much water in sight, particularly under ⊙.

Ditto. Cloudy weather, and some haze upon the horizon, and a little open water, but none under ⊙.

A considerable quantity of water in the direction of the ⊙ Hazy, thick, cloudy weather

Fine clear weather, and a little open water in sight

Cloudy with small light snow at times, some open water, but none under ⊙

Warm fine day, thermometer + 65° in ⊙; cloudy at times. Distant land appeared much distorted by refraction, although the observed dip agrees nearly with the tables. A little water under ⊙

TABLE XIII.—TERRESTRIAL

DATE.	Time of Day.	Barometer.	Thermometer in Shade.	Height above the Sea.	Observed Elevation or Depression of the Horizon.	Tabular Dip.	Tabular Dip in	SITUATION.
1822.	H.		°	Feet.	′ ″	′ ″	′ ″	
Apr. 19	5 P.M.	29.71	+12½	80	Depr. 6 13	8 32	Excs. 2 19	From a hill on Wint. Is.
May 10	10¼ A.M.	29.72	+33	..	,, 9 5	. .	Deft. 0 33	,, ,,
,, ,,	5 49′ P.M.	29.76	+39	..	,, 12 54	. .	,, 4 22	,, ,,
,, 13	10 A.M.	29.87	+27	..	,, 9 12	. .	,, 0 40	,, ,,
,, 14	9¾ ,,	29.81	+44	..	,, 9 28	. .	,, 0 56	,, ,,
,, ,,	5¾ P.M.	29.75	+36	..	,, 12 17	. .	,, 3 45	,, ,,
,, 22	10 A.M.	29.92	+40	22	,, 3 59.6	4 28	Excs. 0 28.4	Observy. Winter Island.
,, ,,	,, ,,	. . .	. .	..	,, 4 29	. .	Deft. 0 1	,, ,,
,, 31	9 ,,	29.84	+32	80	,, 9 37	8 32	,, 1 5	From the hill as before.
,, ,,	3 P.M.	29.94	+40	..	,, 6 0	. .	Excs. 2 32	,, ,,
June 3	3 ,,	29.82	+43	..	,, 8 21	. .	,, 0 11	,, ,,
,, 4	9 A.M.	29.70	+35	..	,, 8 43	. .	Deft. 0 12	,, ,,
,, ,,	9 22′ ,,	. . .	. .	..	,, 8 4	. .	Excs. 0 28	,, ,,
,, 6	3 P.M.	29.70	+40	..	,, 8 54	. .	Deft. 0 22	,, ,,
,, 7	9 A.M.	29.65	+45	..	,, 9 5	. .	,, 0 35	,, ,,
,, ,,	9 4′ ,,	. . .	. .	..	,, 9 26	. .	,, 0 54	,, ,,
,, 8	9 ,,	29.52	+27	..	,, 8 38	. .	,, 0 6	,, ,,
,, ,,	9 4′ ,,	. . .	. .	..	,, 8 26	. .	Excs. 0 6	,, ,,
,, ,,	3 P.M.	29.55	+32	..	,, 5 46	. .	,, 2 46	,, ,,
,, ,,	3½ ,,	. . .	. .	..	,, 6 0	. .	,, 2 32	,, ,,
,, 9	9 A.M.	29.60	+26	..	,, 10 22	. .	Deft. 1 50	,, ,,
,, ,,	10 ,,	. . .	. .	17½	,, 2 38	4 0	Excs. 1 22	From the Hecla's deck.
,, ,,	Noon.	29.63	+29	..	,, 3 19	. .	,, 0 41	,, ,,
,, ,,	3 P.M.	. . .	+32	80	,, 6 45	8 32	,, 1 47	From the hill.

REFRACTIONS—*continued.*

REMARKS, &c.
Cloudy weather; a little open water under ⊙.
A little open water, horizon distinct and well-defined.
Ditto, but none under ⊙
No open water, clear weather and horizon well-defined. Thermometer exposed to ⊙ + 50°
Hazy weather; a light fog bank upon the horizon. No open water.
Fine clear weather, a white fog upon the horizon. Ditto
Cloudy weather; horizon well-defined, a little open water. Observations made on the N. W. part of the horizon
Ditto. Observation made on the N.E. part of horizon. The above two observations were taken with the repeating circle
Fine clear weather. Light breezes from W.
Ditto. Ditto.
Much open water. Light breezes from S.W. and hazy
Ditto. Moderate breezes from N. and cloudy.
Ditto. Ditto.
A little open water. Fine clear weather; light winds from N.W., and cloudy
Ditto. Light breezes from N., and clear weather.
Ditto. Ditto.
Much open water. Moderate breezes from N.W. and cloudy
Ditto. Ditto.
Ditto. Cloudy weather. Fresh breezes from W.
Ditto. Ditto. Ditto.
Ditto. Fine clear weather; fresh breezes from N.
Much open water; but an ice horizon under ⊙. Fresh breezes from N. and fine.
Ditto. Ditto. Moderate breezes from N. and cloudy.
Ditto. Ditto. Ditto.

TABLE XIII.—TERRESTRIAL

DATE.	Time of Day.	Barometer.	Thermometer in Shade.	Height above the Sea.	Observed Elevation or Depression of the Horizon.	Tabular Dip.	Tabular Dip in	SITUATION.
1822.	H.		°		' "	' "	' "	
June 9	3½ P.M.	29 63	+32	17½	Depres. 2 29	4 0	Excess 1 31	From the Hecla's deck.
,, 10	9 A.M.	29 95	+29	80	,, 8 51	8 32	Defect 0 19	From the hill.
,, ,,	10 ,,	. .	.	17½	,, 4 0	4 0	,, 0 0	From the Hecla.
,, ,,	Noon.	30 00	+34	. .	,, 2 20	. .	Excess 1 40	,, ,,
,, 11	9 A.M.	29 84	+32	80	,, 7 16	8 32	,, 1 16	From the hill.
,, ,,	10 ,,	29 81	+36	17½	,, 3 9	4 0	,, 0 51	From the Hecla.
,, ,,	Noon.	29 80	+41	.	,, 2 29	. .	,, 1 31	,, ,,
,, ,,	3 P.M.	29 70	+40	.	,, 1 34		,, 2 26	,, ,,
,, 12	9 A.M.	29 62	+33	80	,, 7 9	8 32	,, 1 23	From the hill.
,, ,,	9¼ ,,		+32	17½	,, 3 43	4 0	,, 0 17	From the Hecla.
,, ,,	Noon.	29 64	+33	. .	,, 2 53		,, 1 7	,, ,,
,, ,,	3 P.M.	29 70	+30	. .	,, 2 32	. .	,, 1 28	,, ,,
,, 13	10 A.M.	29 95	+36	. .	,, 2 10		,, 1 50	,, ,,
,, ,,	Noon.	30 00	+37	. .	,, 3 7	. .	,, 0 53	,, ,,
,, ,,	3 P.M.	.	+38	. .	,, 4 8	.	Defect 0 8	From the Hecla's deck.
,, ,,	3⅛ ,,	. .			,, 4 11	.	,, 0 11	,, ,,
,, 14	10 A.M.	29 92	+40	.	,, 3 26	.	Excess 0 34	,, ,,
,, ,,	3 P.M.	29 90	+34		,, 2 24	.	,, 1 36	,, ,,
,, 22	Noon.	29 80	39	. .	,, 2 48	. .	,, 1 12	,, ,,

REFRACTIONS—*continued.*

REMARKS, &c.
A little open water; but an ice horizon under ☉ Moderate breezes from N. and cloudy.
Ditto. Ditto. Moderate breezes from N.W. and clear weather.
Much water, very little ice upon the horizon. Moderate and cloudy.
Very little water; cloudy weather.
Much open water; some loose ice upon the horizon. Moderate breezes from N.W. and cloudy.
Ditto. Ditto
Very little water; an ice horizon. Cloudy weather.
No open water. Ditto. Ditto.
Much open water, but an ice horizon. Light breezes from W and cloudy
Ditto. Loose ice upon the horizon. Hazy weather.
Much open water, but an ice horizon. Fresh breezes and cloudy
Ditto. Ditto. Hazy weather.
Ditto. Ditto. Fine clear weather, and horizon well-defined
Ditto. Ditto. Ditto.
Much open water; loose ice upon horizon. Fine clear weather, and moderate breeze from N.W
Ditto. Ditto Ditto.
Ditto. Ditto. Ditto
Much open water; horizon ill-defined from loose pieces of ice. Hazy weather, light breeze from S.W
No open water in sight, an ice horizon. Hazy weather, and fresh breeze from E.N.E.

TABLE

Containing OBSERVATIONS for DETERMINING the

DATE	Zenith Distance.	Observed Refraction of Object	Observed Refraction in terms of the contained Arc	Barometer.	Thermometer in Shade.	No. of Degrees fallen through in Leslie's Hygrometer, by moistening the Bulb with Alcohol.
1823.	° ′ ″	′ ″			°	
April 9 A.M.	89 35 18.3	1 16.5	$\frac{1}{2.65}$	30 28	0	10½
„ „ P.M.	00 36 10 8	0 24.0	$\frac{1}{6.45}$	30 20	+ 7	17½
„ 11 A.M.	00 35 38 5	0 56 3	$\frac{1}{3.61}$	30 16	− 3	14¼
„ „ P.M	00 36 8 2	0 26.6	$\frac{1}{7.64}$	30 15	0	21½
„ 12 A M.	00 36 27.8	0 7 0	$\frac{1}{20}$	30 17	+ 3	14¾
„ „ P.M.	00 36 24.4	0 10 4	$\frac{1}{19.5}$	30 27	0	18¼
„ 14 A.M.	00 35 42.0	0 52.8	$\frac{1}{3.84}$	30 30	−14	11
„ „ P M.	00 36 29.4	0 5.4	$\frac{1}{37.6}$	30 16	− 3	17½
„ 21 A M.	00 35 47.3	0 47 5	$\frac{1}{4.27}$	29 89	− 5	15
„ „ P.M.	00 36 3 5	0 31.3	$\frac{1}{6.48}$	30 00	+ 5	24¾
„ 22 A.M.	00 34 58.7	1 36 1	$\frac{1}{2.11}$	30 18	+ 4	16
„ „ P.M.	00 36 17.8	0 17.0	$\frac{1}{11.0}$	30 20	+ 7	27½
„ 23 A.M.	00 36 35.0	0 00	0	30 13	+ 6	14¼
„ „ P.M.	00 36 21.2	0 13.6	$\frac{1}{14.9}$	30 08	+13	26
„ 24 A.M.	00 36 15.5	0 19.3	$\frac{1}{10.52}$	29 92	+ 1½	12
„ „ P.M.	00 36 13.9	0 20.9	$\frac{1}{9.7}$	29 89	+ 8	19½
„ 25 A.M.	00 36 27.0	0 7.8	$\frac{1}{26}$	29 92	+ 8	15¾
„ „ P.M.	. . . .	. .	. .	29 89	+ 8	25
July 29 A.M.	00 36 10.4	0 24.1	$\frac{1}{8.39}$	29 60	+47	.
„ „ P.M.	00 36 11.4	0 23.4	$\frac{1}{8.67}$	29 60	+47	. .

XIV.

TERRESTRIAL REFRACTION with the REPEATING CIRCLE

REMARKS
Fine weather, very light breeze from S.W., and rather cloudy
Moderate and cloudy evening, light breeze from S.W
Moderate and cloudy, light breeze from W. Halo round the sun.
Cloudy and overcast; very light breeze from S.E.
Moderate breeze from N.W., and cloudy weather.
Fresh breeze from N b.W., and cloudy weather.
Light breeze from W., and clear weather.
Light breeze from S.W., and clear weather
Ditto. N.W., Ditto
Ditto. N., Ditto.
Calm, and fine weather, distant land appeared much distorted by refraction, therm in sun + 40°
Very light breeze from N.W., and clear weather, thermometer exposed to sun + 33°
Moderate breeze from N., thick foggy weather with small snow occasionally
Ditto. Rather clearer than in the morning
Fresh breeze from N.b.W. and clear weather, thermometer + 20° exposed to the sun
Ditto. Brilliant halo and mock suns
Fresh breeze from N.W., with snow, thick cloudy weather
Fresh breeze from N.W., and clear weather.
Clear weather; light breeze from N.
Ditto. Ditto.

ABSTRACT

OF

EXPERIMENTS TO DETERMINE THE VELOCITY OF SOUND, AT LOW TEMPERATURE.

THESE Experiments were made by observing the number of beats made by three pocket chronometers by Arnold, during the interval between the report and the flash of a six-pounder. For this purpose, base lines were determined by several actual measurements upon the Frozen Sea, at both the Winter Stations. The gun had an elevation of about 10°, and was directed towards the observers, which were Captain Parry, Lieutenant Nias, and myself; and the observations denoted by the letters P, N, and F.

The Experiments	marked	*(a)*	were made	with a	chronometer making	8	beats	in	3	seconds.
"	"	*(b)*	"	"	"	5	"		2	"
"	"	*(c)*	"	"	"	8	"		3	"

The following Tables present the whole of the Results.

DATE.	Bar.	Therm. Fhrt.	Winds.	Weather.	Length of Base in Feet.	No. of Experiments.	P. No. of Beats.	N. No of Beats	P. No. of Beats.	Velocity per second in feet.	REMARKS
1821. Dec. 29	30.17	−27½°	W.N.W.	Moderate & clear.	2880	2	(a) 8.5		(a) 7.5	960	Wind against the sound.
„ 30	30.16	−30	N.W.b.N.	„ „	2880	7	(a) 7.536		(a) 7.714	1007.2	„
1822. Jan. 9	29.93	−25½	N.	Light „	5632	5	(a) 14.9		(a) 14.65	1016.5	„
Feb. 9	28.96	−25	N.W.	„ „	5645	15	(a) 14.817		(a) 14 9	1013.5	„
„ 27	29.83	−34	W.N.W.	Fresh breeze „	5645	10	(a) 15.8		(a) 15.795	952.9	„
May 20	29.97	+11	N.	Light „ clear	5848	7	(a) 13,821		(a) 13.571	1040.3	Wind four points against the sound.
„ 22	29.86	+28	S.S.W.	„ cloudy	5843	8	(a) 13.344		(a) 13.406	1065.8	Wind with the sound.
1823. Jan. 4	29.80	−43	N.W.	„ clear	8466	2	(a) 21.75		(a) 21.1	1053.1	In the following experiments the gun was to the W. of the observers.
„ 8	29.76	−22	N.N.W.	„ cloudy	..	7	(a) 21.757	(a) 21 95		1033.1	„
„ 11	29.99	−19	S.	„ clear	..	7	(a) 21.429	(b) 21.214	(a) 21.786	1028.6	„
„ 18	29.80	− 5	S.	„ cloudy	..	7	(a) 21.536	(b) 21.071	(a) 21·607	1032.1	„
„ 20	29.81	−22	N.W.	„ clear	.	7	(a) 21.679	(b) 20.786	(a) 21.786	1031.9	„
„ 23	30.21	−34	N.W.	„ „	.	3	(a) 22.063	(b) 21.250	(a) 22.019	1014.7	„
Feb. 13	29.85	−15	W.S.W.	Fresh cloudy	..	7	(a) 21.321	(a) 21.643		1050.9	„
„ 16	29.88	−45	N.W.	Moderate clear		7	(a) 22.414	(b) 21.929	(a) 22.917	985.5	„
„ 21	29.83	−34	N N.W.	„ „	.	7	(a) 22.179	(b) 21 286	(a) 22.179	1009.9	„
June 17	29.90	+33	N·N.W.	„ cloudy	..	7	(a) 20.75		(b) 19.54	1085.6	„
„ 18	29.91	+39	E.b.N.	Fresh, with snow	..	5	(a) 21.18		(b) 20.125	1058.8	„

The

The following are the results of the foregoing observations, arranged according to their temperatures, and also upon the supposition that the accuracy of each day's observations, is in the joint ratio of the number of guns fired, and the number of observers.

Thermr. Fahr.	Mean Velocity per Second.
– 41°.3	985.9 feet.
– 33.3	1011.2 "
– 27.2	1009.2 "
– 21.0	1031.0 "
– 2.0	1039.8 "
+ 33.3	1069.9 "

By comparing the observations made at the temperature of – 41°.3, with those at + 33°.3, it appears that, between these limits, the velocity of sound per second diminishes, as the temperature of the atmosphere diminishes, at the rate of 1.126 foot, for each degree of temperature. From experiments made by Mr. Goldingham at Madras, during the summer months, it appears that at + 87° Fahrenheit, the velocity per second 1158.7 feet, by comparing this result with the observations at – 41.3, the velocity is diminished at the rate of 1.35 foot, for each degree of temperature, supposing the change of velocity proportional to the change in the temperature.

The Experiments on the 9th February, 1822, were attended with a singular circumstance, which was—the officers' word of command "fire," was several times distinctly heard both by Captain Parry and myself, about one beat of the chronometer *after* the report of the gun; from which it would appear. that the velocity of sound depended in some measure upon its intensity. The word "fire" was never heard during any of the other experiments; upon this occasion the night was calm and clear, the thermometer 25° below zero, the barometer 28.84 inches, which was lower than it had ever been observed before at Winter Island. Upon comparing the intervals between the flash and report of a musket with the gun, upon other occasions, there appears to be *no* assignable difference.

ON THE ANALYSIS OF THE ATMOSPHERIC AIR FROM THE POLAR REGIONS.

The air, the subject of these experiments, was collected in two glass bottles closed by caps, cemented in the usual way, with brass stop-cocks; it was analyzed by Mr. Faraday of the Royal Institution, and the following are his results:

100 of air from one bottle gave, by Doberiener's Eudiometrical process	20.364 of oxygen
Another experiment with the same air, gave	20 42 per cent of oxygen
At the same time, 100 of air from the atmosphere of the Laboratory, by the same process, gave	22.045 of oxygen
Again 100 of air from the other bottle, gave	20.72
By another experiment	20.85
At the same time 100 of air from the Laboratory gave	21.88

The following is a copy of the letter accompanying the foregoing analysis.

Royal Institution, 13th February, 1824.

Dear Sir,—I send you an account of the air which you gave me for examination. There is a decided and constant difference between it and the air of this place, which difference cannot depend on errors in the experiments. Perhaps you will be able to recollect the circumstances under which you collected it. If the mode by which it was obtained and preserved until it reached this place be unexceptionable, then the difference between the Polar Air and that of this climate will be established, at least to my satisfaction.—I am, Dear Sir, Your's very truly,

To Rev. George Fisher. (Signed) M. Faraday.

I have merely to state, in reference to this letter, that the circumstances attending the collecting of the air were simply as follows: the bottles in which it was preserved had been open the whole of the winter on shore, at the observatory at Igloolik, at the last winter's station, and were closed in the spring; they were then packed up in oakum by myself, in a chest, which was opened by Mr. Jones and myself in his shop at Charing-Cross, and by him sent immediately to Mr. Faraday for examination. There had not been a fire in the place in which the bottles were kept for a considerable time before they were closed; so that I conceive the air was collected in as unexceptionable a way as could be.

It appears from a mean of the experiments, that the air in the bottles contained 20.5885 per cent. of oxygen, and the atmosphere in Laboratory of Royal Institution at the same time, 21.9625 per cent., which exceeds therefore the quantity of oxygen contained in the air of the Polar Regions, by 1.374 per cent.

ON THE EFFECT OF COLD UPON THE GASES AND DIFFERENT SUBSTANCES.

THE gases experimented upon, were confined in long cylindrical vessels of thin glass, hermetically sealed. Other specimens of the gases were also sent out in large glass spheres, and condensed by pressure, to render the circumstances of the experiments, when combined with very low temperatures, more *favourable; some of these spheres were provided with stop-cocks of brass*, and the others of glass, which circumstances are mentioned in the experiments; and to prevent mistakes, all the vessels had the names of the gases they contained, engraved upon them with a diamond. The results here given, are those occasioned by simple exposure to the atmosphere (unless stated.) The vessels before exposure, were wiped perfectly clean and dry upon the outside, and the spots and blemishes in the glass, or any particular appearance within (if any,) were carefully written down; so that no effect upon the gases should be registered, but what was due to the change of temperature. It may be observed here, that a minute crystallization appeared in every one of the vessels upon the exposure to low temperatures; which may, in some, have been occasioned by some previous humidity in the vessels, although every precaution was taken in filling them in England to prevent it. However this may be, I have given the appearances and circumstances connected with them as well as I was able, so as to enable others to form their own judgment.

SULPHUROUS ACID GAS,

UPON exposure to – 26° Fahrenheit, is condensed into a perfectly white fluid; when exposed to – 40°, the condensation is increased, and the liquid runs in streams down the sides of the vessel. Two or three drops of a brilliant orange-coloured fluid was also formed, together with a minute scattered crystallization upon the upper part of the vessel.

NITROUS ACID GAS,

CONDENSED by pressure in a glass sphere, after exposure to – 26° Fahrenheit becomes colourless, and is formed into a brilliant yellow-coloured fluid at the bottom of the vessel, of the appearance and consistence of thick oil; at – 40°, part of this fluid was frozen, and formed into brilliant yellow crystals; much crystallization also forms upon the upper part of the vessel, without colour, which dissolves at – 20°. When the tubes containing this gas (in a gaseous state), are kept from the light at the temperature of – 46°, although the fluid is formed, yet it is not frozen until it is brought to the light.

Silicated Fluoric Gas

Was not affected by the greatest degree of artificial cold I could produce, by means of a mixture of alcohol and snow, combined with a natural temperature of 45° below zero. A few white depositions on the sides of the glass tubes took place during the voyage.

Carbonic Acid Gas

Was not rendered fluid when tried as above, but several detached spots of tree-shaped crystallization, upon different parts of the tubes, forms at very low temperatures, which is not the case at temperatures above zero.

Ammonia.

After three days exposure to – 26° Fahrenheit, the gas contained in the glass sphere, in which it had been condensed by pressure, was found to be in a fluid state on the upper part of the sphere, in small globules; but there was no liquid formation in the glass cylinder containing this gas, nor any appearance of crystallization in either. Upon exposing both of them to – 40°, the liquid formation in the sphere was much increased, and ran down the sides of the vessel upon moving it. There were also formed seven or eight spots of beautiful clear bluish-green drops of fluid, together with an irregular streak of crystallization upon the upper part of the vessel. In the cylinder was a slight appearance of moisture, like that caused by breathing, but no crystallization: this, therefore, appears to be the temperature nearly at which this gas assumes the liquid form, when not assisted by pressure.

Sul. Hydrogen.

Upon exposing this gas in the sphere to –45°, there was exhibited, at the bottom of it, a dark-coloured gaseous fluid, which disappeared immediately the finger was applied to the vessel. There was much crystallization upon the upper part of the vessel, which also disappeared upon bringing it into a temperature of about zero, without assuming a liquid shape. By exposing this gas to the cold during the winter, a great many black depositions took place upon every part of the vessels.

Olefiant Gas.

No difference of appearance in this gas, with the greatest degree of cold produced, excepting a very minute crystallization upon the upper part of the tubes.

Nitrous Oxide.

After three days' exposure to a temperature of 40 and 45° below zero, a long drop of fluid was formed upon the top of the sphere, colourless, of a thick viscid appearance. A minute crystallization also takes place of the appearance of flies' legs, and by rubbing the vessel with a silk handkerchief (of the same temperature), they move about with great rapidity from the electrical excitation produced by the friction: they disappeared at a temperature of about zero

Nitric Oxide.

After a considerable exposure to — 45°, no change took place, excepting a minute crystallization upon the top of the sphere There were some round bluish-green spots also upon the bottom of the vessel, but as the stop-cock was of brass, it probably might have arisen from some action upon the metal, as the same appearance was not exhibited in the cylindrical vessel containing this gas.

Fluoric Gas.

After exposing this gas three days in a temperature of — 26°, in a glass sphere, several white patches or depositions were formed in different parts of the vessel, and also one at the bottom of the sphere, of a dull greasy appearance, like a drop of melted tallow, which after three days' exposure to between 40 and 45° below zero, became clear and transparent, and a condensation in a liquid shape took place upon the top of the vessel like that caused by breathing, but not in quantity sufficient to run down the sides of the sphere. There was no appearance of any liquid formation, in the glass cylinder containing this gas, nor was there the least appearance of crystallization in either.

Oxygen.

No alteration appeared in the vessels containing this gas, though exposed to — 47° Fahrenheit, excepting a small patch of crystallization upon the upper part of each of them.

CHLORINE.

THIS gas, contained in the cylinder, became quite colourless when exposed to — 45° Fahrenheit, but no appearance of any liquid formation nor any crystallization. But in the sphere into which it was condensed by pressure, it was formed into a bright yellow liquid when exposed to — 26°, with a considerable quantity of crystallization upon the upper part of the vessel; on bringing it into an atmosphere at the temperature of — 20°, the yellow liquid assumed the gaseous state, and the crystallization remained; but upon applying the finger to the sphere, this rapidly diminished, and the crystals, during the time of their dissolution, were surrounded by rings of a clear colourless fluid, which also quickly disappeared. Upon exposing, however, the sphere afterwards to — 20°, it appears that the crystallization will not form at that temperature, but the gas becomes almost colourless.

MURIATIC GAS.

AFTER exposure to — 26°, a long drop of yellow was formed upon the top of the sphere into which this gas condensed by pressure. At — 40°, several large drops were formed upon the top of the tube. In the cylinder containing this gas, no liquid formation appeared at — 45°, nor any crystallization in either of the vessels.

EXPERIMENTS TO DETERMINE THE EXPANSION OF AIR, AT LOW TEMPERATURES.

For this purpose was used a glass cylinder of 1.7 inch in diameter, and 2.6 inches in length; into this was fitted a long tube or stem of ten inches in length, and nearly half an inch in diameter, graduated into 140 equal parts. The cylinder was also fitted with a ground-glass stopper, for the purpose of filling it readily. The relative capacity of the whole, and the several parts of the stem, *viz.*, every ten divisions, were determined by many trials, by weighing the contained quantities of water and mercury. By inserting the extremity of the stem into mercury, (the stopper being securely fitted,) and carried from a warm atmosphere into a cold one, the mercury rises in the stem, till the force of elasticity of the contained portion of air, together with the weight of the incumbent column of mercury within the stem, is equal to the pressure exerted by the atmosphere without. The vessel was fitted to a stand, so that the end of the stem could be immersed into a basin of mercury at pleasure When the whole, therefore, had acquired a steady temperature in a warm atmosphere, a delicate mercurial thermometer was introduced into the centre of the cylinder by means of the glass stopper, and the temperature of the air within determined; the stopper was then slowly fitted in, so as to cause no depression of the mercury in the stem below the surface of that without. In this state, the height of the surface of the mercury was carefully read off upon the stem, and then gently taken into the cold; and after it had been exposed long enough to acquire the temperature of the atmosphere, the height to which the mercury in the stem had risen was also read off. By knowing the capacities to the corresponding parts of the vessel, the ratio of the densities of the contained portion of air, before and after exposure, is known. As the air within the cylinder is under a pressure equivalent to the height of the mercury in the barometer, *minus* the height in the stem, above the surface of the mercury without; to reduce therefore the density thus determined, to what it would be under the atmospheric pressure at the same temperature, we must increase it in the ratio of the compressing forces. Or if A and α be the spaces occupied by the air, before and after exposure, β the height of the mercury in the stem above the level of that without, B the height of the barometer at the time, and d the density of the air required under the pressure, B, then the bulk before exposure, being equal to unity;

$$\text{then } d = \frac{A\ B}{\alpha\ \{B - \beta\}}.$$

As all the experiments made with this apparatus are nearly at the same temperatures, it will be sufficient to take the mean between the observed heights of the mercury within the stem, and also the corresponding temperatures, and compute it as one result. By a mean of fifteen different trials upon different days during the last winter, it appears that at a mean temperature of + 55°.5 Fahrenheit, Barometer 29.946, that the space occupied by the air before exposure was equivalent to 2059,854 grains of distilled water; and the same portion of air at the temperature of − 34°.5 was equivalent to a space of 1924,261; the height of the mercury in the stem, above the level of the mercury without, being 3,702 inches. Both the glass cylinder, and the observed height of the mercury in stem, require each a small correction, to reduce the experiments to the same temperature. According to General Roy, a glass vessel of the capacity of 10,000,000 will become 10,000,129, by an increase of 1° Fahrenheit in the temperature. And by my own experiments it appears, that the rate of expansion of pure mercury from near its freezing point, to the freezing point of water, is about $\frac{1}{140}$th part of its bulk in glass vessels. By applying these two small corrections, the space occupied by the air after exposure was more accurately represented by 1922,03, and under a pressure of 26,210 inches; but which reduced to the mean height of the mercury in the barometer, *viz.* 29,946, becomes 1682,24.

It appears therefore, from the whole, that a volume of air at the temperature of + 55°.5 Fahrenheit, equivalent in bulk to 2059,854, will at the temperature of − 34°.5, occupy a space equivalent to 1682,24, under the same pressure; which is about $\frac{1}{400}$th part for 1° Fahrenheit. The same conclusion is obtained, by taking a mean of the results deduced from the experiments computed separately.

EXPERIMENTS UPON THE EXPANSION OF METALS, AT LOW TEMPERATURES.

THESE experiments were made with bars of different metals, of ten feet in length, *viz.*, cast iron, wrought iron, steel, hammered copper, cast brass, and plate brass; they were placed parallel to each other, about two inches apart, in a strong case made of two-inch deal, eleven feet in length. Each of the bars was attached, by means of a screw, to a transverse iron bar fixed to one extremity of the case, the other ends being left that they might expand or contract according to circumstances. To each of these moveable ends of the bars was attached a finely-divided vernier, each moving in a corresponding dove-tailed groove in a large brass plate firmly screwed to the same end of the case, and upon which was graduated a scale of inches divided into tenths; these divisions were also subdivided by the verniers into hundredths: by this means any relative change in the lengths of the bars might be observed with great distinctness, to less than 1000th part of an inch. For the more perfect observing the coincidence of the verniers with the divisions upon the fixed place, a microscope was attached to the instrument, which sliding upon a transverse bar, and having a motion parallel to the bars themselves, could be brought exactly over either of the verniers.

The bars were about three-quarters of an inch in breadth and depth (excepting the cast-iron one, which was somewhat larger), and were supported in several places by pieces of wood fixed within the case, cut so as to receive them, allowing sufficient room for a slight lateral motion, so that their motion length-ways should not be in the least obstructed. They were nearly adjusted (with the exception of the cast-iron one) to the same length, *viz.* ten feet, at +66° Farenheit, at which temperature the zeros upon the verniers nearly coincided with the zeros upon the plate. It was intended to adjust them accurately to the temperature of +62°, but the warmth of the weather, the number of persons in the room, and the haste necessary in framing the instrument, previous to the sailing of the expedition, prevented it. Subsequent examinations of the bars at very steady temperatures, rendered any dependence upon this adjustment unnecessary, although the range of temperature was not quite so great.

As the accuracy of the results obtained with this instrument must necessarily depend upon the ends of the bars, which were screwed to the transverse bar, remaining in exactly the same position with respect to each other, I had a contrivance very neatly constructed by the ship's armourer; which was, a strong bar of copper fixed in a transverse direction exactly over the heads of the screws (by which the bars were confined), but at the same time perfectly detached from them. In this transverse bar, and over the others, were made square holes, two sides of which were chamfered or sloped off to a fine edge and polished, as were the corresponding parts of the other bars over which it was fixed. Upon these edges were made fine marks at right angles to the bars, by means of a sharp steel point; corresponding ones also were made upon the bars themselves, and by means of a sliding microscope attached to another transverse bar, the coincidence of these lines were observed before and after the readings of the verniers at the other end of the case were taken. They at all times, however, perfectly agreed, and coincided exactly, after the arrival of the instrument in England. The necessity of this precaution was first suggested to me by a curious circumstance which takes place in the contraction of the metals at very low temperatures, which is this: if after a set of readings be obtained with this instrument, either of the bars be gently tapped, as with a key, *&c.*, an immediate change in its length takes place, as indicated by the vernier. This at first naturally appeared to arise from the screws not confining the ends of the bars firmly in their places, and from the friction arising from the supports and verniers; the observations were, therefore, rejected, and the above precaution immediately resorted to. As the free motion of the verniers, and also of the bars upon their supports, were always particularly examined, and which could easily be ascertained by the lateral motion occasioned by pressing gently upon them, this way of accounting for the circumstance appears inadmissible; nor could it have arisen from any gradual change in length produced by an alteration of temperature, as the same was constantly observed after the bars had been exposed to steady temperatures for two or three days. To this rigidity or sluggishness in the powers of contraction in the metals, may be added another property they acquire at low temperatures, which is—that of extreme brittleness. This was continually exemplified in the frequent fractures of the adjusting screws of the different instruments when very slightly handled, also of knives, the clinching of nails, together with the loud complaints of the carpenters, that their tools were either fractured and rendered totally unserviceable, or that their edges were immediately destroyed by using them in those temperatures.

It is evident, from the construction of the instrument, that the differences between the readings of the verniers, at different temperatures, will give the relative variations in length of the different bars due to the change of temperature (since these differences are not affected by any variation in length of the deal case, as this is common to each); and if the absolute rate of expansion of either of them, or of the deal case itself, be known, then the absolute rate of expansion of the others becomes known. The deal was a well-seasoned piece of wood, and had been in the possession of Mr. Bate, the maker of the instrument, for twelve years. The temperature of the bars was ascertained by three thermometers, one placed at each end of the case, and the other in the middle. The instrument was fixed upon the heads of three casks, fixed firmly upon the ground, so that their upper edges should be in an horizontal line, and by this means was supported in six nearly equi-distant places. To protect it from the drift snow, it had, besides its own cover of wood, a strong canvass one made for it. In this state it was left, together with the thermometers, exposed for a considerable part of the winter, a few yards in front of the observatory, and was always ready for observation when steady temperatures occurred. The following observations are the means of a great many readings, taken at various times; those made at temperatures not differing from each other more than five or six degrees, are classed together, and their mean given as one result:—

METALS	Readings at + 52°.	Readings at + 6°.4	Readings at − 15°.9.	Readings at − 40°.
Plate Brass . . .	119.95550	119.87638	119.86250	119.83140
Cast Brass . . .	119.96350	119.88325	119.86942	119.84227
Hammered Copper	119.96550	119.88750	119.87775	119.85427
Steel	119.97100	119.90950	119.90150	119.89458
Wrought Iron . .	119.97650	119.91158	119.90858	119.89981
Cast Iron . . .	120.00200	119.93688	119.93375	119.92910

The simplicity of the instrument renders any explanation of the numbers contained in this table almost unnecessary; it will be sufficient only to say, that if the numbers in the column under +52° represent the relative lengths of the bars at that temperature, then will the numbers in the other columns represent the relative lengths at the respective temperatures under which they are placed.

By comparing the observations with this instrument, after its arrival in England, with its first adjustment by the maker to the temperature of +66°, I found the cast-iron bar somewhat in excess. Although I had not comparisons at so high a temperature, yet by observing the law of the differences between it and the other bars, the circumstance was plain; the others agreed very well. This adjustment, therefore, is altogether rejected, and those observations only retained which have been made at very steady natural temperatures. The discrepancy arose, no doubt, either from the weight of the bar acting upon the screw which held it, from the pitching of the ship in crossing the Atlantic; or, what is more probable, from this bar being the largest, it had not acquired the same temperature as the others, in the unavoidable hurry necessary in the completion of the instrument.

For the purpose of again comparing the bars, after the voyage, at steady temperatures, the instrument was kept in a large room without a fire at the Admiralty, and the comparisons made by Mr. Jones, the optician, and myself, at a mean temperature of +52°, which is higher than any other I had before an opportunity of observing it at. The ends of the bars held by the screws had not in the least started, since the precaution was taken of constantly observing them, as the lines upon them and the corresponding ones upon the detached transverse bar exactly coincided. In the following table I have given the comparisons of the plate brass with the other metals, as its absolute rate of expansion is the best known, and at the same time more convenient, on account of its rate of expansion being greater than the rest. If the differences between the plate brass and the other metals be supposed to increase uniformly as the temperature diminishes, that is from +52° Fahr. to −40°, and if x represent the absolute rate of contraction of the plate brass in parts of the length between those limits; then will the contraction of the other metals be represented by the quantities in this table.

Table of the comparative contractions of Plate Brass and the other metals, for 1° Fahr., in parts of the length.

METALS, &c.	From +52° to −40° Fahr. Mean Temperature +6°
Cast Brass	x − .000000260
Hammered Copper . . .	x − .000001166
Steel	x − .000004319
Wrought Iron	x − .000004294
Cast Iron	x − .000004637

By a mean of ten of the most unexceptionable authorities, it appears that the rate of expansion, or contraction, of plate brass in parts of its length, is .00001027 for 1° Fahr.; if this quantity be substantiated for x, the following will be the absolute rates of expansion or contraction of the other metals, and which are also compared with those deduced from other authorities:—

METALS	Contractions for 1°	Contractions for 1° by other Authorities.	AUTHORITIES.
Cast Brass . . .	.000010010	.000010443	Comm. on Weights & Measures, 1821; & Smeaton.
Hammered Copper	.000009104	.000009444	Smeaton; Philosophical Transactions, 1751.
Steel	.000005951	.000006896	9 Authorities—but agreeing with Lavousier and Laplace; Biot, Traité de Phys.
Wrought Iron . .	.000005976	.000007039	4 Authorities, but agreeing with neither.
Cast Iron. . . .	.000005633	.000006312	" " "

The great difference between these results and those obtained by absolute measurements is very apparent, and seems in a great measure to arise from a variation in the rate of contraction of plate brass and the other metals at different temperatures. If the relative variations in length of the bars, between the temperatures of +52° and +6°.4, be compared with those between +6°.4 and −40°, it appears that the differences between the plate brass bar and the others are the greatest at the lowest temperatures, which must be owing to the plate brass, and also the cast brass, retaining their powers of contraction, at those temperatures, in a greater degree than the less expansible metals.

By dividing the difference of the readings of the vernier attached to the plate brass bar, at the temperatures of +52° and +6°.4, by the difference of temperature, *viz.*, 45.6 degrees, it appears that the contraction of the brass exceeded *that* of the deal by the quantity .0017351 inch for each degree; and dividing this by 120 inches (the whole length nearly), this excess in parts of the length for 1° Fahr. is .00001446: but since this quantity is far greater than that which can be assigned for the expansion of the brass itself, it is evident that the deal must have *expanded* upon the whole, and that at the rate of .000004 nearly in parts of its length for each degree. It is most probable, however, that this expansion is confined only to a few degrees of temperature, arising from the freezing of the moisture within the pores of the wood. By a similar comparison between the temperatures of +6°.4 and −40°, the excess of the deal above the plate brass bar for 1° in parts of its length, is

.00000808; between these limits, therefore, the deal had *contracted* at the rate of .000002 nearly for 1° in parts of its length. The same circumstance appears by comparing it with the other metals; and upon the whole, that a piece of deal, of 120 inches in length, will, by a change of temperature, amounting to 100° Fahr. *i. e.*, from +60 to −40°, *expand* $\frac{1}{100}$th of an inch, or $\frac{1}{12000}$th part only of its length, whatever its law of variation in length may be at the intermediate temperatures.

This curious property of wood, *viz.*, of its alternate contraction and expansion at low temperatures, seems singularly adapted for its preservation when growing in its natural state in high latitudes, particularly in its low and stunted state of growth in these places; for by reason of the dissolving of the snows in the height of summer, it becomes so incrusted with ice, and cemented to the rocks and soil for the greater part of the year, and at the same time exposed to natural temperatures, from the freezing point to 80° below it, that if the same rate of contraction were to continue at these temperatures as it has at moderate ones, it must be fractured in almost every place.

That fir does not upon the whole contract, between the freezing point and zero, I had, before these experiments were made, every reason to expect, from the going of a fir pendulum belonging to the clock. And as I had no other means of determining the absolute rate of contraction in either of the metals, I endeavoured to do it by observing the number of vibrations made in a given time by an invariable brass pendulum, vibrating upon knife edges in hollow cylinders of agate, by the method of coincidences; but the clock with which it was compared, by reason of the cold, would not go well enough for the purpose, although it was taken to pieces and oiled throughout with the unfrozen part of the oil of sassafras (which is the only substance of an unctuous quality that remains fluid at this temperature); it would not go sufficiently regular to be depended upon. I had, before leaving England, suggested this way of determining the contraction of the metals to Capt. Kater, but the time allowed before the sailing of the Expedition was too short for a proper arrangement to be made for this purpose. Several trials, however, of this method were made by Lieut. Palmer and myself, by counting the vibrations, and measuring the intervals with a chronometer; but the want of agreement in the results, when reduced either from the irregular going of the chronometer at that temperature, or by mistakes in counting the vibrations, together with the long exposure necessary for the purpose, rendered it both useless and impossible to repeat them with confidence.

ON THE CONTRACTION OF MERCURY.

These experiments were made with the same glass vessel with which those upon the expansion of air were made, which being nearly filled with mercury, became a thermometer upon a large scale, but open at the end of the stem. The relative capacities of the whole vessel, and the several parts of the stem, were determined by many trials, by weighing the contained portions of mercury with a delicate hydrostatic balance (made by Newman, of Lisle-street), in very small scales, or cups, of platinum. The mercury experimented upon, had been distilled for the purpose of chemical experiments; and by a mean of five different trials with the same instrument, its specific gravity in distilled water of the temperature of + 58° Fahrenheit, was 13.64. The experiments were confined to temperatures not lower than — 30° Fahrenheit, as there is some uncertainty arising from a suddenness in the contraction of the mercury near its freezing point. If, upon exposing the vessel filled with mercury to these temperatures, and after a considerable time, when it appears to have reached its lowest point in the graduated stem, the vessel be then touched, the mercury immediately descends, and this not from any change in the curvature of its upper surface only, since it is seen to descend in every part of the stem. The same circumstance was constantly observed in the common mercurial thermometers; the same thermometer seldom indicating the same temperature when its contained mercury was frozen, which was generally from — 36° to — 38° when frozen in an horizontal position. If it is frozen at lower temperatures, as at 45° Fahrenheit, it still indicates about the same temperature, *viz.*, 36° to 38; but if in this state it be held in a vertical position, and a slight shake be given it, the mercury immediately descends, so as to indicate nearly the same temperature of the atmosphere (as shewn by those spirit thermometers with it previously agreed, at temperatures between 20° and 30° below zero). This circumstance does not appear to arise from any apparent separation of the mercury, either in the stem or in the bulb, at least as far as could be seen with a common magnifying glass; neither can it arise from any sudden contraction of the glass, as it would have caused a contrary effect, and, moreover, would have been apparent in the spirit thermometers, which was not the case. It appears, therefore, that though the power of mutual adhesion between the particles of mercury is considerably diminished by low temperatures, yet it still retains its power of contraction.

As one end of the stem was ground, and fitted into the bulb of the vessel, so as to be taken out at pleasure, the temperature of the contained mercury could be readily ascertained by putting a mercurial thermometer into it. This thermometer, together with a spirit one (for very low temperatures), had been compared with many other mercurial ones, and a correction applied to each to reduce them to the mean of all; and they were kept as standard ones by which the temperatures were registered. As the experiments were made at nearly the same temperature, the means of the observations before and after exposure are taken and computed as one result. By which it appears, that a portion of mercury equivalent in bulk to 2060.65 at + 29° Fahrenheit, will have in the glass vessel an apparent bulk equivalent to 2048.36 at − 29° Fahrenheit, which is a contraction at the rate of .0001027, or $\frac{1}{9736}$th part of the whole for 1° Fahrenheit.

If the contraction of the glass vessel be allowed for, then, according to General Roy's experiments upon the cubical expansion of glass vessels, the bulk of the mercury after exposure will be more accurately represented by 2046.83 instead of 2048.36 at − 29°, which is a contraction at the rate of .0001156, or $\frac{1}{8648}$th part of the whole for 1° Fahrenheit, between these limits, or at a mean temperature of about zero.

From the experiments of Sir George Schuckburgh with a similar apparatus, it appears that from the freezing to the boiling point of water, the expansion of mercury in glass is .0000872, or $\frac{1}{11470}$th part of the bulk, and correcting for the expansion of the glass .0001011, or $\frac{1}{9891}$th part of the whole for 1° Fahrenheit.

ON THE CONTRACTION OF ALCOHOL.

These experiments were also made with the same apparatus. The specific gravity of the alcohol was determined by weighing it in two thin glass flasks, fitted with ground glass stoppers in the usual way, and weighed in the hydrostatic balance before-mentioned. One bottle contained 925 grains of distilled water, and the other 1050 grains, at + 60° Fahrenheit. The temperature of the alcohol was ascertained by introducing a delicate mercurial thermometer into the necks of the flasks, before and after it was weighed, and a mean taken. By several trials at each end of the beam, with different sets of platina weights, the specific gravity with the 925 grain bottle was .8162 at + 61°, and with the other, .815 at + 62°; the mean between which is, .8156 for its specific gravity, at + $61\frac{1}{2}$ Fahrenheit.

The experiments were made in the same way as with the mercury, by exposing the alcohol to moderate, and then low temperatures; and a mean of the readings, before and after exposure, taken, to obviate any error that might possibly have arisen from evaporation during the experiments; which, however, was not perceptible. By a mean of several experiments made at nearly the same temperature, it appears, that a quantity of the alcohol, equivalent in bulk to 2060.65, at + $49\frac{1}{2}$° Fahrenheit, will, at the temperature of − $36\frac{1}{2}$° Fahrenheit, occupy a space equivalent to 1974.85, which is a contraction in bulk at the rate of .000484, or $\frac{1}{2063}$d part of the whole for 1° Fahrenheit, or at the rate of $\frac{1}{114}$ for 180°.

Allowing for the contraction of the glass as before, the bulk after exposure is more accurately expressed by 1972.66, instead of 1974.85. With this correction, the contraction of alcohol in bulk is at the rate of .000496, or $\frac{1}{2014}$th part of the whole for 1° Fahrenheit, or $\frac{1}{112}$ for 180°. According to Dalton, the expansion $\frac{1}{9}$ for 180° at higher temperatures.

The apparent contraction of alcohol in barometer tubes, appears to differ considerably from the above determination. The result, however, by this method is very exceptionable, compared with the above, since the capacity of the stem of the apparatus is very small compared to the bulb; and as the tubes were of greater diameter than the stem, not so much accuracy could be attained in observing the exact height of the contained alcohol, the rise and fall of which, by the change of temperature, was determined by paper scales pasted upon the tubes, the divisions of which, as well as the whole length of the tubes, were determined by a two-foot brass scale, divided to an hundredth of an inch.

By two trials with a barometer tube, at the temperatures of $+ 46\frac{1}{2}°$ Fahrenheit, and $- 40°$, the space fallen through by the upper concave of the alcohol was exactly equal to $\frac{1}{20}$th of the whole length of the original length of the column, or $\frac{1}{1730}$ for 1° Fahrenheit, or at the rate of $\frac{1}{96}$ for 180°. By two trials with another tube, at a different time, the space fallen through by exposure to the temperatures of $+ 42°$ and $- 26°$, was $\frac{44}{1000}$th of the length, of $\frac{1}{1600}$th part for 1° Fahrenheit, or at the rate of $\frac{1}{89}$ for 180°. The mean between these results in the tubes, is $\frac{1}{1665}$ for 1°, or $\frac{1}{92}$ for 180°.

By experiments with the hydrostatic balance, the bottle which held 925 grains of distilled water at $+ 60°$, contained 755 grains of the alcohol at $+ 61°$, and the contained alcohol at $+ 5°$ weighed 787.1 grains. Also the other bottle, which contained 1050 grains of distilled water at 260°, contained 855.6 grains of the alcohol at $+ 62°$, and 873.1 grains at $+ 8\frac{1}{2}°$. By a mean of both, and making a small correction also for the contraction of the glass, amounting to about 0.6 grain in each bottle for the difference of temperature, it appears that its specific gravity was .8156 at $+ 61\frac{1}{2}°$, and .8418 at $+ 6°.7$ Fahrenheit, which is a contraction in bulk at the rate of .000567, or $\frac{1}{1760}$th part for 1° Fahrenheit, or at the rate of $\frac{1}{98}$ for 180° between these temperatures.

In the same way, spirit of wine of the specific gravity of .9270 at $+ 46°$ Fahrenheit, was found to acquire a specific gravity of .9445 at $+ 4°$ Fahrenheit, which is a contraction at the rate of .000331, or $\frac{1}{3000}$th part of the bulk for 1° Fahrenheit.

The following are the comparative indications of several thermometers filled with different fluids. The thermometers were of the same length and construction; they were freely suspended, and the comparisons made at steady natural temperatures.

Mercury.	Carburet of Sulphur.	Chloride of Carbon.	Sulp. Æther.	Oil of Sassafras.	Nitric Acid.	Alcohol.	Sp. Wine.	REMARKS.
°	°	°	°	°	°	°	°	
+58	+53	+58.2	+47	+56	+56.6	+53	+57	
+50.2	+43.7	+46	+40.2	+42.5	+48.2	+44	+45.8	
+49	. .	+42 6		. .	. .	. .	. .	
+32	. .	. .	. .	.	+32	. .	.	The freezing point of these two thermometers was ascertained to be correct by melting snow.
+ 3	+ 2.5	− 9	− 4.1	− 0.7	+ 0.7	− 0.5	− 2.2	
− 8	− 6.2	−11.7	−10.2	− 9.2	− 1	−10	− 8.7	
−12	−12.6	−27.3	−16.7	−18	−15	−18	−19.2	The oil of sassafras opaque and partly frozen in the *upper part* of the bulb of the thermometer containing it The sulp. æther was also partly frozen, having an horizontal layer of ice at the *bottom* of the bulb.
−16	. .	−31	. .	.	−16	−21	−21.5	
−30	−27.5	−44	.	.	−31	−36.5	−36.0	

Carburet of Sulphur.

The effect of intense cold upon this singular fluid, depends entirely upon its being in immediate contact with the atmosphere, instead of being exposed to low temperatures in perfect thermometers, or in stopped bottles. For instance, two thermometers containing this fluid, one of which was perfect and the other broken, were exposed for several days to − 26° Fahrenheit. The fluid in the perfect thermometer was clear, and did not appear to be in the least affected by the exposure; but in the imperfect one, several pieces of a white substance were floating in the bulb, like white wax or camphor.

This effect was subsequently observed upon a much larger scale. Upon taking a glass bottle capable of containing about three pints, and in which was about a pint of the carburet of sulphur into a temperature of − 30° Fahrenheit, no effect was produced upon it, so long as the glass stopper was kept in, except the trickling down upon the sides of the bottle of some of the more volatile part of the fluid which had accumulated there. But upon taking the stopper out, a curious effect was instantly produced, for not only was the surface of the fluid covered with pieces of this white substance, but the sides of the bottle were also covered with a coating of this substance. It would appear, therefore, that it was the more volatile part of the fluid that was affected and congealed. The remaining portion of the carburet of sulphur, which retains its fluidity after the exposure, distinctly divides itself into two portions: the upper part of it had the appearance and consistence of oil; the lower part was a fluid of a dull white appearance, like soapy water. The oily part was very brilliant, and of great refractive power. The white substance which is formed is not very volatile, as I kept a small piece for several days between Zero and – 20 Fahrenheit, without any apparant diminution of its bulk. It dissolves instantly in a small drop of concentrated sulphuric acid, but with some difficulty in alcohol.

Chloride of Carbon

Was not in the least affected by an exposure of two or three days to – 45° Fahrenheit, nor with this degree of cold, assisted by the evaporation of alcohol and nitric ether in the receiver of an air-pump, by wrapping the bulb of the thermometer containing it in fine wool, previously soaked in these liquids, which was kept moistened, by the wool being in contact with a portion contained in a small evaporating dish, placed under the thermometer upon a small glass stool. The thermometer was cemented in the perforated brass cap of a small receiver in the usual way

Sulphuric Ether

Is partly frozen at – 12° Fahrenheit, and more or less according to the temperature, but not perfectly after two or three days exposure to – 46°.

Nitric Ether.

A bottle of this exposed as above to – 46°, was not frozen, with the exception of a very minute portion, like a small feather, floating about in it; but it acquires the consistence of oil. It was firmly frozen by a mixture of snow and alcohol; but I had not the means of determining accurately the temperature at which this took place. A thermometer filled with alcohol placed near it, stood at between – 60 and – 63°.

Oil of Syssafras

Is completely frozen when exposed to the atmosphere at – 23°, but that in a perfect thermometer was not completely frozen at – 40°. If the frozen oil be exposed to a temperature of – 10°, a portion of it becomes fluid, of a brilliant yellow colour. If the oil be now separated into two parts, by pouring off this dissolved part of it, the remaining part consists of large white crystals in the form of rectangular parallelograms, which would not dissolve, though kept at

+50° for several days. The yellow part is frozen into long fine spiculæ, like needles, and the action of light upon it very singular, for it freezes when exposed in a shallow evaporating dish to the light at −16°, but if kept in the dark it will not freeze at −45°. I had frequent opportunities of observing this, as I kept a quantity of each for a considerable time during the winter in a box at the Observatory, where a fire was occasionly kept, by which the temperature was generally such as to dissolve them both when frozen. Upon afterwards opening the box at 30° and 40° below Zero, (at which it had been exposed often for several days) that portion of it which forms into large white crystals, was always found frozen; but the part which forms into fine yellow spiculæ was fluid, but not longer than two or three seconds after the box was opened, as it freezes almost immediately, scarcely giving time to observe its previous fluidity. Upon exposing the yellow part, in a fluid state, to low temperatures at night, during the time of a splendid Aurora Borealis, it acquires the consistence of honey, yet no regular crystallization takes place, but which was the case at twilight when there was less light.

Nitric Acid.

A thermometer filled with this concentrated acid, did not freeze at −40° Fahrenheit, excepting a very small portion (not bigger than a pin's head), and which was observed at −30°. At −47° the portion of it in the stem of the thermometer was opaque and appeared frozen, but that contained in the bulb was still clear and not frozen. It was firmly frozen a few degrees lower by means of alcohol and snow, but the freezing point could not be accurately ascertained; but from the appearance of it before-mentioned, it appears that it is about −48° Fahrenheit. Nitric acid of the specific gravity of 1.260 was firmly frozen at −20°, and fluid at −15°. The rate of contraction of this acid appears to be very uniform; the thermometer filled with it, agreed nearer to the standard mercurial one than any of the others, (though more sluggish) and it never differed from it, more than about 2° from natural temperatures of + 60° to — 30° Fahrenheit.

Sulphuric Acid.

A small quantity of concentrated sulp. acid exposed in a shallow evaporating dish, was firmly frozen at − 40°, and was fluid at − 35°. The same acid diluted with 50 per cent of water, by measure, was partly frozen round the sides of the dish at − 26, and firmly frozen at −30° Fahrenheit.

Chloride of Tin and Chloride of Carbon,

Were neither in the least affected by a considerable exposure to a natural temperature of − 45° Fahrenheit; nor by the greatest degree of artificial cold I could produce, combined with this low temperature.

Chloride of Phosphorus

Is not in the least affected at − 30° Fahrenheit, at − 40 it appears like thick oil, and at − 47 it is frozen, and acquires the appearance of honey of firm consistence, but without any apparent crystallization.

ON THE FREEZING POINT OF DISTILLED MERCURY, THE AMALGAMS, *&c.*

To determine the freezing point of pure mercury; a portion of it was put into a shallow glass evaporating dish, and placed upon a support consisting of a slender rim of copper, with three glass legs. The bulbs of two spirit thermometers were placed upon each side of the dish, and the bulb of another in the centre of the mercury, the thermometer being attached to the stand, and in a vertical position. These thermometers had each been compared frequently with the standard mercurial one, when the temperature was not lower than −30° Fahrenheit, and their respective errors applied at lower temperatures. The great difference between spirit thermometers at very low temperatures, renders any dependance upon them, when accuracy is required, very precarious, without a comparison with the mercurial ones, a few degrees above the freezing point of mercury. Among eighteen spirit thermometers, frequently compared nearly at the same time, there was a difference often amounting to twenty degrees at temperatures between 40° and 50° below Zero; and to show how much this was the case even in those made by the same maker and of the same length and construction, the following is a comparison of ten of them. They were placed in parallel and vertical positions, upon a board fixed to two upright supports about three feet above the frozen sea, and each of them was freely suspended at the end of a nail. The temperature at the time of comparison had been very steady for a considerable time.

No. 1	− 56° Fahr.	Mean − 52°.4 Fahr. – Thermo. alcohol (uncoloured).
2	− 56 „	
3	− 49 „	
4	− 49 „	
5	− 52 „	
6	− 40 „	Mean − 42°.8 Fahr. – „ „ (coloured).
7	− 40 „	
8	− 44 „	
9	− 44 „	
10	− 46 „	

It appears from this comparison, that there was nearly ten degrees difference between the means of the thermometers filled with the uncoloured alcohol and those which were coloured, and the greatest difference is sixteen

degrees. By a mean of several comparisons of the thermometers No. 5 and No. 10, between the temperatures of − 26° and − 30°, No. 5 was lower by 2°.2; and No. 10 was higher by 4° than a mean of seven mercurial ones; by applying these corrections, the true temperature by No. 5 is − 49°.8, and by No. 10 it is − 50° Fahrenheit; or a mean temperature of − 49°.9 Fahrenheit. The temperatures, as indicated by the thermometers with the uncoloured spirit, appear to be more correct than the coloured ones, in which the power of contraction of the spirit appears rapidly to diminish, and when suddenly taken from moderate to very low temperatures, most of the colouring matter was left in the upper part of the stem; they do not therefore seem so fit for use at very low temperatures as the others.

By a great many observations made each winter, pure mercury begins to freeze at − 38°.5 Fahrenheit. A watch-glass full of it will be firmly frozen in about three or four hours when taken from a temperature of + 32° to − 39°, but it remains fluid at a steady temperature of − 38° Fahrenheit. It begins to freeze first at the bottom and in the centre of glass, and generally assumes a kind of a tree-shaped crystallization, or somewhat like the ribs and vertebræ of fish when arranged in parallel positions close to each other; but the crystals composing the mass are so ill-defined, as to present no regular determination of figure, nor the least similarity between them.

An amalgam of 200 grains of distilled mercury, and twenty grains of lead, was firmly frozen at − 35°.5, and fluid at − 31°.5 Fahrenheit.

An amalgam of 100 grains of mercury and three grains of tin, is firmly frozen at − 35°.5, and is fluid at − 34°.5 Fahrenheit.

An amalgam of 200 grains of mercury and as much silver as it would dissolve, was partly frozen after a considerable exposure to − 35.5 Fahrenheit.

An amalgam of 200 grains of mercury and twenty grains of zinc, is partly frozen after a long exposure to − 35°.5 Fahrenheit.

These mixtures were exposed in small thin glass cylinders at steady and natural temperatures, and the above are the nearest limits of the freezing points of each that could be obtained by this means. Nearer limits might probably have been obtained by varying the degree of cold by artificial means, but some uncertainty would have been introduced, arising from the difficulty of maintaining an uniform temperature by this means. The metals were obtained perfectly pure for the purpose of experiment before leaving England; and it appears that the amalgam of mercury and lead is most easily frozen.

AN ABSTRACT

OF THE

VARIATION, DIP, &c. OBSERVED ON SHORE AT THE WINTER STATION UPON WINTER ISLAND, NORTH COAST OF AMERICA, DURING THE YEARS 1821—2, IN LATITUDE 66°.11′.35′ N., AND LONGITUDE 82°.53′ W.

THE first column contains the date; the second, the times of the day when the observations were made, which were generally about nine o'clock, A.M. and three o'clock, P.M. The third column contains the variation. This was observed with an instrument made by Dolland, for the purpose of observing the diurnal motion as well as the variation of the needle. It consisted simply of a long slender needle with a sliding weight to adjust it horizontally, and turned upon a fine steel point in an agate cup attached to the centre of the needle. To this instrument was also attached a telescope with cross hairs, which had a small vertical motion, and the whole having azimuth motion, the telescope could be referred to a distant well-defined object, by which the stability of the instrument could be ensured. The needle was covered with a brass frame which had a glass top, carrying with it a vernier, reading off to minutes upon the graduated arc, upon the fixed part of the instrument. The magnetic azimuth of the object to which the telescope was referred, was determined by making two fine lines drawn upon the moveable part of the instrument coincide with the north and south ends of the needle; and for the better observing the coincidence, a microscope with a single wire was attached to it for the purpose. As a line drawn through the Zero (upon the fixed part of the instrument) and the centre of the needle was parallel to the line of collimation of the telescope, the readings of the vernier compared with the true azimuth of the object gives the variation.

The true azimuth of the distant object, from the place where the instrument was fixed, was determined by placing the centre of a small transit instrument (having complete motion in azimuth) exactly over the place where the centre of the needle was placed, and observing the sun's transit over the vertical wires when it had the same azimuth as the object, which was therefore completed from the known error of the chronometer with which the observation was taken from apparent time, sun's declination and latitude of the place. When the needle was first fixed at Winter Island, and before the true azimuth of the distant object was determined, the stand upon which the needle was placed was thrown down and removed from its first situation by the wolves, so that the variations between Nov. 26th and *Dec. 13th*, were not accurately determined, and they are registered therefore, only to shew the difference between the variation in the morning and afternoon. It was afterwards fixed more securely, by filling up the space between the legs of the stand, and *banking* it round with snow. The precaution was also taken of determining the true azimuth of the object, before the series of observations at each station was commenced, and by repeating the operation when the observations were completed.

The fourth column contains the magnetic dip, which was observed with a new and excellent instrument made by Dolland. The observations here registered, were made with a needle which consisted of two long slender cones, put together at their bases, forming together a needle of about eight inches in length. The centre of this needle was perforated in two places, at right angles to each other, into which was fitted a moveable axis, which by this means could be placed in four different positions with respect to the needle, and afford a greater number of observations than one of the common construction. There was another needle also fitted to this instrument, known by the name of Meyer's needle, consisting of a long rectangular parallelogram, with the corners of the extremities rounded off; to the centre of it was attached a small stem, fixed at right angles to the needle, and having a moveable weight attached to it; by moving the weight near to, or farther from, the axis of motion, the needle may be brought to deflect more or less from its true dipping position of the needle at pleasure. If the dip be observed with this needle in one position, and again when it is inverted (estimating, in each case, the dip from tne same point of the horizon), it is easily shown that the cotangent of the true dip is an arithmetical mean, between the cotangents of the observed dips in these positions of the needle, provided the centre of gravity is perpendicular to the axis of motion. This condition is not necessary in this (nor in the common needles) if the poles be inverted, and the dip in each position of the needle be observed; but the calculation is not near so simple*. If the weight be so adjusted that the needle may be perpendicular, then upon turning the instrument 90° (either way) in azimuth, the needle will shew the true dip without any calculation. If the instrument be moved 180° in azimuth, the needle will shew the magnetic latitude of the place in any part of the world, which is confirmed by experiment. By unscrewing and taking away this perpendicular stem, and the attached weight, the needle becomes, and may be used as one of the common construction. The needles turned, or vibrated upon horizontal edges of agate, and the instrument was adjusted by means of cross levels for the purpose, in the usual way, by means of foot screws; two distant marks were fixed, one towards the magnetic north, and the other towards the south, to which the instrument was always referred at the time of each observation. The axis of motion of the needle was centrically adjusted by means of a contrivance to elevate or depress it at pleasure, so that it might be placed gently upon the agate edges at each observation, by means of finger-screws conveniently placed for the purpose; the ends of the needle moved along a graduated circle in the instrument, divided to 20 minutes, and the divisions were large enough to be subdivided to 2 or 3 minutes, by means of two lenses, fixed at the extremities of a moveable arm, concentric with the needle.

The fifth column contains the time taken by the needle, to complete 100 vibrations. The whole arc described in the first vibration was 80°, and the last arc not less than 5°. The number of vibrations between the limits were generally from about 180 to 210, and the time of completing 100 vibrations determined by proportion. There was a contrivance attached to the graduated rim of the instrument, by which either end of the needle could be confined, and let fall through any extent of arc, at any given time, with con-

* If the centre of gravity is not perpendicular to the axis of the needle, but make with the vertical an angle β, and S and D be the sum and difference of the co-tangents of the observed dips, then cot. true dip $= \frac{S}{2 \pm \text{Tan.}\,\beta.\,D.}$ If when the poles are inverted, the co-tangents should be found to differ from the former ones (d' and d''), by the quantities x and y, then the co-tangent of the true dip will be represented by an equation of the form of $\frac{y \text{ cot. } d' + x \text{ cot. } d''}{y + x}$, a result which depends, however, upon the supposition that the line passing through the centres of gravity and suspension makes the same angle with the magnetic axis of the needle before and after the poles are inverted. I have not seen the investigation of M. Meyer, but as the formula given in his paper "de usu accuratiori acûs inclinatoriæ Magneticæ," is immediately deduced by eleminating β upon this supposition, it appears to depend upon the same hypothesis.

siderable precision, by holding a chronometer in one hand, and the string attached to the trigger in the other. One needle was kept for this purpose throughout the voyage; the poles were, of course, not reversed, and the needle was made to vibrate always upon the same side of the axis of motion.

The other columns contain the state of the barometer and thermometer, and also Kater's hygrometer when it was affected; for, at very low temperatures, it became so coated with ice by exposure, as to remain stationary for many days together.

DATE.	Variation W.	Dip.	The Time of describing 300 Vibrations.	Barom.	Therm.	Kater's Hygr.	REMARKS
1821.	° ′ ″	° ′ ″	″		°		
Oct. 15 A.M.	. .	87 45 43	. .	29.77	+ 8	. .	Moderate breeze from N. and cloudy W.
„ 16 „	. .	. .	295.5	30.14	+ 9	. .	Ditto „ „ S. and snow at times
„ „ P.M.	. .	. .	298.7	30.13	+13	.	Squally wind S.E. (but variable).
„ 17 A.M.	. .	87 40 18	303.6	29.91	+10	.	Light breezes from S.W. and cloudy. Snow at times.
„ „ P.M.	. .	87 59 50	298.4	29.76	+ 8	. .	Ditto ditto Ditto
„ 18 A.M.	.	87 55 57	302.1	29.40	+23	. .	Calm and cloudy. Snow occasionally.
„ 20 P.M.	. .	87 42 5	. .	30.02	+ 1	.	Fine weather. Moderate breeze from N.b.W.
„ 21 „	.	88 3 40	.	30.12	+ 8	. . .	Moderate breeze from S.E. Small snow at times.
Nov. 26 „	59 56 12	. .	. .	29.82	− 1	3.83	Moderate breeze from N.W. with sleet. Aurora very bright shortly afterwards from S.E. to W., not higher than about 10° above the horizon, shooting out bright rays towards the zenith. One of Kater's compasses was continually examined till midnight; but it was not in the slightest degree affected by the aurora.
„ 27 A.M.	55 47 10	. .	. .	29.92	−18	3.83	Faint aurora two hours before this observation in every part of the heavens, particularly from the East through the zenith to the West.
„ „ Noon	54 18 48	. .	. .	29.94	−19	3.83	Stiff breeze from N.W., and clear weather.
„ 28 P.M.	55 19 12	. .	. .	. .	. .	3.83	Fresh breeze from N.W., and clear weather with faint aurora in the S.E.
Dec. 1 A.M.	57 43 12	. .	. .	29.76	−24	3.88	Aurora in every part of the heavens, but particularly in the zenith. Kater's compass examined as before, but was not influenced by the aurora. Moderate breeze from the N.W.
„ „ P.M.	57 19 10	. .	.	29.80	−24	3.88	Fresh breezes from N.W. Clear weather.

DATE.	Variation W.	Dip.	The Time of describing 100 Vibrations.	Barom.	Therm.	Kater's Hygr.	REMARKS.
1821.	° ′ ″	° ′ ″	″		°		
Dec. 2 P.M.	55 45 12	. .	. .	29.88	−25	. .	Moderate breeze from N.W., and clear weather.
„ 6 A.M.	56 20 36	. .	. .	29.76	− 2	. .	Fresh breeze from S.E. and cloudy.
„ 7 A.M.	56 22 36	.	. .	29.89	− 1	.	Moderate breeze from S.E., cloudy.
„ 8 A.M.	56 24 24	.	. .	29.81	− 2	.	Cloudy with fog. The wind just changed from S. to N.
„ „ P.M.	55 8 24	. .	. .	29.78	−[illegible]	.	Moderate breeze from N., and clear weather.
„ 9 P.M.	54 59 8	. .	.	29.69	−19	. .	Moderate breeze from N., clear weather.
„ 10 A.M.	56 3 0	. .		29.60	−20	.	Moderate breeze from N.W., cloudy.
„ 11 A.M.	55 37 36	. .	. . .	29.72	−26	. .	Moderate breeze from N., clear weather.
„ 12 A.M.	55 54 36	. .	. .	29.70	−25	.	Ditto. ditto.
„ 13 A.M.	56 0 0	.	. .	29.91	−31	. .	Light breeze from N., clear weather.
„ 14 A.M.	56 50 0	. .		30.[illegible]	−33	. .	Brilliant aurora at night from the E. to the zenith. Compass tried as before, but not affected.
„ 17 A.M.	57 49 36	. .	. .	29.23	− 9	. .	Moderate breeze from S.E., cloudy.
„ 18 A.M.	56 58 24	. .	. .	29.48	−18	.	Light breeze from N., fine weather.
„ „ P.M.	54 37 12	. .	. .	29.60	−15	.	Moderate breeze from N.E., clear weather.
„ 19 A.M.	56 22 36	. .	. .	29.47	−20	. .	Fresh breeze from N.W., fine weather.
„ „ P.M.	55 39 48	. .	. .	29.45	−17	. .	Moderate breeze from N.b.E., fine weather.
„ 20 A.M.	56 25 24	. .	. .	29.65	−16	. .	Moderate breeze from N.E., fine weather. Brilliant aurora at night from S. to W.S.W.
„ 21 A.M.	56 12 0	. .	. .	29.88	− 8	. .	Strong breeze from N.W., and cloudy.
„ 22 A.M.	57 28 36	. .	. .	29.48	− 9	. .	Light breeze from W. with sleet.
„ „ P.M.	55 36 40	. .	. .	29.41	− 9	. .	Thick cloudy weather with light snow, but cleared up shortly afterwards with faint aurora in S.E.
„ 24 A.M.	56 46 24	. .	. .	29.80	−10	. .	Light breezes from N.W., and cloudy.
„ „ P.M.	54 52 50	. .	. .	29.80	−10	. .	Moderate breeze from N.N.W., cloudy. Brilliant aurora at night.

DATE	Variation W	Dip	The Time of describing 100 Vibrations	Barom.	Therm	Kater's Hygr	REMARKS.
1821.	° ′ ″	° ′ ″	″		°		
Dec. 26 A.M.	56 58 0	. .	.	29.28	− 5	. .	Strong breeze from S.E. and cloudy.
„ 27 A.M.	56 27 36	. .	. .	29.58	− 7	. .	Light breeze from N.E., fine weather. Faint aurora this morning before these observations from E. through the zenith to the W.
„ „ P.M.	54 31 12	. .	. .	29.57	− 8	. .	Light breeze from N.E., fine weather. Faint aurora in N.W.
„ 31 A.M.	57 35 48	. .	. .	29.80	−30	. .	Moderate breeze from N.W., fine weather. Faint aurora at S.S.W. early in the morning.
1822.							
Jan. 2 A.M.	57 16 12	. .	. .	29.58	−24	. .	Moderate breeze from N.W., fine weather.
„ „ P.M.	55 21 0	. .	. .	29.61	−27	. .	Ditto, ditto.
„ 3 A.M.	56 36 24	. .	. .	29.74	−27	1.05	Light breezes from N.E., and thick weather
„ 4 A.M.	57 6 36	. .	. .	29.45	−15	0.12	Fresh breeze from W., cloudy.
„ 5 A.M.	57 8 12	.	.	29.72	−31	. .	Fresh breeze from W., clear weather
„ 7 A.M.	57 1 10	. .	.	29.66	−26	9.45	Moderate breeze from N.W., clear weather
„ 9 A.M.	57 1 36	. .	. .	30.00	−28	9.65	Ditto, ditto.
„ „ P.M.	55 48 36	88 14 20	. .	30.00	−27	. .	Light breeze from N b.W. Streams of aurora from S.E. part of horizon towards the zenith.
„ 10 A.M.	56 14 24	89 13 35	306.1	29.60	−15	. .	Moderate breeze from N.E., and cloudy.
„ „ P.M.	54 54 36	88 6 55	303.1	29.47	−13	. .	Strong breeze from E., and cloudy.
„ 12 A.M.	55 19 24	86 57 40	304.6	29.85	−24	. .	Moderate breeze from N.W., and cloudy.
„ „ P.M.	54 59 0	87 10 40	300.9	29.87	−24	. .	Strong breeze, from W.b.N., cloudy. Aurora shortly afterwards to the E. and W. in vertical streams.
Apr. 16 A.M.	57 3 16	87 44 45	301.1	29.79	+23	. .	Calm, fine weather.
„ „ Noon.	57 4 40	88 9 26	303.3	29.70	+26	. .	Fresh breeze from W., fine weather.
„ „ P.M.	55 5 28	87 40 41	283.1	29.68	+22	. .	Fresh breeze from W., and cloudy. Bright aurora to the S. from E. to W. nearly, with much motion about an hour after these observations.
„ 17 A.M.	55 45 52	87 47 53	288.2	29.61	+13	2.06	Light breeze from N.W. Fine snow occasionally.
„ „ Noon.	53 35 4	88 1 30	302.2	29.62	+24	2.09	Ditto. Ditto.
„ „ P.M.	55 16 52	88 9 41	301.1	29.69	+20	4.04	Moderate breeze from S.W. Thick cloudy weather.

DATE.	Variation W.	Dip.	The Time of describing 100 Vibrations.	Barom.	Therm	Kater's Hygr.	REMARKS
1822.	° ′ ″	° ′ ″	″		°		
Apr. 18 A.M.	56 36 28	88 2 15	302.2	29.80	+20	3.08	Moderate breeze from S.W. Thick, cloudy weather.
„ „ Noon.	55 50 28	87 39 19	296.1	29.80	+23	3.08	Ditto. Ditto.
„ „ P.M.	55 23 28	87 45 15	305.6	29.83	+27	4.04	Ditto. Ditto.
„ 19 A.M.	56 18 28	87 48 7	303.7	29.78	+17	4.03	Calm, thick, cloudy weather.
„ „ Noon.	56 11 52	87 46 56	296.7	29.80	+33½	2.02	Ditto.
„ „ P.M.	56 1 16	87 41 41	301.1	29.77	+12½	2.00	Ditto
May 10 A.M.	58 4 15	87 48 53	297.0	29.80	+33	2.61	Moderate breeze from N.W. Fine weather.
„ „ P.M.	57 59 27	87 29 56	295.5	29.83	+39	2.46	Ditto. Ditto.
„ 13 A.M.	58 33 3	88 13 34	301.2	29.97	+27	2.25	Light breeze from N Fine weather.
„ 14 A.M.	57 51 27	88 7 15	297.2	29.87	+44	1.93	Hazy weather. Light breeze from S
„ „ P.M.	57 4 3	87 48 37	294.4	29.80	+36	1.92	Clear weather. Ditto.
„ 15 A.M.	58 3 8	87 57 7	295.9	29.57	+30	3.03	Hazy with light snow. Moderate breeze from S.E.
„ 20 A.M.	57 59 18	87 51 56	298.8	29.86	+25	2.96	Light breeze from N.N.W Clear weather.
„ „ P.M.	59 21 1	87 42 45	291.8	30.00	+48	2.82	Ditto. Ditto.
„ 21 A.M.	58 26 58	88 3 37	294.6	30.04	+28½	2.61	Light breeze from N. Ditto.
„ „ P.M.	59 39 47	87 32 41	290.3	30.06	+53½	2.58	Ditto. Ditto.
„ 22 A.M.	57 21 51	88 1 37	301.2	29.97	+40	2.29	Light breeze from W. Cloudy at times.
„ „ P.M.	58 44 51	87 49 30	296.2	29.92	+41	2.24	Ditto. Cloudy weather.
„ 23 A.M.	58 12 51	87 57 19	291.8	29.71	+43	2.39	Moderate Breeze from W. Thick, cloudy weather.
„ „ P.M.	57 51 15	87 49 34	292.2	29.64	+47	2.32	Ditto. Ditto.
„ 24 A.M.	58 36 15	87 59 53	299.0	29.40	+48	2.55	Moderate breeze from N.N.E. Cloudy Much snow the preceding night.
„ „ P.M.	56 55 51	88 6 52	297.9	29.37	+54	2.46	Ditto. Ditto. Ditto.

DATE	Variation W.	Dip.	The Time of describing 100 Vibrations	Barom.	Therm.	Kater's Hygr.	REMARKS.
1822.	° ′ ″	° ′ ″	″		°		
May 27 A.M.	57 20 27	87 28 7	288.8	29 62	+39	2.36	Light breeze from S.W. Thick, cloudy weather.
" " P.M.	57 59 15	87 56 37	292.4	29.60	+40	2.33	Ditto. Dark, cloudy weather.
" 28 A.M.	55 50 27	87 40 18	289.6	29.64	+28½	2.51	Fresh breeze from N.b.E. Cloudy.
" " P.M.	58 6 27	87 44 45	286 3	29.70	+35	2.45	Moderate breeze from N. Fine weather.
" 29 A.M.	58 37 51	87 47 30	297.7	29.77	+36½	2 38	Light breeze from N.W. Fine, clear weather.
" " P.M.	57 27 3	88 2 45	299 0	29 80	+58	2.34	Light breeze from W.b.N. Ditto.
" 30 A.M.	59 1 15	87 58 11	294.1	29.81	+37½	2.12	Light breeze from N.b.W. Ditto.
" " P.M.	57 26 15	88 48 11	295.5	29 82	+57½	2 05	Calm. Ditto.
" 31 A.M.	59 27 15	87 31 53	292.9	29.89	+42	1.90	Light breeze from N.W. Ditto.
" " P.M.	59 25 3	87 54 56	293.2	29.95	+51½	1.86	Ditto. Cloudy at times.
June 1 A.M.	58 35 3	87 29 19	290.2	29.95	+41	1.96	Light breeze from S.W. Dark, cloudy weather.
" " P.M.	58 31 15	87 46 23	288.2	29.94	+44	1.96	Ditto. Ditto.
" 3 A.M.	55 21 53	87 49 41	285.2	29 82	+41	2 93	Moderate breeze from N W. Ditto.
" " P.M.	56 42 27	87 48 26	289.2	29.82	+45½	2.52	Ditto Ditto.
" 4 A.M	58 10 15	88 5 49	293.4	29.79	+43½	2.65	Light breeze from S.W. Thick, cloudy weather.
" " P M.	55 53 27	87 40 23	292.0	29.80	+46½	2.44	Ditto Ditto.
" 5 A M.	55 11 15	87 47 49	291.5	29.70	+37	2.69	Fresh breeze from N.W. Cloudy weather.
" " P.M.	58 37 39	87 54 11	292.3	29.66	+34	2.53	Fresh breeze from N.b.E. Ditto.
" 6 A.M.	56 11 51	87 44 7	291.5	29.70	+35	2.70	Moderate breeze from N. Fine weather.
" " P M.	57 46 39	87 29 19	289.7	29.70	+35	2.32	Moderate breeze from N., but a heavy squall at the time of observation. Cloudy weather.
" 7 A M	58 7 51	87 24 37	289.0	29.64	+47½	2.53	Light breeze from N.W. Fine weather.
" " P.M.	57 37 39	87 53 41	289.5	29.61	+37½	2.26	Ditto. Ditto.

ON THE VARIATION, DIP, &c. ISLAND OF IGLOOLIK, N.E. COAST OF AMERICA, 1822—3.

THE observations were made in the same manner as those at Winter Island; with the addition of a column containing the space fallen through by the coloured liquid in Leslie's hygrometer, from the evaporation of pure alcohol applied to one of the bulbs with a camel's-hair brush. Though Kater's hygrometer was extremely sensible at moderate temperatures, yet when exposed to low ones, it often acquired a coating of ice, which obstructed its motion for several days together; whereas Leslie's has the advantage of indicating similar results under the same circumstances; yet the difficulty with this instrument, is the separation of the hygrometric influence arising from the absorbing power of the atmosphere, from that occasioned by the difference of temperature of the bulbs of the instrument, one being at the temperature of the surrounding atmosphere, and the other at a lower temperature arising from the cold produced from the evaporation: the effect produced by this latter circumstance is so considerable, that the instrument (although a very ingenious one) appears to be more a thermometer than an hygrometer at low temperatures. I have endeavoured, however, to correct the indications for the difference of temperature, by a comparison with Kater's hygrometer when the temperatures were above + 32° Fahrenheit. At different temperatures, when Kater's hygrometer indicates the same degree of humidity, the difference between the contemporary indications of Leslie's will be the effect due to the difference of temperature; and by frequent comparisons of this kind, the indications are corrected and reduced to what they would have been at the temperature of + 32° Fahrenheit, and are given in a separate column. As these corrections may be considered somewhat objectionable, forasmuch as the other hygrometer is supposed not to be affected by a change of temperature, I have also given the observations just as they were taken, that they may be corrected upon any other supposition. The alcohol used was of the specific gravity of ·815 at +62° Fahrenheit.

DATE.	Variation W.	Dip.	Time of 100 Vibrations.	Barom.	Therm.	Space fallen through by Leslie's Hygr.	Ditto corrected.	Kater's Hygr.	REMARKS.
1822.	° ′ ″	° ′ ″	″		°	°	°		
Nov. 13 P.M.	. . .	87 53 0	301.7	29.90	−29	. .	. .	. .	Light breeze from N. Fine weather.
„ 14 P.M.	. . .	88 18 11	303.4	30.10	−25	. .	. .	. .	Moderate breeze from N.N.W. Cloudy.
„ 16 A.M.	. . .	88 0 48	301.7	29.52	−23	. .	. .	. .	Light breeze from N.W. Clear.
„ „ P.M.	. .	. . .	297.0	29.50	−23	. .	. .	. .	Ditto. W.
„ 18 A.M.	. . .	87 46 13	296.0	29.91	−24	. .	.	. .	Light variable winds. Clear weather.
„ „ P.M.	. . .	. . .	301.7	29.90	−22	.	. .	. .	Light breeze from S.W. Ditto.
„ 19 Noon	. . .	87 57 19	303.0	29.83	− 9	. .	. .	. .	Ditto. Hazy.
„ 22 A.M.	. . .	87 42 17	307.7	29.58	−37	. .	. .	. .	Light breeze from N.W. Clear.
„ 23 Noon	. . .	87 46 39	297.7	29.79	−41	. .	. .	. .	Calm, clear weather.
1823. Apr. 9 A.M.	84 4 0	87 39 49	286.8	30.28	0	10.5	23	. .	Light breeze from S.W. and cloudy. Aurora the preceding night, and faintly this morning in S.E.
„ „ P.M.	83 49 30	87 47 28	282.0	30.20	+ 7	17.5	35.2	. .	Same weather.
„ 11 A.M.	81 34 15	88 8 37	288.2	30.16	− 3	14.2	27.2	. .	Light breeze from W. and cloudy. Halo round ☉.
„ „ P.M.	83 27 20	87 59 49	290.6	30.15	0	21.2	33.6	. .	Light breeze from S.E. Dark, cloudy weather.
„ 12 A.M.	83 51 30	87 42 0	285.8	30.17	+ 3	14.7	35.0	. .	Moderate breeze from N.W. Snowing all night, but now clearing up.
„ „ P.M.	84 34 0	87 56 0	288.7	30.27	0	13.2	35.6	. .	Fresh breeze from N.b.W., and cloudy.
„ 14 A.M.	83 12 15	88 2 0	284.1	30.30	−11	11	41	. .	Light breeze from W. Clear weather.
„ „ P.M.	83 43 36	87 58 6	287.0	30.16	− 3	17.5	41	. .	Light breeze from S.W. Ditto.
„ 21 A.M.	82 45 20	87 57 34	279.8	29.89	− 5	15	39.2	. .	Light breeze from N.W. Ditto.
„ „ P.M.	83 15 45	87 49 15	319.3	30.00	+ 5	24.7	44.3	. .	Light breeze from N. Ditto.
„ 22 A.M.	83 12 40	87 45 49	281.2	30.18	+ 4	16	35.6	. .	Calm and fine weather. Thermometer in ☉ + 40°.
„ „ P.M.	83 32 20	88 3 15	286.2	30.20	+ 7	27.5	42.9	. .	Light breeze from N.W. Clear weather. Thermometer in ☉ + 33°.
„ 23 A.M.	80 35 40	88 0 23	282.6	30.13	+ 6	14.2	32.5	. .	Moderate breeze from N. Thick foggy weather. Snow occasionally.
„ „ P.M.	83 19 30	88 4 19	284.5	30.08	+13	26	41	. .	Ditto. Ditto.
„ 24 A.M.	82 23 40	87 57 30	281.7	29.92	+ 1.5	12	35	. .	Fresh breeze from N.b.W. Clear weather. Thermometer in ☉ + 20°.
„ „ P.M.	83 24 40	88 10 19	288.6	29.89	+ 3	19.5	36.5	. .	Ditto. Brilliant Halo with mock suns.
„ 25 A.M.	82 54 40	87 53 26	284.4	29.92	+ 8	15.7	32.7	. .	Fresh breeze from N.W. with snow.
„ „ P.M.	82 58 20	88 5 41	286.3	29.89	+ 8	25	42	. .	Ditto. Clear weather.

„ 26 A.M.	81 57 20	87 54 30	285.9	30.05	+ 6	14.5	32.5	. .	Strong breeze from N.W. Cloudy weather.
„ 28 A.M.	83 52 0	87 57 19	286.2	30.00	+25	21.7	28	. .	Moderate breeze from S. Ditto.
„ „ P.M.	84 11 0	88 7 0	288.0	29.83	+25.5	31.5	37	. .	Fresh breeze from S., and clear weather.
„ 29 A.M.	82 54 0	87 51 15	281.4	29.78	+31.5	23	23.5	. .	Light breeze from N.W. Thick foggy weather, with snow.
„ „ P.M.	83 25 20	88 4 4	286.5	29.80	+20	28	37.6	. .	Ditto Clearing up.
„ 30 A.M.	81 56 20	88 1 26	287.0	29.99	+ 8	12.5	39.5	. .	Strong breezes from N.W. Clear weather.
„ „ P.M.	83 7 45	88 9 41	288.4	30.08	+10	21.5	37.6	. .	Strong breezes from N.W. Clear weather.
May 1 A.M.	82 9 20	88 0 37	279.2	30.06	+12	23.7	39.2	. .	Light breezes from N.W. and cloudy. Halo round ⊙.
„ „ P.M.	83 39 0	88 19 4	292.2	30.00	+14	34.2	48.2	. .	Ditto. Parhelion E. and W. of ⊙.
„ 2 A.M.	82 19 40	88 3 11	287.1	29.95	+15	17	30	. .	Moderate breeze from E., thick weather with snow.
„ „ P.M.	82 12 20	88 7 56	281.6	30.00	+14	21.5	35.5	. .	Fresh breeze from N.E. Weather clearing.
„ 3 A.M.	82 22 20	88 10 19	273.9	30.03	+ 8	15.5	32.5	2.39	Fresh breeze from N.b.E. Thick, cloudy weather.
„ „ P.M.	82 0 0	88 11 34	282.1	30.02	+16	20.2	32.7	2.23	Ditto. Ditto.
„ 7 A.M.	82 44 30	89 25 13	281.8	29.97	+36	27.5	24	4.80	Fresh breeze from E. Foggy, with snow and rain.
„ „ P.M.	83 39 0	88 8 27	289.3	30.05	+37	40.7	36.2	3.31	Ditto. Ditto.
„ 8 A.M.	82 16 40	88 22 30	284.5	30.31	+42	30	21	4.34	Moderate breeze from S.E. Thick, cloudy weather.
„ „ P.M.	84 14 40	88 19 53	286.9	30.40	+46	40.2	27	2.74	Light breeze from S.E. Ditto.
„ 9 A.M.	83 28 30	88 19 15	287.0	30.46	+42	31.5	22.5	3.51	Light breeze from N.W. and cloudy.
„ „ P.M.	84 4 40	88 8 0	286.0	30.45	+46	45.5	36.7	2.41	Ditto. Ditto.
„ 10 A.M.	82 40 30	88 12 49	281.2	30.41	+35	31	27	3.07	Moderate breeze from W. Cloudy. Halo round ⊙. A dense white fog at the end of observation.
„ 12 A.M.	. . .	88 28 56	283.2	30.16	+28	24.7	28	3.32	Fresh breeze from N.W., and cloudy.
„ „ P.M.	. . .	88 28 37	284.5	30.15	+25	26	32	3.06	Ditto, ditto.
„ 13 A.M.	. . .	88 20 0	282.7	30.02	+22	20.5	28.5	3.25	Ditto. Clear weather.
„ „ P.M.	. . .	88 34 30	284.0	30.10	+29	27	29.5	3.07	Ditto. Ditto.
„ 14 A.M.	84 11 20	88 18 40	281.7	29.95	+22	21.5	32.5	3.03	Light breeze from W.b.S., and hazy.
„ „ P.M.	85 3 20	88 23 4	282.7	29.88	+35	36.5	33.5	2.36	Fresh breeze from S. Thick weather, and much snow.
„ 15 A.M.	83 56 20	88 36 43	286.2	29.76	+39	27.5	21.5	2.95	Light breeze from S.b.E. Thick cloudy weather with snow.
„ „ P.M.	83 47 20	88 24 30	288.6	29.75	+38	36.5	31	2.32	Ditto. Ditto.
„ 17 A.M.	82 30 40	87 55 9	283.8	29.46	+26	18.5	23.5	4.56	Strong breezes from N. Cloudy weather.
„ „ P.M.	82 32 40	88 13 23	280.4	29.47	+32	24.2	24.2	3.66	Moderate breezes from N. Cloudy.

DATE.	Variation W.	Dip.	Time of 100 Vibrations.	Barom.	Therm.	Space fallen through by Leslie's Hygr.	Ditto corrected.	Kater's Hygr.	REMARKS.
1823.	° ′ ″	° ′ ″	″		°	°	°	″	
May 19 A.M.	83 26 40	88 10 49	283.7	29.74	+23	19	26.5	3.63	Fresh breezes from N.W. Clear.
„ „ P.M.	83 15 40	88 17 7	283.5	29.73	+28	28	31.2	3.38	Ditto.
„ 20 A.M.	83 32 45	88 10 30	275.3	29.73	+14	20	34	3.26	Light breeze from W.b.N. Cloudy.
„ „ P.M.	85 7 40	88 5 7	264.4	29.66	+25	28	34	3.09	Light breeze from W.b.N. Cloudy.
„ 21 A.M.	82 50 20	88 14 11	285.3	29.59	+17	19.5	30.5	3.61	Strong breezes from W.N.W. Thick, cloudy weather.
„ „ P.M.	82 47 0	88 17 53	287.3	29.59	+21	20	29	3.32	Ditto, with snow.
„ 22 A.M.	83 16 15	88 21 45	286.6	29.55	+28	24	27.2	3.57	Calm, with light snow.
„ „ P.M.	84 3 20	88 18 11	281.5	29.[illegible]5	+39	39.5	33.5	2.58	Light breeze from S.E. Thick, cloudy weather.
„ 23 A.M.	82 22 15	88 20 19	283.2	29.55	+31	26.5	27.5	3.45	Moderate breeze from S.E. Thick weather, with snow.
„ „ P.M.	83 3 0	88 26 4	281.6	29.65	+3[illegible]½	37	35.5	2.73	Ditto.
„ 24 A.M.	82 28 40	88 11 19	283.4	29.69	+33	31.5	30.5	3.26	Ditto.
„ „ P.M.	84 14 20	88 20 45	278.0	29.64	+37	37	32.5	2.64	Ditto.
„ 26 A.M.	84 21 20	88 18 13	278.5	29.80	+40	32.5	25.2	3.71	Light breeze from S.E. Thick, cloudy weather.
„ „ P.M.	84 51 0	88 24 49	287.0	29.84	+48	52	36	2.37	Ditto. Ditto.
„ 27 A.M.	83 11 20	88 24 56	274.8	30.00	+25	20.2	26.2	2.83	Moderate breeze from W.b.N. Fine clear weather.
„ „ P.M.	83 21 20	88 9 53	279.1	30.10	+40	42.5	35.2	2.51	Very light breeze from W. Ditto.
„ 28 A.M.	82 33 40	88 25 30	279.0	30.05	+38	33	27.6	2.61	Light breeze from N. Thick, cloudy weather.
„ „ P.M.	83 27 40	88 22 37	283.1	29.97	+45	46.5	34.5	1.66	Moderate breeze from S.b.W. Ditto.
July 16 A.M.	82 6 31	88 19 49	282.8	29.84	+56	51	26	2.94	Calm, fine weather.
„ 17 A.M.	81 48 11	88 19 23	282.9	29.81	+57	48.5	22.5	3.05	Calm and cloudy.
„ „ P.M.	82 32 11	88 18 41	283.4	29.81	+60	58.5	23	2.84	Ditto.
„ 18 A.M.	80 51 51	88 27 19	280.9	29.75	+55	39	15	3.17	Calm. Cloudy, rainy weather.
„ „ P.M.	82 11 11	88 16 56	285.1	29.72	+63	58	23	2.92	Moderate breeze from S.E. Rather cloudy.
„ 19 A.M.	82 50 51	88 36 26	291.2	29.68	+60	43.5	13	3.08	Light breeze from W. Fine weather.
„ „ P.M.	83 19 11	88 3 15	291.5	29.68	+68.5	67.5	26	2.30	Light breeze from S.W. Thermometer in ⊙ + 114° Fahr.
„ 21 A.M.	80 43 11	88 20 30	275.9	29.36	+41	31	23	4.56	Moderate breeze from S.E. Cloudy weather.
„ „ P.M.	81 42 31	88 24 45	278.6	29.38	+47	34.5	19.5	4.11	Ditto.

AN ABSTRACT OF THE MAGNETICAL OBSERVATIONS.

DATE.	Latitude N.	Long. W.	Variation W.	Dip.	Time of 100 Vibrations.	REMARKS.
	° ′	° ′	° ′	° ′ ″	″	
1821.	. .	. .	. .	69 59 44	333.3	Mean of observations in and near London, before and after the expedition.
July 4	61 13	64 43	52 45	83 58 51	. .	Upon a floe of ice in Hudson's Straits.
Aug. 3	65 8	79 35	52 12	87 9 11	. .	Ditto.
„ 17	65 30	85 15	17 7	87 27 52	. .	On shore. Duke of York's Bay. Southampton Island.
„ 22	66 31	86 28	48 33	88 7 28	. .	On shore. North side of Repulse Bay.
„ 29	66 13	84 40	52 20	87 30 35	. .	On shore. Duckett Cove.
Sept. 6 – „ 13	66 38	84 11	54 0	87 51 55	. .	Lyon's Inlet.
1822.	66 11	82 54	57 24½	87 51 9	297.3	Mean of all the observations made at the winter station, Winter Island.
July 6	66 37	81 39	62 17	87 47 13	299.6	Upon the sea ice.
„ 22	69 34	81 14	82 32	87 37 9	293.9	Ditto.
Aug. 6	69 32	81 23	86 6	88 6 26	. .	Ditto.
Sept. 9	69 48	83 28	89 18	88 21 21	. .	Fury and Hecla's Straits. Upon the ice.
1822-3.	69 21	81 37	83 1½	88 9 49	286.7	Mean of all the observations made at the Winter Station, Island of Igloolik.

TABLE

Of the MEAN RESULTS of the MAGNETICAL OBSERVATIONS at both WINTER STATIONS

I.—AT WINTER ISLAND IN 1821—2.

Lat. 66° 11′ N. Long. 82° 54′ W.

DATE.	No. of Times of Observation.	Variation W.	Dip.	Time of completing 100 Vibrations	Mean State of Thermometer.
		° ′ ″	° ′ ″	″	°
1821—Middle of October . . .	6	. . .	87 51 15	299.7	+ 9
1822—Beginning of January . . .	5	. .	87 56 38	304.9	– 2¼
„ Middle of April	12	56 1 6	87 51 25	298.7	+ 22
„ Middle of May	12	58 16 20	87 52 17	296.2	+ 38
„ End of May . . .	12	57 17 16	87 51 20	293.7	+ 43
„ Beginning of June . .	14	57 32 50	87 43 57	290.6	+ 45½
MEANS		57 24 23	87 51 8	297.3	

II.—AT THE ISLAND OF IGLOOLIK. 1822—3.

Lat 69° 21′ N. Long. 81° 37′ W.

DATE.	No. of Times of Observation.	Variation W	Dip.	Time of completing 100 Vibrations	Mean State of Thermometer.
		° ′ ″	° ′ ″	″	°
1822—Middle of November . . .	9	. .	87 54 55	300.4	– 25½
1823—Middle of April	18	83 9 [illegible]0	87 56 47	285.3	+ 2
„ Beginning of May . . .	17	82 59 37	88 8 43	284.9	+ 17
„ Middle of May	17	83 45 23	88 18 28	283.6	+ 32
„ End of May	14	83 11 0	88 19 45	282.2	+ 36
„ Middle of July	9	82 3 12	88 20 17	283.6	+ 30
MEANS		83 1 32	88 9 49	286.7	

In order to compare the following observations with the formula, expressing the relation between the magnetic force and the dip, *viz.*, $f \propto \left\{\frac{1}{4 - 3 \sin.^2 d}\right\}^{\frac{1}{2}}$. where f and d represent these quantities. The time of completing 100 vibrations by many observations (with the needle employed for this purpose,) in and near London, in April, 1821, was 330″.1; and on the return of the Expedition it was 336″.5; the mean between these results is 333″.3, for the time of making 100 vibrations. By many observations also, with the same instrument, before and after the voyage, by myself, with a great many others, (with another instrument of the same construction belonging to the Board of Longitude,) made by Professor Rigaud, Captain Home, R. N., and myself, at several places near London with seven different needles, two of which were of Meyer's construction, the dip was found to be 69° 59′ 44″, for January, 1823, (which is about the middle time of the observations) which nearly agrees with Captain Sabine's determination.* From this data, it appears that the *computed* time of making 100 vibrations at Winter Island is 309″.5, the dip being 87° 51′ 9″; whereas by a mean of all the observations made during the winter and summer at that place, the *observed time* was 297″.3; the time therefore of completing the 100 vibrations at Winter Island was less than that computed from the formula by 12″2. In the same way, at the second Winter's Station at the Island of Igloolik, the mean of all the observations gives the time of completing 100 vibrations 286″.7, the dip being 88° 9′ 49″; whereas the time computed from the formula is 309″.4. In this case also, the time of completing the 100 vibrations was *less* than that computed from the formula, by the quantity 22″.7. At each place, therefore, the vibrations of the needle indicated a greater intensity of force than that deduced from the above formula, which assigns a difference of 0″.1 only between the times of completing the 100 vibrations at each Winter Station; but by observation it was 10″.5.

The great difference observed in the times of making the vibrations during the winter and summer times, was very considerable at each of the Winter Stations, and therefore hinders any rigid comparison of this kind from being made. For instance, in the middle of Winter, at Winter Island, the time of completing the 100 vibrations was 304″.9, but which gradually diminished as the summer advanced, and in the following June, it was 290″.6, the difference being 14″.3. Also at the second Winter Station at Igloolik, in the winter, the time of making 100 vibrations was 300′.4, but in the following June it was 283″.0, the difference being 17″.4; at both places the intensity of the force was considerably greater during the summer than in the depth of winter, as the abstract of the observations themselves (page 276) will shew; and the time of making the 100 vibrations in the winter time nearly agrees with the computed time.

The great irregularity in the results of the observations for determining the variation, renders it difficult to form any idea of the quantity of its daily change, between the hours of observation in the morning and afternoon, although each result is a mean of never less than 5, and often 10 or 12 readings of the needle. The fixed telescope of the instrument was always referred to the distant object, put up for the purpose of ensuring the stability of the instrument, before the readings were taken, and the sluggish motion of the needle assisted by gently tapping upon its cover, as well as every other possible precaution taken to ensure an accurate result. At Winter Island during the months of November, December, and January, the westerly variation in the morning was *greater* than in the afternoon by 57′, from a mean of more than 300 observations; by a mean of all the observations at this place both winter and summer, the morning exceeded the afternoon variation by 13′.24″. But at Igloolik, the second Winter Station, the variation in the morning was *less* than in the afternoon by 38′.54″, from a mean of near 600 observations made during the spring and summer months at that place. At Winter Island the dip was 19′ greater; and at Igloolik 1′ less in the morning than in the afternoon. The time of completing 100 vibrations was 1″.3 *greater* in the morning than in the afternoon at Winter Island; but at Igloolik, it was 2″.3 *less* in the morning than in the afternoon; so that with respect to the variation, dip, and the time of completing 100 vibrations, contrary results were obtained at the Winter Stations in the morning and afternoon observations. The number of observations for determining the dip amount to 143 made at different times, and each of these a mean of from 8 to 16 different readings of the needle, in its different positions: the observations upon the vibrations of the needle have been taken at as many different times; most of the results are means between two sets of vibrations, and many of them (when they have differed) means of three or four sets.

The only agreement which appears, by comparing together the observations made at each Winter Station, is the increase in the magnetic force as the summer advances, which is very apparent; and as the time of completing the 100 vibrations by the same needle was about six seconds *greater* after the return of the Expedition, than before it left England it does not seem probable