XVI. *A Comparison of Barometrical Measurement, with the Trigonometrical Determination of a Height at Spitzbergen. By Captain* EDWARD SABINE, *of the Royal Regiment of Artillery, F. R. S.*

Dated from Spitzbergen, July 24, 1823.

Read May 6, 1824.

THE hill selected for the comparative measurement was, as far as could be judged, the highest, within convenient distance, of which the ascent was practicable, being rather above the general height of the hills on the western part of the north coast of Spitzbergen; the summit was distant less than two miles from the Observatory on the Inner Norway Island, in a direction very nearly due south, as the mark, which was placed to determine the point of measurement, was within the field of the meridian transit instrument: the hill was situated on the main land, and was divided from the island on which the Observatory was established, by a sea channel of little more than a mile across, making part of the harbour of Fair-haven. The annexed sketch of the harbour and of the adjacent coast will be sufficient to point out the positions of the hill and of the Observatory, and is the more necessary, as the plan of Fair-haven, published in Captain PHIPPS's Voyage, (in which an endeavour might otherwise be made to trace them,) is so exceedingly inaccurate though purporting to be from actual survey, that after having been nearly three weeks on the spot, I am even more perplexed than on the

day of arrival, to assign in the plan, the island which is intended to represent the one on which the Observatory is placed, or the position of the hill in question; the latter, I apprehend must have been designed either by the one marked *(a)* in Captain PHIPPS's, (or rather in Mr. D'AUVERGNE's) plan, or by that marked *f*, although neither corresponds, even within ordinary limits, in height, or in relative position. The present sketch, Plate XIII. is taken principally from a manuscript survey of Captain BEECHEY's, when at Spitzbergen as a Lieutenant in Captain BUCHAN's expedition of 1818; Captain BEECHEY's Survey has been found remarkably correct wheresoever we have had an opportunity of verifying it.

The shore of the main land to the north eastward of the hill forms a small bay, which being frozen over, afforded a perfectly level base, in which no correction was required for inequalities of surface, and the consequent liability to error introduced in the reduction was avoided. Having stationed a line of poles in such manner as to cover each other exactly, by means of a telescope placed at the one extremity, the distance between the extremes was carefully measured with a GUNTER's chain, by Mr. HENRY FOSTER, of His Majesty's Ship Griper, and myself, and was found to amount to 36 lengths, or 2376 feet; the chain was drawn along the surface of the ice at each remove, so that the links were prevented from entanglement; it was stretched at each repetition as tightly as two persons could draw against each other, and the spots marked by flat plates of iron, furnished with long spikes by which they were fixed securely in the ice; the temperature of the air was 35°, and of the chain 32°. In

a second measurement, with the same precautions as on the first occasion, the difference did not amount to more than an inch and half. The extremities of the base, being abreast of two projecting points of land, one on the main shore, and the other on a small rocky island, offsets were made at right angles to the base, each of 38 feet, and the spots carefully marked, as containing between them the distance originally measured, with the additional advantage of a firm foundation at the extremities for future operations. This base is the line marked A B in the annexed plan, Plate XIV.

A polished copper cone borne at the end of a staff was securely fixed at the summit of the hill; the apex of the cone was proposed as the height to be measured, and was 44 inches above the highest pinnacle of the hill.

The base had been chosen for convenience in measurement, although its direction was not the most suitable for obtaining the horizontal distance of the cone nor indeed was the cone itself visible from B; a third station, C, was therefore selected across the bay, close to the waters' edge, and the distance A C obtained from the base AB, and the angles at A, B, and C. A C thus became a base for the determination of the horizontal distance of the cone, enabling its height to be ascertained from its zenith distance observed at A and C.

The instrument used for the horizontal and vertical angles was a repeating circle upon the recently improved English construction; concerning which, as it regards the vertical angles, it will be sufficient to notice, that of six observations of the meridian zenith distance of the sun to obtain the latitude of the Observatory, whereof four were on

the northern and two on the southern meridian, the extreme differences in the latitude deduced from the results did not amount to 7 seconds; and as each zenith distance in the present determination is a mean of several repetitions, they may be presumed to be free from any error which could affect the conclusion. It was not considered necessary to go through the process of repetition in the horizontal angles, especially as there were four verniers on the circle; each angle, however, is the mean of separate observations by Mr. FOSTER and myself, both of which are inserted. It will be seen, that in the triangle A. B. C. the three observed angles fell short by 57 seconds of 180°. It was not however deemed necessary to repeat the observations, for the purpose of detecting an error which does not make a difference of one inch in the length AC, nor, consequently, in the altitude of the hill; a third of 57 seconds, or 19 seconds, has however been added to each of the observed angles to complete their sum to 180°.

A corroboration of the measurements from A and C was obtained by including the Observatory, which was visible from the three stations, and from whence the zenith distance of the cone was also observed; the angles were taken, as nearly as could be judged, to the middle of the door of the Observatory, which faced the south; as however it did not present so definite an object as a station pole, and as moreover the distance of the cone from the Observatory was much greater than from A and C, and the angle of elevation consequently much less, it may be preferable as a fixed determination to take a mean of the results at A and C, and to consider the one obtained at the Observatory simply as corroborative.

The following detail comprises the observations, and the computed results.

From Station A,

The circle being nine feet above half tide.

Horizontal Angles.	CAB. FOSTER 63° 09′ 16″;	SABINE 63° 09′ 16″;	Mean 63° 09′ 35″.*
	OAB. —— 128 27 12,5;	—— 128 27 17;	—— 128 27 15.
	OAD. —— 124 08 35;	—— 124 08 33;	—— 124 08 34.
	OAC. —— 65 17 40;	—— 65 17 40;	—— 65 17 40.
Zenith distance of the Cone.	Mean of 4 observations . . —— 76 53 48 Mean of 2 observations . . —— 76 53 47 Mean of 2 observations . . —— 76 53 48	—— 76 53 48.	

From Station B.

Horizontal Angle A.B.C. FOSTER 57°40′11″,5; SABINE 57°40′15″. Mean 57°40′32″.*

From Station C,

The circle being nine feet above half tide.

Horizontal Angles.	ACB. FOSTER 59° 09′ 14″;	SABINE 59° 09′ 52″,5;	Mean 59° 09′ 52″.*
	ACD. —— 102 10 33;	. . . . .	. 102 10 33.
	ACO. —— 96 40 36;	—— 96 40 20;	—— 96 40 28.
Zenith distance of the Cone.	Mean of 4 observations . . —— 75 07 45 Mean of 2 observations . . —— 75 07 46 Mean of 2 observations . . —— 75 07 50	. . 75 07 47	

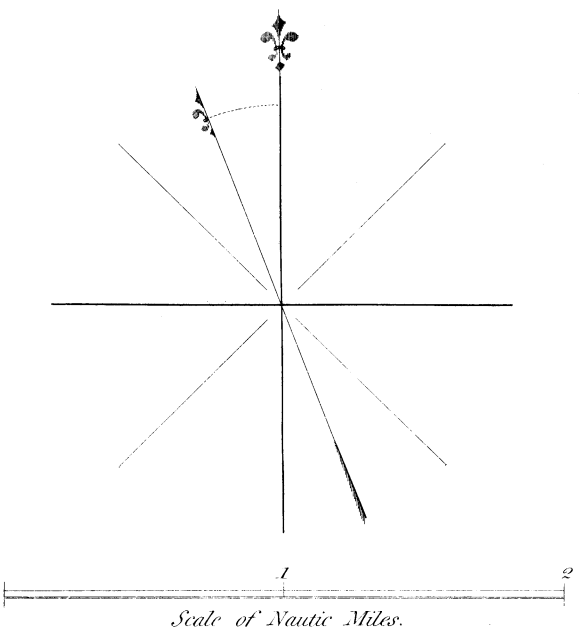
From the Observatory,

The circle being 31.5 feet above half tide.

Zenith distance of the Cone.	Mean of 4 observations; SABINE 82°51′15″ Mean of 2 observations; —— 82 51 20.	. . 82° 51′ 17″,5.

* One third of 57″ added to complete the sum of the angles at A, B, and C to 180°.

SKETCH
of the Harbour of
FAIR HAVEN,
and of the
adjacent Coast of
SPITZBERGEN.

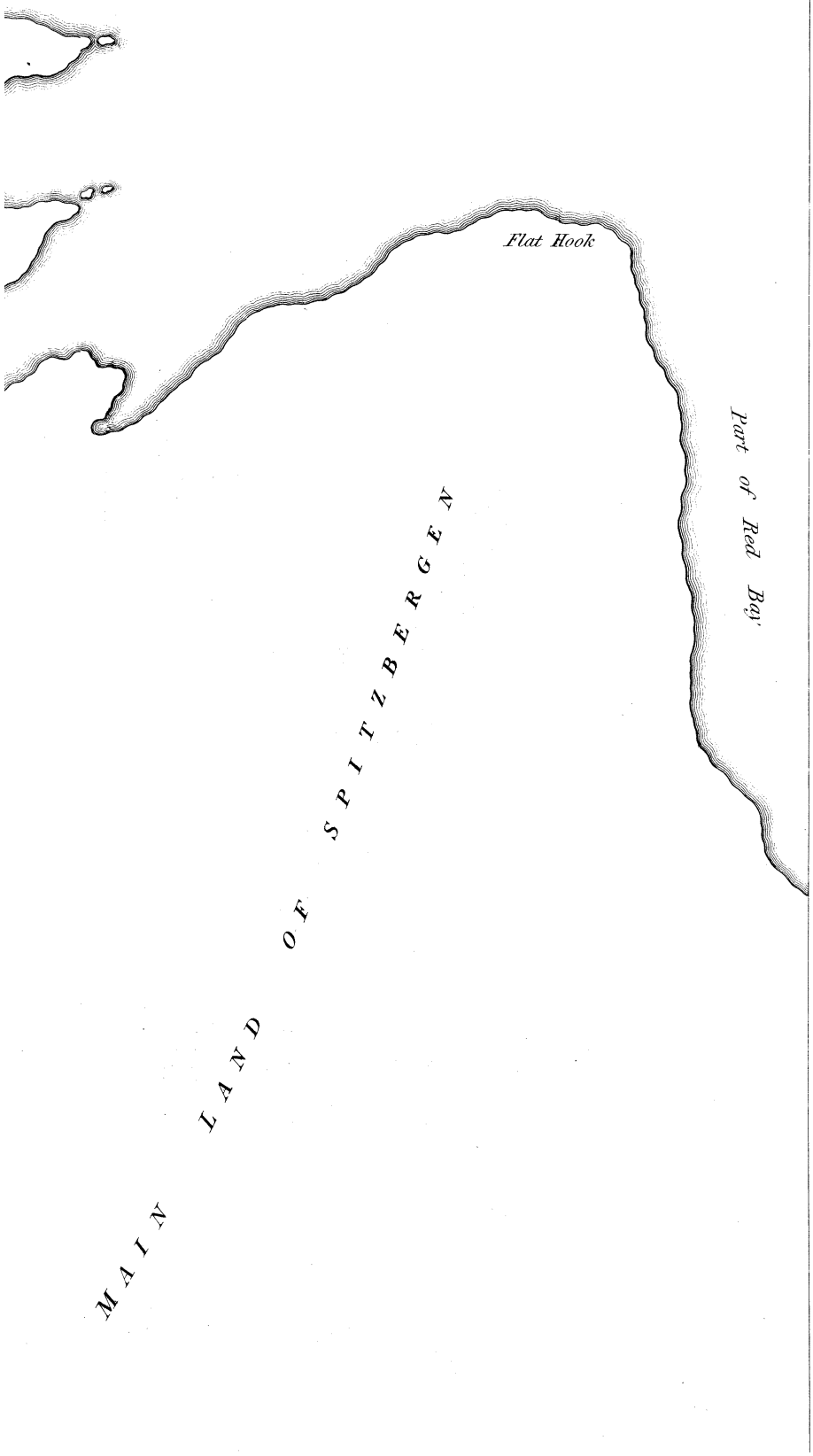


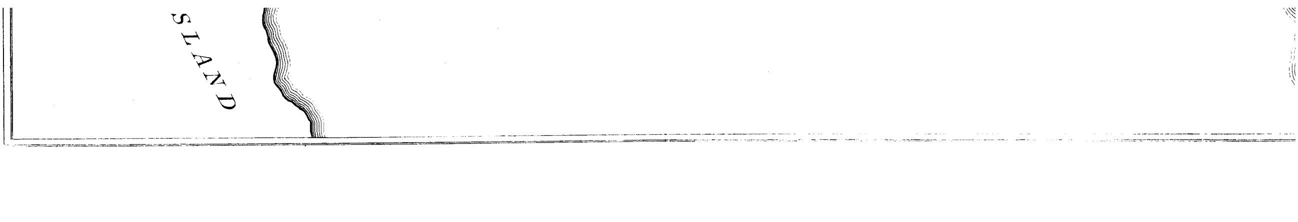
S. 71° 38' 40" W. dist. 53.161 feet.

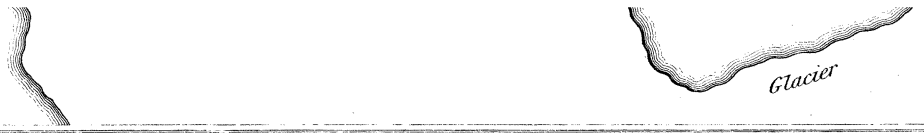
Hackluyt's Headland

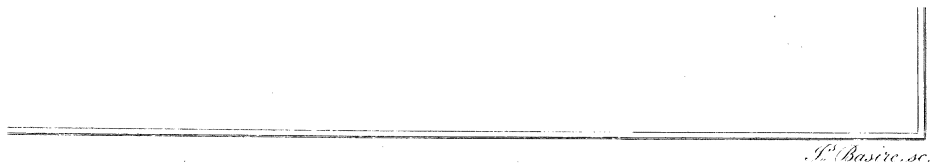
PART OF AMSTERDAM ISLAND


Vogelsang
Cloven Cliff
N. 25° 5′ 28″ W. dist. 11473 feet.
Observatory
O
Phipps's Island
C
A
B
Glacier
D
Hill
FOUL ISLAND
Foul Point
Glacier

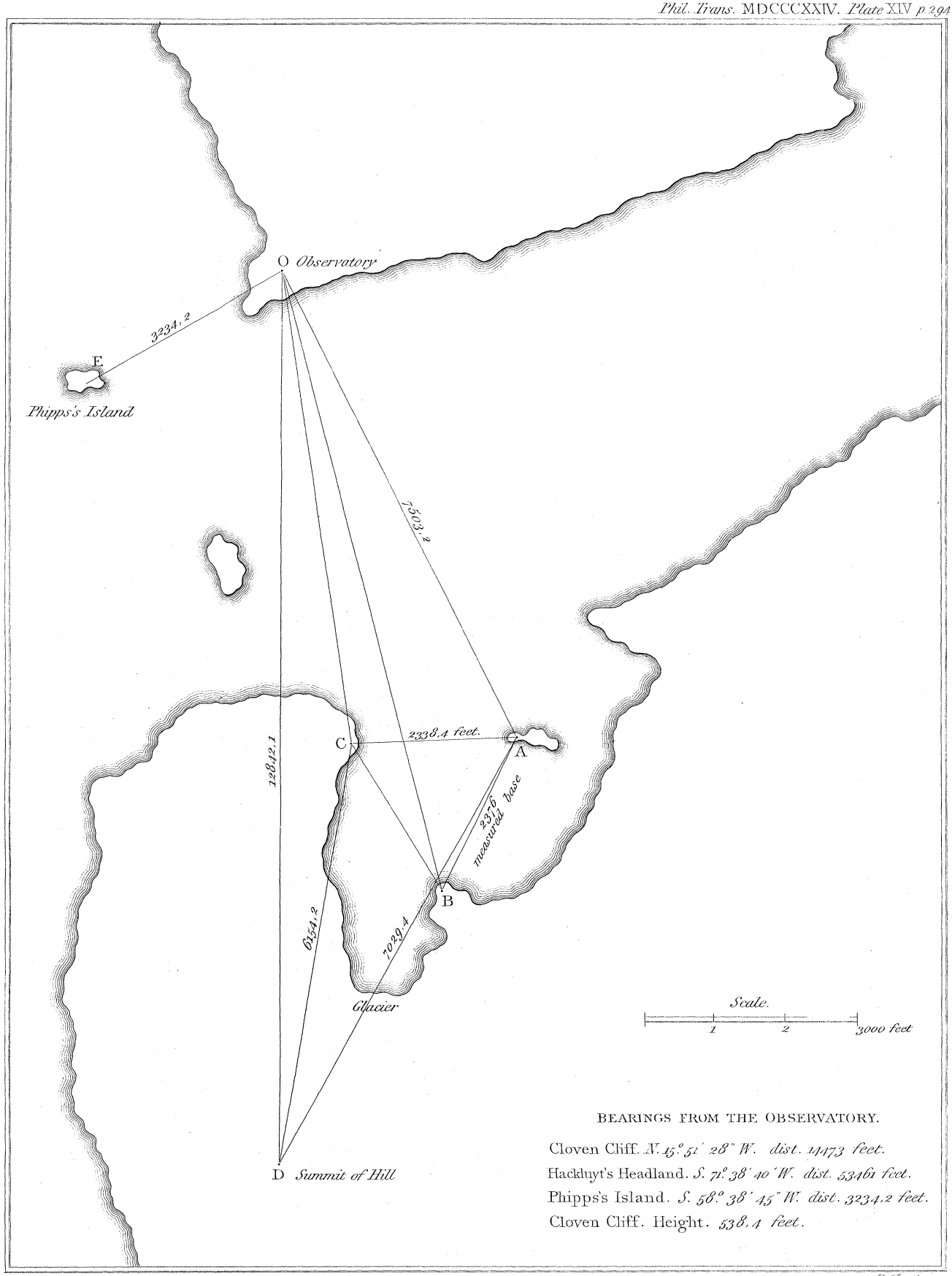

Flat Hook
Part of Red Bay
MAIN LAND OF SPITZBERGEN


SLAND


Glacier



L. Basire. sc.



BEARINGS FROM THE OBSERVATORY.

Cloven Cliff. *N.* 45.° 51′ 28″ *W. dist.* 14473 *feet.*
Hackluyt's Headland. *S.* 71.° 38′ 40″ *W. dist.* 53461 *feet.*
Phipps's Island. *S.* 58.° 38′ 45″ *W. dist.* 3234.2 *feet.*
Cloven Cliff. Height. 538.4 *feet.*

P. Basire, sc.

Deductions.

AC = 2338,35 feet. AO = 7503,2 feet.
AD = 7029,4 feet. OD = 12842,1 feet.
CD = 6154,2 feet.

Altitude of the Cone.

From Station A.	*From Station* C.	*From the Observatory.*
1645,2 feet.	1643,1 feet.	1641,4 feet.

The mean of the three results is 1643,2 feet; and of the first and second 1644,15 feet; and if one-twelfth of the intercepted arc be added to the zenith distance, to compensate for the effects of terrestrial refraction, the first mean will be reduced to 1642,8 feet, and the second, which is considered the preferable, for reasons already assigned, to 1644 feet.

Barometrical Measurement.

The instruments employed for this purpose were a marine barometer made by Mr. JONES, and a mountain barometer made by Mr. NEWMAN; the first having a glass cistern, and the second an iron cistern: Mr. JOHN FREDERIC DANIELL, Fellow of the Royal Society, whose attention had been particularly devoted to the construction and improvement of meteorological instruments, was kind enough, at my request, to superintend their progress through the makers' hands.

In the construction of these barometers, the tube, cistern, and scale, were secured, in the first instance, or designed to be secured, immoveably to each other, and the scale was subsequently graduated from the surface of the mercury in the cistern. It happened that this operation was performed in

both cases, when the height of the mercury in the tube was 30,400 inches, which thus became in both barometers a neutral point at which no correction was needed, equivalent to the more ordinary adjustment of the zero of the scale to the level of the cistern; and from whence, at all other heights of the mercury, a correction would obtain, additive to the reading if the height should exceed 30,400 inches, and subtractive if below that amount: the diameters of the tubes were respectively .31 and .15 inches; and their ratio to the capacity of the cisterns being of JONES'S as 1 to 11, and of NEWMAN'S as 1 to 54, $\frac{1}{11}$, and $\frac{1}{54}$ of the respective differences between the height of the mercury indicated by the scale, and 30,400 inches were the corrections to be applied.

The temperature of the mercury at the time of observation was shown in both the barometers by a thermometer having its bulb in the cistern and immersed in the mercury itself; the verniers were furnished with a tangent screw for slow motion, and being made to encompass the tube, assured the proper position of the eye in adjusting the zero of the vernier to the surface of the mercury; the adjustment was capable of being made with much precision by the assistance of a microscope.

The instruments having been thus constructed independently of each other, and without reference to other barometers, were compared at Mr. NEWMAN'S house, on their completion in May 1823, by Mr. DANIELL, Mr. NEWMAN, Mr. JONES, and myself, as follows:—

	A.M.		P.M.	
	Newman's.	Jones's.	Newman's.	Jones's.
Mr. Daniell .	30.188	30.192	30.110	30.120
Mr. Newman .	30.188	30.200	30.106	30.119
Mr. Jones . .	30.182	30.192	30.116	30.120
Captain Sabine	30.180	30.191	30.103	30.122
Mean . . .	30.1845	30.1937	30.1087	30.1202
Capacity . . .	—.0039	—.0187	—.0052	—.0254
Capillary action	+.0880	+.0280	+.0880	+.0280
	30.2686	30.2030	30.1915	30.1228
Differences; Jones's less	.0656.		.0687.	
	Mean .067			

The cause of the difference of .067 parts of an inch in the indications of the two barometers did not appear obvious, either to Mr. Newman or to Mr. Jones; and though its occurrence was not quite so satisfactory as a perfect, or even as a nearer accordance might have been, it was no otherwise important than as it made an index correction of .067 necessary to be applied, additive to Mr. Jones's or subtractive to Mr. Newman's, to cause the height of the one to be inferred from that of the other.

On my arrival in Norway in June, I was surprised and mortified to perceive, that, after so much pains had been bestowed, a greater difference obtained in the indications of the barometers than in the former comparison; on a close examination, a small quantity of mercury was discovered to have lodged between the cistern of Mr. Jones's and its brass enclosure, which I at first concluded had escaped from the cistern; no leak was however perceptible, and the cistern and tube, as well as every other part of the barometer were

apparently uninjured. I had with me a third barometer made by Mr. NEWMAN for a Gentleman at Hammerfest, at the same time and with equal care as the others, and which had been compared with them in London: by means of the third barometer the alteration was ascertained to have taken place in Mr. JONES's, and not in either of Mr. NEWMAN's. It has since occurred to me, as affording a possible explanation of the alteration, that after the comparison in London, Mr. JONES took his barometer with him to his house to engrave the neutral point, and the diameter of the tube, upon the brass cover of the cistern, and I remember that he spoke of one or two screws which required to be tightened, and which, he observed, might affect the relation of the cistern and scale. That the alteration should have taken place at that time and in some such manner; and that the mercury which appeared between the cistern and its cover had lodged there accidentally in the original putting together of the instrument, and that it was not therefore concerned in producing the change, would seem the more probable supposition, than that it should have escaped subsequently from the cistern; since, if a part of the mercury had found a means of escape, more would have followed either then or since, which however has not been so, as no alteration has taken place subsequently in the relative indications of the two barometers. Having ascertained this last fact on my arrival at Spitzbergen, in July, a careful series of comparisons was instituted to determine the exact amount of the alteration since the original comparison at Mr. NEWMAN's, and to obtain a fresh index correction and neutral point, since each would be alike affected, whether the cause were a

displacement of the scale, or a diminution of mercury in the cistern. The subjoined comparisons will show that an alteration, amounting to 0.129 parts of an inch, being supposed to have taken place since the first comparison, making the index correction of Mr. JONES's + 0.196, and its neutral point 30.271, will reconcile all the comparisons within such limits as may readily be allowed as errors of observation. The mean difference of fourteen comparisons thus reduced is less than four ten-thousandths of an inch; whence it is reasonable to conclude, that from the same number of observations, made under similar circumstances, the height of NEWMAN's barometer may be inferred from that of JONES's, and *vice versa*, to an equal degree of exactness.

The table of comparisons shows the actual readings of the two barometers, corrected only for the expansion of mercury and of the scale to a mean temperature of 32°; the last column exhibits the differences in excess or defect, of JONES's on NEWMAN s, after the application of their respective correction for capacity, capillary action, and an index error of + 0.196.

	NEWMAN'S.	JONES'S.	*Diff.*
Hammerfest, June 10,	30.116	30.002	+.003
Spitzbergen, July 12,	29.890	29.791	+.003
- - 13,	29.867	29.764	—.003
- - 13,	29.857	29.757	—.001
- - 13,	29.864	29.762	—.002
- - 13,	29.860	29.765	+.005
- - 14,	29.888	29.783	—.003
- - 14,	29.910	29.798	—.010
- - 15,	29.937	29.826	—.006
- - 15,	29.885	29.784	000
- - 16,	29.811	29.715	000
- - 16,	29.756	29.666	+.003
- - 17,	29.698	29.611	+.002
- - 17,	29.721	29.633	+.003

Mean difference, JONES's in defect .0004 nearly

In the experiments for determining the height of the hill, NEWMAN'S barometer was employed on the summit, and JONES'S by the sea. The station of the lower barometer was on the outside of a house framed of wood with boarded walls, which was constructed for my pendulum experiments; the house was 12 feet square, and stood withinside a tent of sufficient dimensions to admit of passage room between the walls of the tent and house; the barometer was so suspended as to be entirely detached from the side of the house, and the walls of the tent were unhooked during the observations; the cistern was 21 feet above the level of half tide. NEWMAN'S barometer was suspended beneath the cone on the summit of the hill on the 17th of July, and was not removed from thence until the afternoon of the 21st, being suffered to remain under a temporary protection, which was of course removed during the observations; the cistern was on a level with the highest point of the hill, and 44 inches below the apex of the cone, which, being the proposed point of measurement, renders an addition of $21 + 3.66 = 24.66$ feet necessary to the result obtained by the barometric difference, to give the total height of the cone above half tide. The times at which the observations were repeated, were previously concerted; and as the motions of the observer on the summit of the hill were visible with a good telescope from the Observatory, the simultaneous observation was assured. The hygrometer and detached thermometer were used in all cases in the open air and in the shade: the hygrometer was the recent invention of Mr. DANIELL, which is distinguished by his name; the results deducible from the barometric differences, under the observed circumstances of the atmo-

sphere in respect to temperature and aqueous vapour, are computed agreably to the method published by Mr. DANIELL, in the 13th volume of the Journal of the Royal Institution.

July 17th. P. M. The weather dull with little wind; the hills generally enveloped in fog.

	OBSERVATORY, SABINE.				HILL, FOSTER.			
App. time.	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*
4.30	29.671	40	35	34	28.012	39	37.3	In a cloud more or less dense during the whole period.
5.00	29.673	40	35	34	28.009	36.2	35.2	
5.30	29.674	39.5	35	34	28.009	35.5	34.5	
6.00	29.676	39.5	34.5	34	28.000	34.9	34.9	
	29.6735	39.75	34.9	34	28.0075	36.4	35.5	35.5
Corrections: Reduction to 32°	—.0200				—.0105			
Capacity . .	—.0561				—.0445			
Capillary action	+.0280				+.0880			
Index . .	+.1960				. . .			
True Barom. heights	29.8214				28.0405			

Result. Height of the Cone 1644,58 *feet.*

July 18, *P. M.* A thick fog with a moderate breeze.

	OBSERVATORY, SABINE.				HILL, FOSTER.			
App. time.	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*
3.20	29.675	40.5	36	Fog.	28.021	36.	33.5	Dense fog.
3.30	29.6755	40.5	36	-	28.021	35.5	34	-
4.00	29.677	40	35.5	-	28.014	36	35.5	-
4.30	29.678	39.2	35.6	-	28.024	36	34.8	-
5.00	24.679	39	35.2	-	28.033	35.8	35.8	-
5.30	29.681	39	35.2	-	28.026	34.8	34.8	-
6.00	29.682	39	35.2	-	28.029	34.5	33.5	-
6.30	29.684	39	35.2	-	28.033	35	34	-
7.00	29.685	39	35.2	-	28.029	34.5	34	-
7.30	29.686	39	35.2	-	28.027	35	33.5	-
8.00	29.686	39	35.2	-	28.029	34.5	33.	-
	29.6808	39.4	35.4	35.4	28.026	35.2	34.2	34.2
Corrections: Reduction to 32° .	—.0190				—.0075			
Capacity . . .	—.0554				—.0441			
Capillary action . .	+.0280				+.0880			
Index . . .	+.1960				. . .			
True Barom. heights	29.8304				28.0624			

Result. Height of the Cone 1630,66 *feet.*

July 19-20. After midnight. Weather clear and fine.

	Observatory, Sabine.				Hill, Foster.			
App. time.	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*
12.30	29.679	39.4	35	34.5	. . .	. . .	. . .	. . .
12.35	. . .	. . .	. . .	. . .	28.054	42	38.5	33.5
12.45	. . .	. . .	. . .	. . .	28.041	42.8	39.5	34.5
12.50	29.673	39.5	36	34.5	. . .	. . .	. . .	. . .
13.05	. . .	. . .	. . .	. . .	28.024	43.5	39.8	35
13.10	29.667	40	37	34.7	. . .	. . .	. . .	. . .
13.25	. . .	. . .	. . .	. . .	28.036	44.5	40	35.5
13.30	29.659	39.8	35.7	35.2	. . .	. . .	. . .	. . .
13,45	. . .	. . .	. . .	. . .	28.021	45	40.8	36.5
13.50	29.652	39.8	37	35.3	. . .	. . .	. . .	. . .
14.05	. . .	. . .	. . .	. . .	28.037	44.9	40.8	35.8
14.10	29.649	39.2	37.6	36	. . .	. . .	. . .	. . .
	29.6932	39.6	36.4	35	28.0355	43.8	39.9	35.1
Corrections: Reduction to 32°	—.0197				—.0281			
Capacity . . .	—.0570				—.0443			
Capillary action .	+.0280				+.0880			
Index . . .	+.1960				- - -			
True Barom. heights	29.8108				28.0511.			

Result. Height of the Cone 1635.4 *feet.*

July 21. A.M. Calm and clouded on the Hill; light rain at the Observatory.

	Observatory, Foster.				Hill, Sabine.			
App. time.	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*	*Barom.*	*Merc.*	*Air.*	*Point of Deposition.*
10.30	29.328	41.8	38.5	Rain	27.673	39.8	39.	39 Rain.
11.	29.325	41.9	39.2	—	27.666	38.8	38.2	36.5
11.30	29.323	42	40	—	27.663	39.2	39.	36.2
12.	29.319	42.2	40	—	27.660	40	38.8	37
12.30	29.317	42	41	—	27.661	41.3	39.8	37.2
	29.3224	42	39.7	39.7	27.6646	39.8	39	37.2
Reduction to 32° .	—.0248				—.0186			
Capacity . . .	—.0885				—.0510			
Capillary action .	+.0280				+.0880			
Index	+.1960 or +.1845				- - -			
True Barom. heights	29.4331 or 29.4216				27.683.			

Result. Height of the Cone { *Index Corr.* +.196 = 1652.06 *feet.* / *Index Corr.* +.1845 = 1641.7 *feet.*

Having brought down NEWMAN's barometer from the hill to the Observatory on the afternoon of the 21st, its direct comparison with JONES's was resumed, for the purpose of ascertaining that it had sustained no injury, and to make an additional trial of the index correction and neutral point, as the height of the mercury was then much lower than in the former comparisons. The barometer had been progressively falling from the afternoon of the 19th, and continued to descend until between 5 A. M. and $7^h\ 30^m$ A. M. on the 22nd, when it reached 29.244 its lowest depression: it had fallen considerably, therefore, and was still falling when I began to compare the barometers on the afternoon of the 21st: the surface of the mercury in the tube of NEWMAN's, the diameter of which is only .15 parts of an inch, was convex as usual, though not so much so as when rising or stationary; but in JONES's, the diameter of which is double that of the other, or .31, the convexity had entirely disappeared, so that the zero of the vernier, when marking the level of the highest part of the mercury, coincided with the part which was in contact with the glass, and I was even doubtful whether there was not a slight concavity in the centre. I had not leisure at the time to examine the comparisons, but continued to repeat them at intervals, until the following morning, when, as the mercury began to rise, I became more strongly impressed than on the preceding evening, that it had been previously slightly depressed in the centre below the level of the sides, and that the depression had ceased to obtain. On applying the respective corrections to the comparative readings contained in the subjoined table, it appeared that as soon as the mercury had began to rise, the index correction of +.196

produced its former correspondence between the barometers, but that previously to that period, and when the mercury has been supposed to have been, as described, slightly concave in the tube of JONES's, its indications with the additive of +.196, would be uniformly too high for the agreement; as much so on the average as .0105, or one-hundredth of an inch nearly. I have considered it preferable, therefore, to employ +.1845 as the index correction on the 21st instant, instead of +.196, as it was the difference actually observed by direct comparison on the same afternoon, and, as far as can be judged, under similar circumstances: the result, however, has been computed on both suppositions, and is inserted. No such uncertainty exists in any of the previous observations, as, on all the former occasions, the mercury in both barometers presented a more or less convex surface.

In the following table the actual readings are given as before, reduced to the temperature of 32° for the expansion of mercury, and the scale; and the last column shows the index correction required in each comparison to produce an agreement.

		NEWMAN'S.	JONES'S.	Index correction.	
July 21.	6 P.M.	29.311	29.259	.184	
—	10 P.M.	29.314	29.262	.184	
—	12 P.M.	29.312	29.259	.186	
22.	3 A.M.	29.306	29.253	.186	.1845
—	3.50 A.M.	29.303	29.253	.183	
—	5.00 A.M.	29.294	29.244	.183	
—	7.30 A.M.	29.303	29.250	.186	
—	12 Noon.	29.360	29.295	.195	
—	1.30 P.M.	29.367	29.302	.194	
—	2.30 P.M.	29.373	29.310	.194	.195
(FOSTER obs.) —	2.45 P.M.	29.383	29.316	.197	

The results of the barometrical measurements, collected in one view, are as follows:

July 17.	Height of the Cone.	1644.58 feet.		
July 18.	- - - -	1630.66		
July 19.	- - - -	1635.4		
July 21.	- - - -	1641.7	or with + .196	1652.06 feet.
	Mean	1638.08		1640.07

It may be seen that the result obtained on the 18th of July deviates more considerably than any of the others from the general mean; which may be in some measure, if not entirely, accounted for by a circumstance which was noticed by Mr. FOSTER at the time of registering the observations, namely, that the freshness of the wind on the hill obliged him to steady the barometer either with the hand or with a guy; the very slight deviation which may have been occasioned thereby from the perpendicular suspension of the instrument, would cause the ascent of the mercury in the tube, and in consequence render the deduction of the height of the cone erroneous in defect; and such it would appear to have been. It will be further seen that the particular observations on the hill varied more from each other on that day than on the other occasions: omitting the observations of the 18th of July, the mean barometrical result is 1640.5 feet.

The following table exhibits a general view of the several determinations;

Trigonometrical	From Station A	Altitude of the Cone.	1645 feet.
	From Station C	- - -	1642.9
	From the Observatory	- -	1640.6
Barometrical	July 17.	- - - - - -	1644.6
	July 18.	- - - - - -	1630.7
	July 19.	- - - - - -	1635.4
	July 21.	- - - - - -	1641.7

Whence, it may be concluded that in these experiments the two methods of measurement have been found to correspond within the limits, which, under circumstances, may be attributed to accidental, and indeed to unavoidable errors.

It may be expected that whilst on the spot, some means may have occurred to me of explaining the very great difference which is recorded by Captain PHIPPS to have been found in the height of an hill in Amsterdam island, measured geometrically by himself, and barometrically by Dr. IRVING, in which the latter measurement exceeded the former by 85 feet, in between fifteen and sixteen hundred feet; the observations on that occasion were conducted with so much apparent care, and the difference was so great, as to have caused more or less doubt to have prevailed from that time to the present, of the equal applicability of the barometric formula in the higher, as in the middle and lower latitudes. I do not however feel better able than before, to conjecture in which of the operations the mistake originated, for such I do not doubt there must have been. I was desirous to have repeated the measurement of the hill itself, but time did not permit; judging, however, by the eye, in comparison with other hills on the coast, and especially with the one which has been the subject of this communication, and which was not more than a few miles distant, the lowest, that is the geometric result, appeared the most likely to have been correct; nevertheless a mistake of nearly a tenth of an inch, is a great amount with a barometer which was registered to thousandths; especially as the tendency of probable errors is on the other side. For

example, it is very probable that the mercury may have been heated by the warmth of the person who carried it up the hill, which heat it would not part with so readily as the thermometer suspended by its side: I believe this to be a very frequent source of error in barometrical measurements, and that the insertion of the attached thermometer in the mercury itself in the cistern, is a great practical improvement. This error would have most effect, when the difference was greatest between the temperature of the air and that of the human body; but it would render the computed height less than the correct, whereas Dr. IRVING'S measurement is already in excess. So also, as the barometer does not seem to have been furnished with a means of adjusting the scale to the level of the cistern, and as no correction appears to have been made for the descent of an inch of mercury from the tube into the cistern, its true height may have been, from this cause, actually less than the observed; but this also would encrease the elevation of the hill.

I had supposed it possible that the view of the summit, which was the station of the barometer, might have been intercepted from the low ground on which the base was measured, and from whence the angles of elevation were taken; but this conjecture was not borne out on the spot. I must leave it, therefore, in its former uncertainty, though I trust with this difference, that the question is no longer of the same interest or importance as before.

Having thus detailed the particulars of this comparative measurement, I may be allowed to notice, that I have had much disappointment in not having it in my power to try the experiment on a hill of greater elevation; but those

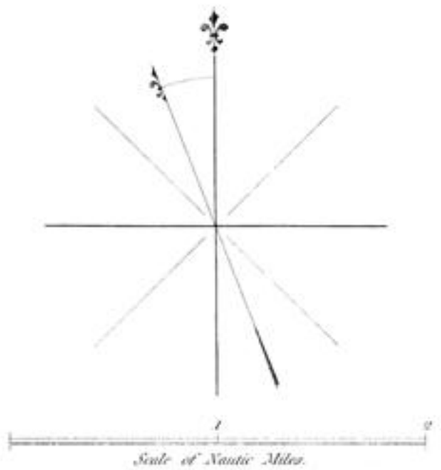
which exceeded it in height, were at such a distance in the interior, in a country so more than ordinarily difficult to traverse, that it would have required far more time than was at my disposal to have made the attempt. We were ourselves misled in our expectations, and were it not pointed out, others might still be so in their judgments, by the incorrectness with which the height of the hills on the Northern part of the coast of Spitzbergen are set down in the 8th plate of Captain PHIPPS's voyage; and with all the appearance of the utmost accuracy. I have already expressed the belief that the hill marked *f* in that plan, was designed to represent the one now measured, in which case its inserted height, 2400 feet, is nearly $\frac{1}{3}$rd, or 800 feet too high; and if it be not the same hill, it is still more in error. As its distance did not much exceed $1\frac{1}{2}$ miles from the island where Captain PHIPPS's base was measured, it is far more probable that the error has taken place in the insertion in the plan, rather than in the actual measurement, which was doubtless made with the same scrupulous attention to accuracy, with which Captain PHIPPS, and the scientific gentlemen who accompanied him, appear to have conducted other operations of the same kind; the genuine record might now have furnished materials, interesting perhaps in a geological view, of tracing how much, or possibly how little diminution in height, the naked and pointed summits of the Spitzbergen hills have sustained in the lapse of half a century, and in a climate which is considered as peculiarly destructive.

Spitzbergen, July 24, 1823.

Note. London, 1824. During a residence at Drontheim, in Norway, in the autumn of 1823, I had occasion to employ the same two barometers in measurements of heights, and I made, in consequence, the following comparisons of their respective indications, at times when the height of the mercury was very different: the results are in remarkable correspondences with those at Spitzbergen, in page 299, and may be considered an additional justification of the employment of the two index corrections on that occasion.

Newman's.	Jones's.	Index correction.
29.130	29.091	+ .183
30.254	30.128	+ .196

SKETCH
of the Harbour of
FAIR HAVEN.
and of the
adjacent Coast of
SPITZBERGEN.



Vogelsang
Cloven Cliff
N. 45° 54' 30" W. dist. 11475 feet.
Observatory
Phipps's Island
Flat Rock
Port of Red Bay
S. 77° 38' 30" W. dist. 53161 feet.
Hawkins's Headland
FOUL ISLAND
Foul Point
Glacier
Glacier
Hill
PART OF AMSTERDAM ISLAND
MAIN LAND OF SPITZBERGEN