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Cruise of the "Balæna" and the "Active" in the Antarctic Seas, 1892-93. I. The "Balæna"

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Source: *The Geographical Journal*, Vol. 7, No. 5 (May, 1896), pp. 502-521

Published by: geographicalj

Stable URL: <http://www.jstor.org/stable/1773994>

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fact I may say it is impossible, to get any one in New Zealand to act as porter upon the glaciers. Mr. Fitz Gerald solved the problem by not carrying any provisions at all, as you will have heard in his paper to-night. This was a ready way out of the difficulty, but one which, I think you will admit, few would care to try. During my stay at the Hermitage I had a chance of observing the infinite variety of plants and animals of these regions. The flora is really very beautiful, combining to a certain extent what we are accustomed to think of as alpine with the richer vegetation of the lower regions, and I am sure that there is a great field here for botanists. The birds, too, are wonderful, especially the kea parrots. The intelligence of these birds is quite extraordinary; their curiosity is easily roused by any strange object, and whenever anything puzzles them, they seem to hold a sort of informal meeting, one standing in the centre and haranguing his fellows. Their loud jabber is very amusing; one feels that it would be almost possible to get to understand their language. They are a very ill-tempered bird. We put two into a box with a partition between them; they broke through this and killed one another—the partition, I suppose, preventing them from meeting with the fate of the Kilkenny cats. Meantime many of their friends had assembled from the whole surrounding neighbourhood, and their persistent efforts, day and night, to liberate the prisoners were rather touching, but very noisy. I am not aware that the nest of the kea parrot has ever actually been seen. I must not omit this chance of expressing the great admiration which I felt for Mr. Fitz Gerald's Swiss guide, Zurbriggen, throughout this expedition. He is a man who seems, in every way, worthy of the high esteem felt for him by all those who have ever employed him. Altogether, I congratulate Mr. Fitz Gerald on the success of his expedition, and, as myself a witness of the hardships he had to endure and the obstacles he had to surmount, I think I may say that this success was very fairly earned.

The PRESIDENT: It only remains for us to thank Mr. Fitz Gerald, who has performed a great and important public service in discovering this, probably the only pass through the great snow range of New Zealand, and who has enhanced the interest of these surveys by the resolute way in which he has faced and overcome extraordinary difficulties. I am sure you will all pass a very cordial vote of thanks to Mr. Fitz Gerald for having told us so admirably the story of his expedition, and for having illustrated it with so many interesting views. I call on you to pass this vote of thanks unanimously, and to allow me to thank Mr. Fitz Gerald for his paper.

CRUISE OF THE "BALÆNA" AND THE "ACTIVE" IN THE ANTARCTIC SEAS, 1892-93.

I. THE "BALÆNA."

By WILLIAM S. BRUCE.

WITH the exception of a flying visit made in 1874 by the *Challenger*, the Antarctic Regions had up to 1892 been entirely neglected since Ross's expedition of 1843, and well-nigh forgotten. An accident of commerce then led to a slight revival of scientific interest. A fleet of four whalers set out in September, 1892, from Dundee to search the Antarctic seas for the bowhead (*Balæna mysticetus*), or some similar whale. The fleet consisted of the *Balæna*, in which I sailed as naturalist, the *Active*, the

Diana, and the *Polar Star*. Our vessels, after a voyage which was prolonged to thirty or forty days beyond the calculated time, and during which the chief fact of much interest was the complete failure of the north-east trade winds, met at the southern ice in Erebus and Terror gulf. There we found an earlier arrival, the Norwegian sealing vessel *Jason* (Captain Larsen), the ship in which Nansen set out from Iceland for his famous crossing of Greenland. The *Jason* was strictly on commerce bound, though the spirit of the great explorer who had sailed in her earlier had in some measure descended on Captain Larsen, for, without any special resources, he showed a zeal for extending our knowledge of these regions that would not have been unworthy of the leader of a purely scientific expedition. A scientific department had been attached to the Dundee whalers. With the consent of the owners and masters, the Royal Geographical Society spent over £150 in equipping these four vessels with instruments for geographical observation. The Meteorological Office provided a complete set of meteorological instruments. Mr. Leigh Smith, who has done so much to enlarge our knowledge of the Arctic regions, extended his exploring interest to the Antarctic by adding to the *Balæna's* equipment a handsome outfit of biological apparatus, a deep-sea thermometer, etc., for my use. Professor Haddon contributed two deep-sea thermometers, and Dr. H. R. Mill a pocket-aneroid and a spectroscope. The *Active*, the *Diana*, and the *Polar Star* were supplied by Professor D'Arcy Thompson with a zoological outfit, while he drew up a series of careful directions to guide us all in the collecting and preserving of natural history specimens. I take this opportunity of thanking these gentlemen and many others not named for their support. Dr. Mill especially was untiring in his endeavours to make the expedition a scientific success; for, besides the valuable personal contributions mentioned above, he drew up, on behalf of the R.G.S., a valuable set of instructions for the naturalists, and of suggestions for the captains who were now to sail for southern seas for the first time. I have to thank Professors James Geikie, D'Arcy Thompson, Dr. John Murray, and Mr. Robert Irvine for their valuable appendices to this paper. Mr. Andrew J. Herbertson has given me many valuable suggestions in compiling the tables; and Mr. William C. Spence's help has been invaluable to me in drawing up this report.

We sailed on September 6, 1892, and the *Balæna* first saw ice, in the afternoon of December 16, about $59^{\circ} 40' S.$ and $51^{\circ} 17' W.$ The same night about ten o'clock we sighted our second berg. From this point I give a brief journal of the voyage for the few days until we finally settled down to look for whales among the ice.

December 16.—Position at noon, $59^{\circ} 24' S., 51^{\circ} 1' W.$ (by observation). The weather was fine and bright in the earlier part of the day, becoming overcast and rainy in the afternoon and evening. The wind was westerly, backing a little in the afternoon, varying from a gentle

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to a moderate breeze. The barometer fell steadily from 29·834 inches at 6 a.m. to 29·515 at 8 p.m. The sea was smooth to slight. All day we were surrounded by myriads of birds, mostly cape pigeons, among them being thousands of blue petrel and smaller numbers of molly-hawk. On the water surface, from quite near to the ship to far on the horizon, we could see thousands of the finner or blue whale, blowing the water into fountain-like spouts, and filling the air with their characteristic note of booming resonance.

December 17.—Position at noon, 61° 6' S. and 52° 3' W. (by account). The weather was foggy all day, with the temperature falling throughout the day from 33·7° to 29·8° Fahr. The wind was light and varying from the west. The barometer was fairly steady, rising slightly after 8 a.m. The sea was smooth. The same day I was called on deck to see, as I was told, some small seals. They were swimming with rounded backs just below water, and only the head above it. What the sailors took for seals were really penguins, with their silky, hairlike feathers looking like wet fur. The sailor refuses to recognize feathers in this close-fitting fleece, black on the back and white on the breast. We met with drift ice and a few bergs, both small and great. To-day we saw and shot our first seal, a sea-leopard (*Stenorhynchus leptonyx*), one of the largest kinds, as it drifted past us asleep. The lead was cast, with 100 fathoms no bottom.

December 18.—Position at noon, 61° 44' S. and 52° 18' W. (by account). Rainy and foggy weather, with a uniform temperature a little above freezing. A light wind in the morning rose in the evening to a moderate gale, accompanied by squalls; it veered round from E. by S. at 8 a.m. to W. at 4 p.m., and backed in the evening to W.S.W. The barometer fell slightly till noon, rising again towards the evening. We passed a great many large bergs and much broken ice. The bergs were mostly tabular, with a few other shapes. There were a few birds of the kinds already mentioned.

December 19.—Position at noon, 62° 12' S. and 52° 13' W. (by observation). The fog rose suddenly at 8 a.m., revealing a bright sun; the sky was cloudy, and became quite overcast by evening; the temperature remained practically uniform, about a degree above freezing. The wind backed from N.W. by N. to N.N.E., rising from a light breeze at 8 a.m. to a fresh gale at 8.30 p.m. The barometer fell considerably in the course of the day. The sea was slight, with a northerly swell. When the fog lifted we found ourselves surrounded by icebergs, the resounding murmur of which had been reaching us through it. One berg of 10 miles' length, by bearings, that we saw yesterday, we found now considerably broken up by the swell. To-day we saw the largest berg the *Balæna* met; it was 30 miles long. At noon we came on a great body of ice, which, according to the skipper, was the main pack. There was an icy sky towards the South Orkneys

to the north-east. Hitherto we had been pursuing a more or less southerly course, but now headed in an almost westerly direction.

December 20.—Position at noon, $62^{\circ} 18' S.$ and $53^{\circ} 45' W.$ (by account). Very foggy; with same temperature as yesterday. The wind was light all day, veering from N.W. by N. at 6.30 a.m. to W. by S. at noon, and backing to W. by N. by 8 p.m. The barometer rose from 28.805 at 6.30 a.m. to 28.951 at 8 p.m. The sea was smooth, with a heavy cross swell from N.W. by N. and N.E. by N., and at 4 p.m. very heavy from N.W. by W. Soundings were got in 161 fathoms, and the bottom temperature was 29.8° Fahr., the surface temperature being 30.3° Fahr. We met many bergs and much broken berg ice. During the day we saw cape pigeons and petrels, blue, stormy, and white. The last Ross found to indicate proximity to the main pack.

December 21.—Position at noon $62^{\circ} 21' S.$ and $54^{\circ} 3' W.$ (by account). The fog still continued thick, becoming clearer at 3 p.m., but soon coming down again as thick as ever. The temperature was a degree lower than the last two days, except at midday, when it rose to 34.2° Fahr. Moderate wind, backing from N.W. by N. at 9 a.m. to N.E. by E. at midnight. The barometer continued to rise until 8 p.m., standing then at 29.045, and then fell again. The sea was still smooth, with N.W. swell, which became slighter to midday; and in the afternoon a slight N.E. swell. The colour of the water after 8 p.m. was a dirty green. A number of soundings gave depths from 139 to 170 fathoms. We were still amongst bergs. Besides the birds of yesterday, we saw a sheath-bill and some terns; there were many whales, none resembling the bow-head, and also some seals.

December 22.—Position at noon, $63^{\circ} 2' S.$ and $54^{\circ} 31' W.$ (by observation). The weather was foggy and overcast with fine snow; the temperature varied between 29.9° Fahr. and 31.9° Fahr. A light wind backed from N.E. by E. to S.S.W. from 2 a.m. to 10 p.m. It is notable that, in spite of this change of wind, the fog, as stated above, still continued. The barometer was unsteady in the morning, but during the afternoon it rose, till at midnight it stood at 29.097. The sea was still smooth, with a slight N.W. by N. swell, and the water of a dirty green colour. Soundings in the afternoon gave 235 fathoms, the bottom temperature being 28.6° Fahr., and surface 30.9° Fahr. Soundings at 8 p.m. gave 175 fathoms, with a bottom temperature of 29.5° Fahr.; at 50 fathoms, of 29.7° Fahr.; and at surface, 29.7° Fahr. Still the same birds and whales.

December 23.—Position at noon, $63^{\circ} 24' S.$ and $54^{\circ} 11' W.$ (by observation). The weather was at first hazy and overcast, and then became brighter, though cloudy; a slight snow-shower at 8 a.m.; the temperature remained as yesterday. The wind was light and variable, W. by S. to S.E. by S. The barometer rose to 29.264 at 10 p.m. The sea varied from slight to calm, and the water from being inky became a

dirty brown. This latter colour, like the snowy petrel, of which we saw some to-day, Ross had noted as an indication of proximity to the main pack. When to the south-east of Danger islands we passed great chains of bergs and great quantities of pack ice, having sighted Joinville Land and the islands in the early morning. We passed a good many seals, and for the first time saw the white seals (*Stenorhynchus carcinophaga*). We still had the birds before mentioned.

December 24.—Position at noon, $64^{\circ} 13' S.$ and $55^{\circ} 52' W.$ (by observation). This is the exact point which Ross reached on New Year's Day, 1843, and there is no record that any one did so before, or has done so since, till Christmas Eve, 1892. We fastened to a large floe, on the look-out for the whales reported by Ross. We were within 12 miles from Cape Seymour, and Mount Haddington was visible further to the west. The weather to-day was fine and bright, a cloudy sky being at times broken by brilliant sunshine; morning and evening there were slight snow-showers. The temperature varied from 29.3° Fahr. to 32° . Light wind, chiefly from S. by W., being more variable in the afternoon. The barometer rose all day to 29.482 inches at midnight. The sea was very smooth, and in the evening calm. To-day we first marked down a current, which was S.S.E. Soundings at 8 p.m. gave 194 fathoms, Ross having there registered 200. Bottom temperature, 28.6° Fahr.; at 100 fathoms, 29.2° Fahr.; at 50 fathoms, 29.3° Fahr.; and at surface, 32° Fahr. The water was olive-brown in colour, as well as the water-washed parts of the pack and the bergs. The bergs were large, numerous, and tabular. One weatherworn berg had masses of rock and soil on it, but, the harpooners thinking it dangerous, I was not allowed to secure any specimen of this rock and soil. We captured some seals, and, though we saw many whales and grampuses, we saw no whale resembling the bowhead. All the previously named birds were present, and we shot and secured for the first time the sheathbill and the emperor penguin. At midnight it was a perfect calm, as the *Active*, the *Diana*, and the *Balena* lay fastened to the floe—the *Polar Star* not having yet joined us. I took several photographs of our surroundings at midnight, but no photography could give a hint of the light and colour of this Antarctic midnight. Never have I witnessed such excellent delicacy of colour. Though the sky was grey, the ice the whitest of the whites, and the sea in contrast blackness itself, yet rosy hues, purples, soft blues, translucent greens, and yellows shed their coloured mantle of light upon the whole; different indeed from the tropics, where colours are infinite and brilliant, yet often perhaps too crude.

December 25.—Position at noon, $64^{\circ} 23' S.$ and $56^{\circ} 14' W.$ (by observation). We remained fast all day to the floe, in fine weather with very slight showers of fine snow in the early morning. The temperature varied more than usual, ranging from 29.4° Fahr. to 35° Fahr.

There were light airs from E. to S. till early afternoon, and a calm after. The barometer went on rising, reaching 29·704 inches at 6 p.m. The calm sea was still of the brown colour. Soundings were obtained at 8 p.m. in mud at 200 fathoms, again confirming Ross. The bottom temperature was 28·9° Fahr.; at 120 fathoms, 28·8° Fahr.; at 60, 29·2° Fahr.; and at surface, 31·8° Fahr. There were remarkably few appearances of animal life.

This day ends the regular and accurate record of positions, till it was resumed on February 18 on our leaving the ice.* The whole ship's attention was given to the search for the expected whale, north, east, south, and west of Ross's 1843 position, varied with the catching of about 1000 seals. This went on to January 12, when hopes were finally given up of getting whales. So far as it goes, this search failed to confirm Ross's statement as to the existence of the black whale in these waters, though a contradiction of the statement would not, in my opinion, be justified till a search be made more extensive, both in space and in time, than was undertaken on this occasion. Whales there were, as already stated, but whales of the finner tribe, which require very different ships and tackle to those we were supplied with. Were vessels and tackle such as are used off the Norwegian coasts despatched to the Antarctic, I am confident that the blue whale fishery could be prosecuted with great success.

Day after day followed, till February 18, with the same tasks, namely, bringing seals on board and "making them off." I was usually out with one of the boats, but sometimes remained on board, and then often at the wheel. On these occasions meteorological observations suffered, but during gales, when all hands were usually on board, fairly copious notes were taken.

The scientific work of the expedition was not done in very favourable circumstances; commerce was the dominating note. A great deal more might have been done for the geology and the biology of these Antarctic Regions if some opportunities for landing had been afforded me. So early as December 26 I had the misfortune to lose the bucket for taking samples of surface water, and, as it was never replaced, observations for salinity were completely stopped after that date; and as for temperatures, they were only got under such imperfect conditions as lowering the thermometer over the ship's side when she was quite still.

The following notes contain observations between December 16, 1892, and February 18, 1893.

Land.—The *Balæna* was never within less than 6 miles of land. What we saw of it from that distance was entirely snow-clad, except on

* The Dundee vessels cruised during the two months between 60° and 65° south and 51° and 57° west; that is to say, within an area measuring 300 by 180 miles.

the face of precipitous slopes, where snow could not lie. These uncovered parts appeared quite black, and, so far as could be judged in the circumstances, were of igneous origin.

A few rocks secured from a piece of ice and from the stomachs of penguins bear this out, for Professor James Geikie informs me that a rough examination of them shows them to be mostly of igneous origin. The two largest specimens, he says, are olivine. The smaller ones will need a more careful examination, but among them he recognizes basalt, basalt lava, and possibly gabbro. Dr. Murray, however, finds evidence of continental rocks in some bottom samples I secured. I regret that I was unable to bring more rock specimens, several of the largest having been heaved overboard by some unknown member of the crew. I believe these latter were also olivine.

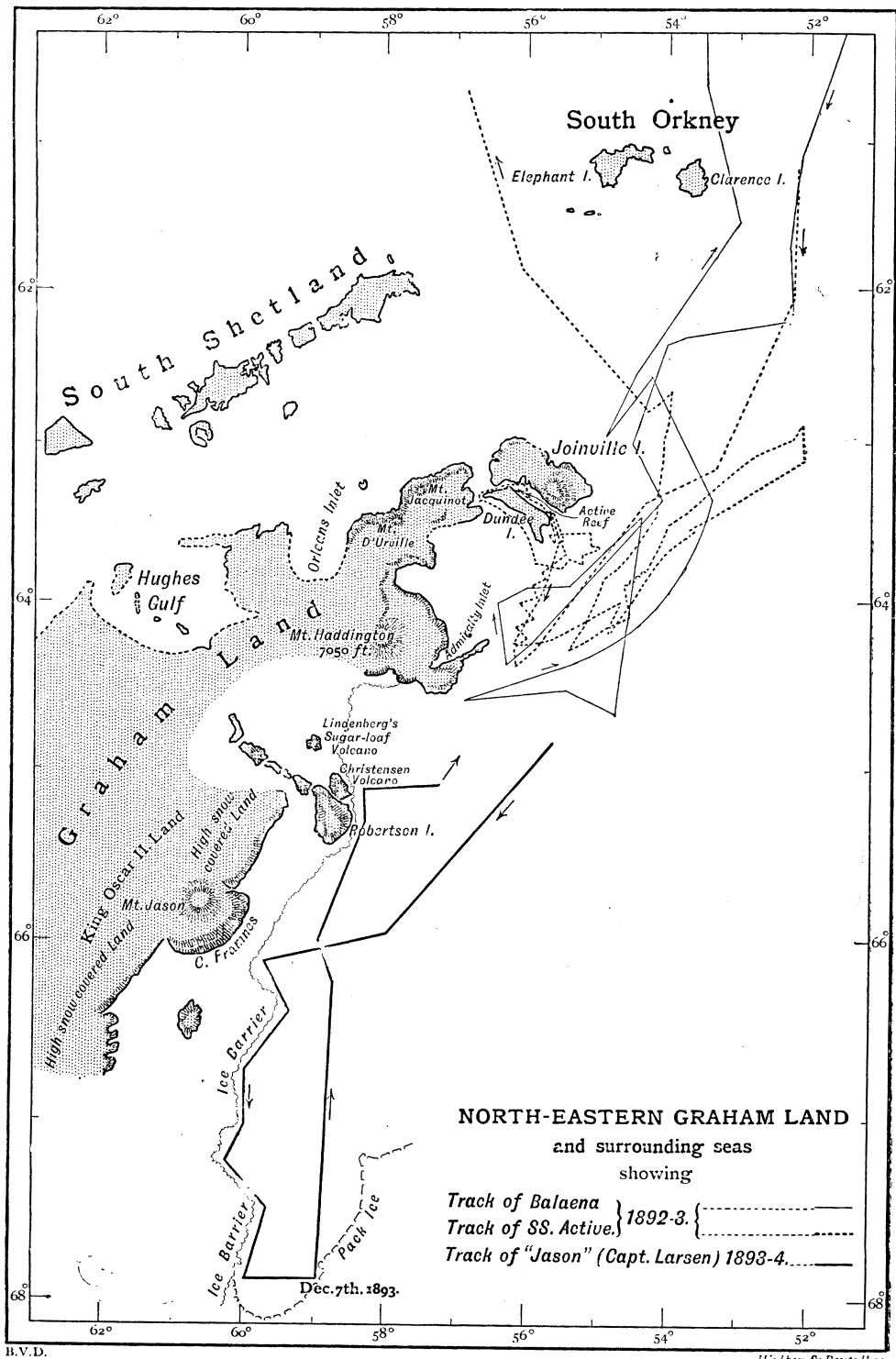
On several occasions I saw rocks and soil on the ice and on bergs, and once we passed a very stratified earthy piece of ice, but I was not allowed to procure specimens.

As to the geographical distribution of land, the *Balæna* made no important discoveries. The small islands in the northern portion of Erebus and Terror gulf were thought to be somewhat inaccurately charted, but no correction was made. On January 12 we were in *about* lat. $64^{\circ} 35' S.$, long. $56^{\circ} 52' W.$, and saw what appeared to be high mountainous land* and glaciers at a distance of 60 miles, stretching from a point about $64^{\circ} 25' S.$ and $59^{\circ} 10' W.$ to about $65^{\circ} 30' S.$ and $58^{\circ} W.$ Captain Fairweather said definitely that this was land, and has marked it in his chart as such. I should rather be inclined to call it, in Ross's words, "an appearance of land," for, although it certainly looked like it, and I believe may have been the east coast of Graham's Land, yet one must remember how often Ross sailed over what he believed to be certain land, and how others have mapped out regions which never existed.

It is extremely regrettable that no effort has been made to approach this supposed land, and, if it really existed, to map it out accurately. This seemed to me quite possible, for by all appearances there was no very compact ice in that direction; certainly we could have got much nearer than we did. But back to the seals and blubber was the *mot d'ordre*.

Ross ('Antarctic Voyages,' ii. 324) calls the attention of future explorers to the belief of Captain Crozier and his officers, that they saw smoke issuing from a certain mountain; what mountain, however, Ross does not very clearly particularize. This phenomenon had not been observed by any one on the *Erebus*, but he thinks it may have accidentally escaped notice there. Captain Crozier's observations he attributes to wreaths of snow or mist whirling round the hilltops. I believe, from

* Captain Larsen (1893-4) confirmed and extended his own and our discovery in the following season by mapping out the eastern coast of Graham's Land to about 68° south.



his description, that Ross refers to Mount Percy, the highest peak of Joinville island. If I am right in this belief, we had on February 6 an opportunity of confirming Ross. The *Balena* was in $62^{\circ} 58' S.$ and $54^{\circ} 45' W.$ by bearings, less than 20 miles from shore. The low-lying land was enveloped in a bank of mist, but the peaks shone forth brilliantly in clear air and a cloudless sky, and neither from Mount Percy nor from any other hill, as far as the eye could reach, did we see any sign of an issue of smoke. Moreover, on Christmas Day we observed Captain Crozier's phenomenon, and found it to be accounted for by Ross's explanation. Mount Haddington had wreaths of clouds whirling over it, and appeared at times as if smoke were issuing from it; but the clouds swept away and left a smokeless peak in the clear air.

Ice.—The whole of the district we traversed south of the latitude of the South Shetland islands is strewn with bergs, and south of $62^{\circ} S.$ they become very numerous. There was no day in which there was not some record of bergs being seen, but in some districts we found the sea much more thickly studded with them than in others. We met with the greatest number of bergs to the south-east of Danger islands, where I have counted from the deck at one time as many as sixty-five of great size, to say nothing of smaller ones. We met with very many about 60 to 100 miles north-east of Joinville island at the end of December, and also at the beginning of January, in about $64^{\circ} 30' S.$ and 54° or $55^{\circ} W.$ On January 11, in $64^{\circ} 32' S.$ and $55^{\circ} 25' W.,$ we came across a row of ten bergs of great length running east and west along the pack edge. On February 10, when in company with *Diana* and *Jason*, we saw many great bergs, one 4 miles long, another 1 mile long. The longest we met with was fully 30 miles in length, and one was 10 miles long by bearings. Many others measured 1 to 4 miles in length. The highest berg recorded by us was about 250 feet above water, but many were not over 70 or 80 feet high; I should say the height of most of the bergs was about 150 feet. I have recorded a berg twice the height of the *Jason* lying a considerable distance S.S.W. of Paulet island. On January 1, off Danger islets, there were bergs half as high again as the *Diana* and the *Active*, and in the same place a berg three-fourths the height of the *Diana*. Nearly all the bergs are tabular or weather-worn varieties of the tabular. On December 18 we came across several more varied in shape than usual; one was beautifully conical, and one had very well-marked stratification. On December 20 we saw a castellated berg, looking like part of some strange fortification; one was hewn into beautiful Doric pillars; others were in the form of grand arches; others had great caves hollowed out of them, which in some cases were connected with vertical holes piercing their upper surface. Through these holes, when a heavy swell beat up the caverns, columns of water and spray were ejected, often to a great height. Other bergs overhung their water-worn bases. Strange cracks and

fissures abounded. The whole face of a long berg sometimes exhibited a row of perpendicular fissures, the walls of which were bowed out. On several occasions, notably on December 18 and 20, I saw bergs which were fringed with pale brown along their upper edge, and sometimes with pale brown streaks, like a vein, apparently sandwiched in their main mass. This, I believe, has not been before noted. Ross mentions the base of bergs and pack-ice being coloured brown by organisms that exist very abundantly in the water, which our observations also confirmed. But this new observation refers to the top of the bergs, at a height of perhaps 150 to 200 feet above sea-level; and that, too, in bergs that had never been overturned. The tops being inaccessible, we got no specimen.

Apart from these very occasional streakings, the bergs are white. There is a complete absence of tints, except for the infinitely varied play of the light. In the fissures one gets the most magnificent blue, a blue which Mr. Burn Murdoch, the artist of our *Balæna* company, thinks resembles cobalt. But it cannot be described, and no palette has resources to paint it. Those who wish to appreciate its purity and intensity must see it for themselves. Similarly, there are brilliant splashes of emerald green, with an infinite number of other shades. Many of the overturned pieces of some broken-up berg look like huge masses of sulphate of iron that have undergone some oxidation. Although on many dark nights we were surrounded by bergs, in no case did I observe any such phenomenon as a luminous glow on them, as Dr. John Murray has noted.* But I have, I believe, observed a luminous glow from the pack-ice.

The pack-ice of these regions was said on the *Balæna* not to be heavier than in the north, if it were as heavy. It is also similar in nature. Therefore I need not describe it here. The conglomeration of pack and broken pieces of bergs is also similar to that of the north. One must note, however, how frequently it is coloured brown by the diatoms, *Corethron criophyllum* and others, which swarm in the water near the main pack.

We first met the dense pack-ice on December 19, in lat. $62^{\circ} 20'$ S., $52^{\circ} 20'$ W., the edge of which lay in a more or less easterly and westerly direction, and the sky seemed, too, to indicate ice towards the South Orkneys; but, by steering a more westerly course than we had been doing, we avoided it, as it appeared to trend in a southerly direction in about $53^{\circ} 20'$ W. On December 24, in $64^{\circ} 13'$ S. and $55^{\circ} 51'$ W., we fastened to the edge of a great floe, the end of which could be seen only at the masthead. On January 11 we ran east and west along the pack edge, which lay in about $64^{\circ} 37'$ S., our position at noon being $64^{\circ} 33'$ S. and $55^{\circ} 25'$ W.; but on January 12 we saw fairly open water

* The *Scottish Geographical Magazine*, vol. ii. p. 534.

to the south-west. The pack edge was seen, besides on the above dates, on the 5th, 7th, 19th, 20th, and 21st of January; but I cannot define the ship's position quite satisfactorily for these last-named dates, and I am therefore unable to say how and where the pack edge was, except on December 19 and January 11. The *Balæna's* work lay almost entirely between about latitudes $64^{\circ} 30'$ S. and $62^{\circ} 30'$ S., and longitudes 53° W. and 56° W. We never entered the main pack, except on one occasion at its extreme edge. In this region we only met with scattered pack-ice or with streams of pack-ice, which were sometimes very heavy. In February there was a considerable amount of pack-ice in Erebus and Terror gulf.

Red snow was reported to me on one occasion; but I rather suspect, from the description I had given me, that the colour was due to the blood of a slaughtered seal, which had soaked through the snow.

Sea.—The colour of the sea in those parts varies very much. Now it is blue and clear, now olive-brown and opaque; and between these two colours there is a series of shades from greenish blue, dark green, and olive green, and of transparency from clearness to opaqueness. The browner water seems to be in the neighbourhood of a great body of ice; we noted it at Christmas-time, coming into it first on December 23, and emerging from it on December 27, both north and south of Ross's 1843 position; and again we met it on the 10th, 11th, and 12th of January, in a second attempt to get south-west. For the rest of the time we found the water mostly blue, or very nearly so. The olive-brown colour is due to the *Corethron* diatom, which swarms, as we have said, in great quantities in these waters, and colours the pack-ice. It abounds on every shelf below the surface of the water, and in the holes of the honeycombed ice. The bases of bergs are coloured by it. The bluest water we found most profitable to hunt for seals in. After December 26, for reasons already stated, salinities were beyond my reach; but I was still able to take advantage of a few occasions of ascertaining deep-sea temperatures. The table of temperatures must be read with regard to these conditions. The deep-sea thermometers were left down for about two or three minutes before they were inverted; in no case were they left down for less than two minutes, and I should have preferred that the instrument should have been left down longer. It is, perhaps, of interest to remark that the reversing frame and Negretti and Zambra's thermometer had never before been used in this part of the globe, and it is a great pity I had no opportunities to use it oftener. The results, although very few, nevertheless are interesting, since they tend to indicate the intermediate cold layer and the correct bottom temperatures, which the experiments made by Sir James Ross and the *Challenger* failed to show. They are also similar to readings at similar depths of the Arctic seas.

On Decem' er 26, at 1.30 a.m., there was a dead calm; the dry-bulb fell to 24.6° Fahr., and a very thin layer of ice formed on the surface of the water. The temperature of the water was 31.1° , and

the specific gravity 1.0269 for that temperature by the salinometer. Again on January 7 there was a dead calm, and the surface of the water froze, the dry-bulb standing at 31.3° . This time I had no means of taking the temperature and salinity of the water. On January 17 I lowered the thermometer and kept it in four or five minutes in a long cylindrical hole about 6 inches in diameter in a piece of honeycombed pack-ice about 1 foot below the surface; the piece of ice was slowly passing across the stern of the vessel. I found the temperature to be 31.2° Fahr. The thermometer had the usual small cistern, which contains a considerable amount of water surrounding the bulb, and in this, as in other cases, as little time as possible was lost in drawing up and reading the instrument. On February 17, when the dry-bulb registered a temperature of 20.8° Fahr., the lowest record on the *Balena*, there was no sign of ice forming on the water, but the water was far from smooth; a considerable amount of ice, however, was formed on the bows and other parts of the vessel exposed to spray.

South of Joinville Land we never experienced much swell, even during and after the hardest gale; it was interesting to note how a comparatively narrow stream of ice always broke the swell.

Not much attention was paid to currents. In the neighbourhood of Danger islets they were very strong; at times it was difficult for the vessel to make headway against them. These, I should say, were most likely tidal. In the neighbourhood of bergs they were also impetuous. I was in one of two boats one day that pulled for about four hours in the neighbourhood of a berg, and so strong was the current that we were only just able to hold our own against it. Near bergs the drift-ice moves very fast, now onward, now swaying round, caught in a whirlpool, and boat-steerers have to keep a sharp look-out to prevent being nipped.

Here follow the few observations made on currents:—

December 24.— $64^{\circ} 13'$ S. and $56^{\circ} 14'$ W. Current S.E. by S.

January 1.—S.E. of Danger islands. Current W., 2 or 3 knots per hour.

January 29.—S.E. of Danger islands. Current strong.

February 2.—3 miles E. of Danger islands. Current S.W., slight.

On several occasions I threw out floats.*

Weather.—The meteorological observations of the expedition are more complete than any other set of observations, and for general (though perhaps more for local) conditions we have some interesting notes.

Periods of calms and gale alternate in this part of the world. On Christmas Eve and Christmas Day there was a perfect calm; the sky, except at the horizon, had a dense canopy of cumulus rolls, which rested on the summits of the western hills, and when the sun was just below the horizon, the soft greys and blues of the clouds and the

* Up to the end of 1895 none of these floats had been recovered.

spotless whiteness of the ice, as it floated in the black and glassy sea, were tinted with the most delicate of colours—rich purples and rosy hues, blues, and greens passing into translucent yellows. This was a very typical calm day, but there were also calm days with cloudless skies and brilliant sunshine. Should a gale blow from a southerly direction, it was usually accompanied by snow, and if from a northerly direction, by wet fog, as shown below:—

FEBRUARY 8, 1893.

| Time. | Wind Force 1-12. | Clouds, 0-10. | Weather. | Dry-bulb. |
|-------|----------------------|---------------|---------------------------------------|-----------|
| 1 | N.W. 3 | — | thick wet fog | 32·3 |
| 8 | N.N.E. 4 to 5 | 10 | overcast; thick very wet fog, and raw | 32·8 |
| 10 | N.N.E. | 10 | overcast; foggy, raw, raining | 31·9 |
| 12 | N. by W. 2 | 10 | overcast; thick fog; very wet sky | 33·4 |
| 16 | S.W. 6 to 7 | 10 | overcast; misty round horizon | 30·1 |
| 20 | S.S.W. 10 | 10 | overcast; snow showers since 6 p.m. | 29·6 |
| 22 | S.S.W. 10 | 10 | overcast; snowing; coarse dirty night | 29·2 |

On January 29, 30, 31 and February 1 we had a hard gale. It blew chiefly from the S., but backed and veered between S.S.W. and S. by E. At times on the 29th and 30th I have recorded wind of a force up to 10. On the 29th I have noted that this was pronounced by all to be the heaviest of all since we made the ice; on the 30th the skipper told us that had we been in the open ocean, with our vessel in good trim, she would scarcely have borne close-reefed topsails. From 10 p.m. on the 29th till 8 a.m. on the 30th we steamed full speed* against the wind, and only made about 1 mile headway. Snow was falling almost continuously, being very fine and slight. The thermometer fell from 31·7° Fahr. to 27·7° Fahr. Again on February 10 I have recorded a brief N.W. and N.N.W. gale, after which there were some hours of calm. The wind by 8 a.m. on February 12 had veered to S., force 1, and, remaining S., increased to force 8 by 11 a.m., rising to a recorded 11 to 12 at noon. At 4.30 a.m. on the 13th it had not abated in the least; from 8 a.m. to 3 p.m. force 8 is recorded, and in the evening there was only a strong breeze. In this instance I must have recorded too great a force according to some authorities, since I am here to tell the tale; but our captain described it as the hardest gale that ever blew in the Arctic or the Antarctic, and so hard that we could not have borne close-reefed topsails in the open. For part of the time thick fog prevailed, and fine snow was driven before the wind. The thermometer fell from 32·4° Fahr. to 25·2° Fahr. The barometer was lowest at 10 a.m. on the 12th, standing at 28·978 inches, and by 1 a.m. on the 13th had only risen to 29·057.

* Under most favourable conditions, calm sea and no wind, the vessel can steam 8 knots.

Observations were made every two hours as far as was possible, and have been grouped in twelve columns for each day. The mean of these has been calculated for every month, and again from these twelve means the mean temperature of the month has been obtained. In no case does the mean monthly temperature exceed that of the freezing-point of water. For the last two weeks of December it was 31.1° Fahr., which was also the mean temperature of January, while that of the first eighteen days of February was 29.7° Fahr. In the region traversed from lat. 61° S. to $64^{\circ} 40'$ S., and from long. 53° W. to 57° W., which may roughly be compared to that of the Færoës in the northern hemisphere, the mean air-temperature in the month of maximum temperature is half a degree below the freezing-point, instead of about 23 degrees above it. It may be assumed that January is the warmest month, since the observations made in December, while giving the same mean temperature, were obtained only in the latter, and presumably the warmer, fortnight of the month. Except for the rise at 6 a.m. in December, which is the mean of only two readings, and is therefore not considered, the two hourly mean temperatures cross the line of the melting of ice only at 4 and 8 p.m. in December, and at 2 p.m. in January, the mean maximum at 2 p.m. in February coming within two-tenths of it.

The warmest twelve hours of the day (8 a.m. to 6 p.m.) averaged 31.5° in December, 31.4° in January, and 30.5° in February; while the night temperatures (8 p.m. to 6 a.m.) were 1.1° lower in January, and 2.9° lower in February (the night means cannot be calculated satisfactorily for December).

The following table shows the maximum and minimum readings in each month and for the whole period:—

| | Maximum. | Minimum. | Range. |
|--------------------|---------------------------------|---|-------------------------------|
| 1892. | | | |
| December 16-31 ... | 37.1° , noon on 16th | 24.6° , 1.30 a.m. on 6th | 12.5° |
| 1893. | | | |
| January 1-31 ... | 37.3° , 2 p.m. on 15th | $\left\{ \begin{array}{l} 27.7^{\circ}, 8 \text{ p.m. and midnight} \\ \text{on 30th} \end{array} \right\}$ | 9.6° |
| February 1-18 ... | 36.2° , 4 p.m. on 7th | | 20.8° , noon on 17th |

Hence the extreme temperatures recorded were—maximum 37.3° and minimum 20.8° , giving a range of 16.5° Fahr.

As with temperature observations, pressure observations were made every two hours, as far as was possible, and have been grouped in twelve columns for each day. The mean of these has been calculated for every month, and the whole period mean has been obtained. The mean pressure for the last two weeks of December was 29.357 inches; for January, 29.273 inches; and for first eighteen days of February, 29.160 inches. There is thus a falling off in pressure from December

to February, the mean for the whole period, December 16 to February 18, being 29·263 inches, or about half an inch lower than for the corresponding season in the Fœrœ islands. All the means attain a maximum at 10 a.m. and 6 p.m., and all, except those for February, at midnight also. There seems to be a minimum period during the early morning hours. On the whole the pressure appears to be greater in the afternoon than in the forenoon; but the forenoon data are insufficient for obtaining reliable results.

The following table shows the maximum and minimum readings in each month and for the whole period:—

| | | Maximum. | Minimum. | Range. |
|----------------|-----|------------------------|-------------------------|-----------|
| 1892. | | | | |
| December 16-31 | ... | 29·834, 6 a.m. on 16th | 28·801, 8 a.m. on 20th | 1·033 in. |
| 1893. | | | | |
| January 1-31 | ... | 29·753, 4 p.m. on 2nd | 28·745, 10 p.m. on 20th | 1·008 in. |
| February 1-18 | ... | 29·750, 4 p.m. on 6th | 28·850 | 0·896 in. |

Hence the extreme pressures recorded were—maximum 29·834 inches, and minimum 28·745 inches, giving a range of 1·089 inch.

Biology.—Prof. D'Arcy Thompson has treated biology at sufficient length for so general an account as this, and with much greater skill than I should. It may be mentioned, however, that we saw no whale in the least resembling the Greenland or bowhead whale (*Balæna mysticetus*), but many finners, hunchbacks, bottlenoses, and grampuses. Also four species of seals, all of them true seals, viz. the sea-leopard (*Stenorhynchus leptonyx*); Weddell's false sea-leopard (*S. Weddellii*); the crab-eater, or white Antarctic seal (*S. carcinophaga*); Ross's large-eyed seal (*S. Rossii*).*

Between the Falkland islands and the ice, and in the ice, I saw several white ropy-looking coils in the water, about a foot or so in length, and about an inch thick. I succeeded in securing one, but this, unfortunately, was heaved overboard before I could preserve it. This, a compound ascidian, was seen by Sir Joseph Hooker, in 1843, and later by the *Challenger* in 1873, but is now for the first time fully described.

All these observations were made, and these specimens procured, between December 16, 1892, and February 13, 1893. On the latter date we had glutted our ship with seals, and turned her head homewards. The following afternoon we passed Clarence island, the most easterly of the Shetland group, its three bold ridges looming through mist and scud. The land was wild and majestic, towering over the

* "Notes on Seals and Whales seen during a Voyage to the Antarctic" (Brit. Ass., Nottingham, 1893), by W. S. Bruce. Also "Animal Life seen on a Voyage to the Antarctic," *Proc. Royal Phys. Soc.*, vol. xii. pt. 2, xxvi. pp. 350-354.

adjacent icebergs. Like other land we had seen, it was entirely snow-clad, except on the most precipitous slopes, which were short and abrupt to the south, but long and easy to the north. On February 20, at 9 a.m., we passed our last berg in about $60^{\circ} 27' S.$ and $53^{\circ} 40' W.$, or about 40 miles north of Clarence island. Port Stanley was reached on the morning of February 28; Portland on May 24; and finally, on May 30, we came to rest at Dundee.

(*To be continued.*)

APPENDIX I.

Preliminary report on rock specimens obtained by W. S. Bruce from floating ice and from the stomach of penguins, by Professor James Geikie, LL.D., F.R.S. :—

“The large specimens of the dark rock are all basalt, and contain a good deal of olivine. There is nothing peculiar about them, for they exactly resemble many of the basalts obtained in this and other European lands.

“The small fragments obtained from the stomachs of penguins show little variety. So far as I can judge, without microscopic examination, they consist mostly of basalt. A few, however, seem to be trachyte. Most of the specimens appear to be water-worn more or less, and exactly resemble the small subangular and partially rounded *débris* which, along with larger fragments, one finds upon the coasts of a region composed of igneous rocks. I could find no trace of sedimentary or schistose rocks amongst the samples.”

APPENDIX II.

Preliminary report on samples of marine deposits obtained by W. S. Bruce off the eastern extremity of Joinville island, by John Murray, LL.D., PH.D., etc., and Robert Irvine, F.C.S., etc. :—

“The samples of marine deposits from the eastern side of Joinville island come from depths of 130 to 235 fathoms. Those from the lesser depths consist of fragments of polyzoa and basaltic gravel. Some samples consist of basaltic and quartz sand. The samples from the greater depths consist of blue muds made up of many particles of quartz, volcanic rocks, feldspars, hornblende, augite, tourmaline, together with a few globigerina and other foraminifera, many diatoms and sponge spicules, and amorphous clayey matter. The mineral particles indicate that the adjoining land contains true continental rocks.”

APPENDIX III.

Preliminary report on samples of sea-water obtained by W. S. Bruce between latitudes $56^{\circ} S.$ and $63^{\circ} S.$, and between longitudes $54^{\circ} W.$ and $56^{\circ} W.$, by John Murray, LL.D., PH.D., etc., and Robert Irvine, F.C.S., etc. :—

ANALYSIS OF ANTARCTIC WATERS.

| Position. | | ${}^{\circ}\text{S}_0$. | ${}_{17.5}\text{S}_{17.5}$. | ${}^{\text{S}}_{15.56}$ Calculated from ${}^{\circ}\text{S}_0$. | χ . (Chlorine.) | CO_2 Milligrams per <i>litro</i> . | $\frac{\text{D}}{{}^{\circ}\text{S}_0 - 1000}$. χ | $\frac{\text{D}_1}{{}^{\circ}\text{S}_0 - 1000}$. $\frac{\text{CO}_2}{\chi}$ |
|---|---------|--------------------------|------------------------------|--|-------------------------|---|--|--|
| 62° 31' S. 54° 2' W. } 56° 25' S. 55° 35' W. } | surface | 1027.37 | 1025.93 | 1025.10 | 18.777 | 49.95 * | 1.4576 | 0.5480 |
| | surface | 1027.32 | 1025.88 | 1025.06 | 18.746 | 48.94 † | 1.4575 | 0.5582 |

APPENDIX IV.

Preliminary report on biological collections brought home by the naturalists of the Antarctic Expedition, by Professor D'Arcy Thompson:—

"The collections brought home by Mr. Bruce, of the s.s. *Balæna*, and the other members of the recent expedition to the Antarctic were not large, but almost everything that they contained was interesting. Owing to the circumstances that my laboratory and museum (in which most of the specimens have been deposited) are at present being rebuilt, I can only give, in the mean time, the merest outline of the principal contents. The collection of birds was a very good one, but it is a matter of great regret that the bulk of it was retained by the captain of the *Balæna*, and has been dispersed owing to Captain Fairweather's too modest estimate of its interest and value. Among the specimens thus dispersed was a small gull with coral bill and dove-coloured neck and throat, which I only saw for a few moments, and which appeared quite new to me.

"Three splendid skins of emperor penguins were secured, all very large; in one case the bird had weighed 74 lbs. A whole skeleton and a portion of a second were prepared by Mr. Bruce and presented to our museum. Skins, and in most cases skulls, were also obtained of the black-throated penguin, *P. adeliae*; of the so-called *P. Herculis*, doubtless the same species in immature plumage; and of *P. taniatus*, the ringed penguin. The white-headed penguin, *P. papua*, was also observed in quantity, and a skull and egg are in the collection. This very valuable series of penguins has been fully described by Dr. Donald of the s.s. *Active*, in a paper about to be published by the Royal Society of Edinburgh.

"The other birds do not call for much remark, except perhaps one specimen of the Antarctic skua, in which the golden tinge on the brown feathers of the breast is very conspicuous.

"A small dolphin, not yet identified, but probably a young specimen of a known species, was brought home from the Falklands. Among the invertebrates, by far the most interesting specimen is one of the great compound Ascidian, apparently identical with that mentioned by Professor Herdman in the 'Challenger Report.' This form has not hitherto been named on account of the bad condition of the *Challenger* specimen, and another in the British Museum; but the present specimen is fairly well preserved, and promises to be of great interest. A considerable number of shizopod crustaceæ of the genus *Euphania* were preserved. They are all large species. One of them appears to be identical with *E. Murrayi* (Sars), of which only two specimens are recorded in the 'Challenger Report.' The others we have not yet identified, and some at least are almost certainly new.

* = 51.2 per litre.

† = 50.17 per litre.

"The tow-nettings from the Antarctic consist almost entirely of the characteristic diatomaceous genus *Corethron*, which is present in a very large number of forms.

"On the homeward voyage, Mr. Bruce took a number of tow-nettings in the south temperate and torrid zones of the Atlantic. In these the copepods are well preserved and very numerous; but we have not examined them, nor shall we do so until the report is published of the *Buccaneer* collections, with which these will doubtless closely agree.

"On the whole the zoological collections of the expedition are disappointingly small. But it must be remembered that in the hurry and work of a sealing and whaling voyage no attention can be spared to the naturalist's need, unless, indeed, special arrangements have been made, and the cost of the voyage in part defrayed with that end in view. But, on the other hand, of the collections brought home, the objects gathered in the extreme south are one and all either new or rare, and whet our appetite for further scientific exploration of the Antarctic seas."

TABLE OF SOUNDINGS.

(W. S. BRUCE.)

| Date. | Civil hour. | Depth in fathoms. |
|-----------------------|--------------------------------|-----------------------------|
| 1892, December 17 ... | Noon | 100, no bottom. |
| No. 3, " 20 ... | 19.30 | 161 |
| " " 21 ... | 9.0 | 142 |
| No. 6, " 21 ... | 10.0 | 140 |
| " " 21 ... | 11.30 | 139, white sand. |
| " " 21 ... | 12.0 | 139, white sand. |
| No. 7, " 21 ... | 20.0 | 170 |
| No. 8, " 21 ... | 22.0 | 147 |
| No. 9, " 22 ... | 2.0 | 180 |
| No. 13, " 22 ... | 6.0 | 130 |
| No. 17, " 22 ... | 10.0 | 235 |
| No. 18, " 22 ... | 14.0 | 235 |
| No. 19A, " 22 ... | 20.0 | 175 |
| " " 23 ... | 9.30 | 80, rock. |
| " " 23 ... | 14.0 | 126 |
| " " 23 ... | 24.0 | 180 |
| " " 24 ... | 20.0 | 194 |
| " " 25 ... | 20.0 | 200 |
| " " 28 ... | 18.30 | 121 |
| 1893, January 20 ... | 10.0 | 305, no bottom. |
| " " 22 ... | 20.0 | 310, no bottom. |
| " " 23 ... | 18.0 | 310, no bottom. |
| February 1 ... | 14.0 | 130, sand and small stones. |
| " " 1 ... | 18.0 | 130, sand and small stones. |
| " " 1 ... | 22.0 | 138 |
| " " 1 ... | 24.0 | 132 |
| " " 2 ... | { between } { 2.0 and 8.0 } | 140 |
| " " ... | 19.20 | 160, rock. |
| " " 5 ... | 10.0 | 200 |
| " " 5 ... | 14.0 | 140, green mud. |
| " " 5 ... | 19.30 | 109, stones and mud. |

The numbers are those of samples from the lead which have been preserved.

TABLE OF SURFACE AND DEEP SEA TEMPERATURES.
(V. S. BRUCE.)

| Depth in fathoms. | Dec. 20, at | | | December 21, at | | | December 22, at | | | D. c. 24, at | | Dec. 25, at | | Dec. 28, at | | Jan. 20, at | | Jan. 23, at | | Feb. 1, at | | Feb. 2, at | | February 5, at | | | | | |
|-------------------------|----------------------|------|------|------------------------------------|------|------|------------------------------|------|------|-----------------|------|----------------|--------|----------------|-----|----------------|------|----------------|--------|---------------|----|---------------|-----|----------------|-----|-----|----|-------|---|
| | 19.30 | 21 | 22 | 9 | 10 | 12 | 10 | 14 | 20 | 20 | 20 | 20 | 18.50. | 30. | 30. | 18. | 18. | 19. | 19.20. | 19. | 14 | 19.33 | 19. | 140 | 109 | 19. | 14 | 19.33 | |
| Surface ... | (20.9) at 20 | 30.7 | 31.0 | 30.1 | 31.4 | 30.9 | 29.7 | 31.3 | 31.6 | — | 30.8 | 30.7 | 29.9 | — | — | 29.9 | 30.1 | 30.1 | — | — | — | — | — | — | — | — | — | — | — |
| 50 | — | — | — | — | — | — | — | 29.3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 60 | — | — | — | — | — | — | — | 29.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 100 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 108 | — | — | — | — | — | — | — | 29.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 120 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 129 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 138 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 139 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 141 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 146 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 159 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 160 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 169 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 174 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 193 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 199 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 234 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 304 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| 339 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |
| Bottom in fathoms; | 161 | 142 | 140 | 139 | 170 | 147 | 175 | 194 | 200 | 121 | 305 | 310 | 130 | 160 | 230 | 140 | 109 | — | — | — | — | — | — | — | — | — | — | — | |
| Positions | { 62° 18' 53° 45' | — | — | { 62° 21' S. 54° 3' W. noon. | — | — | { 63° 2' 54° 31' noon. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | |

Until December 25 positions are correct; after that date there exists some doubt, but the positions may be regarded as very nearly correct; they are the best results obtainable. The deep-sea thermometer has not been corrected for error. It was supplied by A. Frazer, Edinburgh. The surface thermometer was B. T., No. 3211, and has been corrected.

| Date. | Wind. | | Barometer. | | Thermo. | | Weather. | Sea surface. | |
|-------------|--------------------|--------------|------------|------------|---------|---------|-----------------------|--------------|---------|
| | Direction. | Force. | Barometer. | Att. ther. | Dry. | Wet. | | Temp. | Sp. gr. |
| 1892. | | | | | | | | | |
| December 17 | W. | 3-3 | 29-445 | 58-67 | 35-55 | 35-22 | F. | 34-73 | 29-0 |
| 18 | { N.E. W. | { 2-5 4-3 | { 29-261 | { 54-27 | { 33-52 | { 33-23 | Fr. | 32-50 | 29-5 |
| 19 | { N.W. N.N.E. | { 1-9 4-6 | { 29-278 | { 48-97 | { 34-00 | { 33-72 | O.F. | 32-17 | 27-5 |
| 20 | N.N.E. | 2-6 | 29-962 | 49-28 | 33-95 | 33-63 | F. | 31-53 | 26-5 |
| 21 | N.W.N. | 1-7 | 29-104 | 45-83 | 32-97 | 32-33 | F. | 31-55 | 27-5 |
| 22 | E. | 1-5 | 29-091 | 48-67 | 32-28 | 31-67 | F. | 30-95 | 28-0 |
| 23 | S. | 2-2 | 29-264 | 51-47 | 33-42 | 32-45 | O.G. | 32-25 | 27-5 |
| 24 | S. | 2-0 | 29-470 | 49-48 | 32-84 | 31-80 | C.B.S. | 32-74 | 27-0 |
| 25 | S. | 0-3 | 29-659 | 49-30 | 32-53 | 31-45 | C.B. | 32-52 | 28-0 |
| 26 | E. | 2-3 | 29-763 | 51-05 | 30-15 | 29-43 | O. | 32-18 | 27-0 |
| 27 | E. | 5-0 | 29-595 | 47-75 | 31-15 | 31-20 | O.G. | 31-52 | 27-5 |
| 28 | E. | 4-6 | 29-509 | 41-13 | 31-27 | 31-27 | O.G.M. | 31-90 | 27-0 |
| 29 | N.N.E. | 3-6 | 1-9-499 | 48-15 | 31-32 | 31-32 | O.G. | 31-76 | 27-0 |
| 30 | E. | 2-0 | 29-548 | 49-35 | 30-14 | 30-25 | O. | 31-07 | 27-0 |
| 31 | S.E. | 1-6 | 29-584 | 47-08 | 31-65 | 31-10 | C.B. | 31-28 | 27-0 |
| 1893. | | | | | | | | | |
| January 1 | E. & N. | 1-9 | 29-624 | 45-08 | 31-70 | 30-62 | C. | 31-58 | 27-5 |
| 2 | N. | 1-4 | 29-633 | 48-60 | 31-55 | 34-55 | B. | 32-33 | 27-5 |
| 3 | N.E. | 4-1 | 29-197 | 47-70 | 33-67 | 32-52 | O.S., C.B. | 31-87 | 27-5 |
| 4 | N.E. | 3-0 | 29-409 | 46-72 | 33-80 | 33-03 | O.M.Q., 5 S. | 31-92 | 27-0 |
| 5 | Calm | 0-0 | 29-512 | 48-70 | 34-76 | 34-00 | O. | 32-20 | 27-0 |
| 6 | E. & N.E. | 3-2 | 29-416 | 49-95 | 35-38 | 34-15 | O.S.Q. | 32-10 | 27-0 |
| 7 | W. | 0-8 | 29-481 | 50-40 | 35-00 | 33-64 | O.S. | 31-92 | 27-5 |
| 8 | W. | 1-7 | 29-424 | 51-67 | 34-73 | 33-88 | O.M.F. | 32-32 | 27-5 |
| 9 | { N.E. N.W. | { 1-5 0-2 | { 29-270 | { 50-90 | { 35-23 | { 34-52 | O.F. | 33-08 | 27-0 |
| 10 | S. | 5-2 | 29-150 | 43-50 | 32-20 | 31-62 | O.M., 10 S. | 31-87 | 27-5 |
| 11 | Calm | 1-0 | 29-330 | 50-03 | 36-10 | 34-82 | C.B.V. | 32-34 | 27-5 |
| 12 | { N. S.E. | { 3-4 1-7 | { 29-241 | { 48-82 | { 33-28 | { 32-55 | O.S. | 32-03 | 28-0 |
| 13 | { E. Calm | { 1-4 0-0 | { 29-379 | { 49-54 | { 33-02 | { 32-12 | O.F. | 32-02 | 27-5 |
| 14 | N.E. | 1-2 | 29-604 | 47-27 | 35-05 | 33-28 | C.B. | 32-30 | 27-5 |
| 15 | N. | 2-1 | 29-685 | 48-77 | 34-57 | 33-40 | B.F. | 32-03 | 27-5 |
| 16 | N.N.E. | 2-9 | 29-655 | 44-27 | 31-72 | 31-15 | F. | 31-80 | 27-5 |
| 17 | N. | 3-8 | 29-682 | 46-03 | 33-50 | 32-75 | O.M.G. | 32-23 | 27-5 |
| 18 | N.W.N. | 3-6 | 29-452 | 46-63 | 34-15 | 33-78 | F., O.M.G. | 32-05 | 27-0 |
| 19 | W. | 4-2 | 29-051 | 44-83 | 33-03 | 32-17 | O.G.M., F., iv., 6 S. | 32-05 | 26-5 |
| 20 | W. | 2-9 | 28-934 | 46-20 | 34-22 | 33-80 | O.F.G. | 32-38 | 26-5 |
| 21 | { W. S. | { 1-3 2-0 | { 28-897 | { 47-52 | { 34-12 | { 33-38 | F., C.B. | 32-88 | 27-0 |
| 22 | W. | 1-0 | 29-119 | 48-38 | 34-70 | 33-44 | O.M., C.B. | 32-74 | 27-0 |
| 23 | { Calm E. | { 0-0 3-0 | { 29-122 | { 49-28 | { 32-15 | { 31-27 | C.V., O. 3½ S. | 31-42 | 27-0 |
| 24 | E. & S. | 3-8 | 28-741 | 48-88 | 31-87 | 31-35 | O.M.S. | 31-72 | 27-5 |
| 25 | S. | 3-3 | 29-105 | 48-30 | 32-02 | 31-63 | O.M.D. | 32-13 | 27-5 |
| 26 | S.S.E. | 1-5 | 29-415 | 48-92 | 32-77 | 31-85 | O., C.B. | 32-40 | 27-5 |
| 27 | E. | 0-7 | 29-563 | 45-00 | 32-78 | 30-93 | C.B. | 32-05 | 27-5 |
| 28 | S. & E. | 2-8 | 29-474 | 43-55 | 30-92 | 29-78 | C.B. | 31-62 | 28-0 |
| 29 | S. | 6-7 | 29-161 | 41-67 | 29-93 | 29-74 | C.B. | 31-28 | 28-0 |
| 30 | S. | 7-2 | 28-624 | 40-26 | 29-38 | 29-00 | O., C. | 30-80 | 27-5 |
| 31 | S. | 6-6 | 29-089 | 48-52 | 30-32 | 30-32 | O.M., 11 S. | 31-58 | 27-5 |
| February 1 | S. | 6-3 | 29-014 | 43-77 | 30-65 | 31-57 | O.M., 10 S. | 32-05 | 27-5 |
| 2 | S.E. | 2-3 | 29-165 | 47-80 | 31-28 | 31-08 | O. | 31-88 | 27-5 |
| 3 | S.E. | 2-5 | 29-128 | 49-14 | 31-46 | 30-78 | O.V., O. 3 S. | 31-50 | 27-5 |
| 4 | S.E. | 4-5 | 29-010 | 31-47 | 31-62 | 31-43 | O.F., 16 S. | 31-12 | 27-6 |
| 5 | S.S.E. | 5-2 | 29-299 | 45-40 | 31-23 | 31-05 | O.M., 12 S. | 31-27 | 27-9 |
| 6 | { S. W. | { 2-6 2-2 | { 29-723 | { 44-13 | { 33-22 | { 31-85 | C.B.V. | 31-50 | 27-0 |
| 7 | W. N.W. | 2-8 | 29-399 | 46-23 | 35-05 | 34-23 | O.F., 4 S., C.B.V. | 31-73 | 27-3 |
| 8 | { N. S.W. | { 2-1 7-0 | { 29-099 | { 46-80 | { 30-48 | { 31-88 | O.F., 3 E.D., 4 S. | 30-95 | 27-6 |
| 9 | S.S.W. | 4-4 | 29-520 | 44-50 | 31-18 | 30-55 | O.M. | 31-58 | 27-2 |
| 10 | N.N.W. | 3-4 | 29-433 | 45-57 | 33-73 | 33-49 | O.M. | 31-43 | 26-5 |
| 11 | N.W. | 2-7 | 29-254 | 47-72 | 34-62 | 33-93 | B.C.F. | 31-13 | 27-0 |
| 12 | S.S.E. | 5-4 | 29-141 | 43-35 | 29-24 | 28-90 | O.F., 11 S. | 30-76 | 27-0 |
| 13 | S. | 7-0 | 29-246 | 42-73 | 26-13 | 25-75 | O.Q.S. | 31-22 | 27-4 |
| 14 | { S.S.E. N.W. | { 1-8 3-3 | { 29-131 | { 45-30 | { 28-75 | { 28-25 | C.B., O.M. | 31-82 | 27-0 |
| 15 | E. | 2-7 | 29-097 | 43-83 | 29-43 | 28-58 | O.M., 10 S. | 31-13 | 27-2 |
| 16 | { N.E. S.E. | { 3-4 6-0 | { 29-008 | { 52-26 | { 30-60 | { 31-04 | O.M., 5 S., LV., 4 D. | 30-94 | 27-5 |
| 17 | S.S.E. | 4-6 | 29-152 | 42-92 | 24-12 | 24-17 | C. | 30-00 | 27-5 |
| 18 | { N.E. N.N.W. | { 1-4 3-4 | { 29-330 | { 46-73 | { 31-94 | { 31-58 | O.M.G.F. | 30-68 | 27-4 |
| 19 | N.N.W. | 3-9 | 29-181 | 49-63 | 35-33 | 35-05 | O.F., 11 D. | 31-77 | 27-5 |
| 20 | W.N.W. | 2-7 | 29-101 | 48-27 | 33-28 | 32-77 | F., 4 D., C.B. | 31-32 | 27-0 |
| 21 | W.N.W. | 4-3 | 29-254 | 51-14 | 35-18 | 34-66 | C.B. | 31-34 | 27-2 |
| 22 | N.W. | 4-9 | 29-310 | 53-42 | 35-56 | 34-86 | O.M.F. | 31-26 | 27-8 |
| 23 | N.N.E. | 2-0 | 29-030 | 48-77 | 32-72 | 32-63 | O.M.F.D., 8 V. | 30-98 | 27-0 |
| 24 | S.W. | 5-3 | 29-248 | 44-50 | 30-30 | 30-05 | O.M.F., LV., 4 S. | 30-83 | 26-8 |
| 25 | W.S.W. | 2-6 | 29-184 | 53-13 | 33-73 | 33-37 | O.M., C.B. | 33-40 | 26-0 |
| 26 | { S.W.W. W.N.W. | { 4-9 4-0 | { 29-542 | { 53-68 | { 38-55 | { 37-92 | C.B., O.M., 1 V. | 36-82 | 26-5 |