The "Southern Cross" Expedition to the Antarctic, 1899-1900
Author(s): C. E. Borchgrevink
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THE "SOUTHERN CROSS" EXPEDITION TO THE ANTARCTIC, 1899–1900.*

By C. E. BORCHGREVINK.

It was on December 30, 1898—somewhat sooner than I had expected—that the *Southern Cross* first struck the scouts of the antarctic ice-pack, in lat. 51° 56′ S., long. 153° 53′ E. My experiences of 1894–95 justified the anticipation that we should encounter ice early on the southward voyage by going so far west; in fact, it appears to me that in this locality the ice conditions are always unfavourable. I had, however, purposely taken that course in order to satisfy myself respecting the land reported by Captain Wilkes, and which, it seems clear to me, was, in reality, Balleny. It was an anxious but interesting moment as I watched, from the crow's nest, the vessel as she rose on the swelling ocean and dashed in among the grinding ice-blocks. Trembling and shaking, she forged her way onwards, while the swell grew rapidly less as we successfully pushed into the inner ice-pack.

Since we entered the ice there had met us quite a different bird-life to that seen in the open sea, which had consisted principally of albatrosses (*Diomedea*) of several species, and various petrels, including the mutton-bird (*Œstrelata lessoni*) and *Prion vittatus*. The last-named followed us some distance into the ice, but it left us long before we came into the dense pack. A brown-backed bird with a white border to the wings, white underneath, and in body and beak much like a puffin, met us at once when we came into the ice, and was usually seen as long as the ice was slack, but after the pack got denser the bird was seldom to be seen. We saw from time to time specimens of

* Read at the Royal Geographical Society, June 25, 1900. Map, p. 500.

Ossifraga gigantea, *Oceanites oceanicus*, as well as *Daption capensis*, and some penguins (*Eudyptes adeliæ*). *Pagodroma nivea* and *Thalassoica glacialoides* were best represented. Among the seals we saw about this time were two young sea-leopards, as well as some white seals, one specimen of which appeared, from the form of the skull, to be different from the rest, though alike as regard the skin and the size. On January 8 we saw the first specimen of the giant penguin *Aptenodytes forsteri*, but did not succeed in securing it. On January 12 the bird-life was very rich. In the evening Mr. Hanson did some valuable work with the plankton bag, and brought in amongst other things a great many shrimps.

On January 14, 1899, when approximately in 65° 42′ S. and 163° E. long., I entered the crow's nest at midnight, and discovered high snow-clad land to the south. The land stood out sharply in a haze of crimson and gold, which grew more brilliant as the sun rose, until the contours of peaks and crevasses suddenly grasped the beauty of the young day and reflected it out all over the immense ice-pack, where the dark water-pools between the floes changed suddenly from deepest azure to blood red, while the young snow on the ice blushed in delicate crimson. It was Balleny island which we sighted.

The seals which were shot about this time seemed to be far advanced in moulting, and they looked a good deal darker in their new coats. The moulting starts on the back, in a straight line from nose to tail. It is remarkable that neither in the stomachs of the white seals, nor in the intestines, had food of any kind been found. Some few whales had been seen, mostly of the blue kind. On January 16, we were still lying fast in heavy pack, the wind blowing very hard from the south-west. We were in lat. 65° 43′ S., and long. 164° 9′ E. The compass error 26° 5′ E.

On January 18 we saw two large penguins (*A. forsteri*). It was a pair. These birds must have a wonderful power of location, as the male dived when about 600 yards from the vessel, reappearing close by the floe where his mate was seated, the intervening space being covered with ice-floes. On January 20, Mr. Hanson for the first time secured some skuas (*Lestris*). Like other species of *Lestris*, it was very curious, and came close to the side of the vessel. The 21st was noteworthy for the discovery by Mr. Hanson of a new species of seal. The body was not unlike that of the ordinary seal, but the neck was of more than ordinary thickness, and under the chin it extended to a great round muscular purse. The head was short and broad, the eyes large and protruding, and the mouth short. The eyes were somewhat slanting. It had six front teeth in the upper jaw, two in the under jaw, but no back teeth. On January 23 we experienced very heavy ice-pressure, tremendous ice-blocks rising violently against us. The *Southern Cross* sighed and groaned under the pressure brought to bear upon her. She was lifted 4 feet bodily out of the water on one occasion. During this

time Captain Jensen and I spent many cold and anxious hours in the crow's nest. For weeks we remained buried in the snow and ice, and as the summer advanced I began to foresee a possibility of not being able to get through with the vessel. Instead of trying the doubtful chance of getting southwards in the vicinity of Balleny, I determined, after consultation, owing to the advanced season, to work northwards towards open water, with the intention of making a fresh attack on the ice-pack further east. This plan was followed, and after a hard fight in the pack for 48 days, the *Southern Cross* ran into open water, lat. 70° S., and long. 174° E.

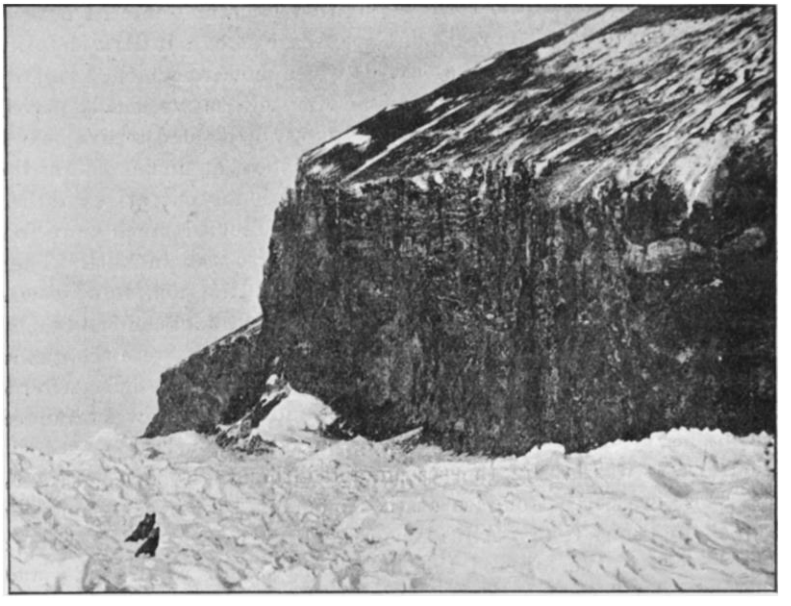
On February 15 and 16, the *Southern Cross* was compelled to lie to in a storm of blinding sleet, with decks and rigging covered thick with ice. On the evening of the 16th we sighted land, and entered Robertson bay on the 17th. The rocks of Cape Adare stood out dark and conspicuous as we steamed into the bay. It was a moment which, I believe, will live in the memory of my staff and myself, as we slowly moved towards the low beach whereon man had never attempted to live before. At 11 p.m., for the first time in the world's history, an anchor fell at the last *terra incognita* on the globe. Already while far out at sea it had struck me that the cape and its surroundings seemed much more free from ice and snow than was the case on my first visit in 1894. Then the cape had several feet of ice and snow on the top, now it was absolutely bare. Only here and there were ice-blocks left on the beach; the rest was dark and bare, and on the peninsula itself were the guano deposits, while at this late season only a few penguins were left. After a brief stay on shore, we returned to the vessel, and quickly all was arranged for a speedy commencement of landing our stores, instruments, dogs, and outfit. It was late in the season, and although Robertson bay, to my surprise, was free from ice at that moment, I knew that it might fill up again at any time. Already, on the 18th, we were hard at work landing stores. We lowered the boxes into small whale-boats, and pulled near the shore, where some of us had to wade into the breakers and carry the things ashore. On the 23rd we were suddenly interrupted in our work by a strong gale from the south-east. The gale increased, and developed into a blizzard.

On March 1, the Union Jack, presented by His Royal Highness the Duke of York, was formally hoisted on Victoria Land, greeted with loud cheers from those on shore, and with a salute and dipping of the flag from on board. The following day the *Southern Cross* left us at our pioneer settlement on Cape Adare, which I christened Camp Ridley.

On landing, I had carefully selected and taken on shore with me the following members of my expedition: Lieut. W. Colbeck, R.N.R., magnetic observer; Mr. Nicholai Hanson, zoological taxidermist; Mr. Louis Bernacchi, magnetic observer, astronomer, and photographer; Dr. H. Klovstad, M.A., M.D.; Mr. Hugh Evans, assistant zoologist; Mr. Anton

Fougner, general assistant; Mr. Colbein Ellefsen, cook; the Finn Savio and the Finn Must. I cannot but at once add that in their special departments all of these showed themselves exceptionally zealous and capable, and during the year that we fought shoulder to shoulder in those regions there always existed an honourable rivalry in making each of their several departments as perfect as possible.

On March 12 Mr. Bernacchi and I scaled Cape Adare to the height of 3670 feet, as indicated by the aneroid. The ascent was very steep for the first 800 feet, principally over worn rocks on the mountain-side. On the top there were great mounds of pebbles and large boulders stretching from east to west, on undulating ground. At 800 feet I

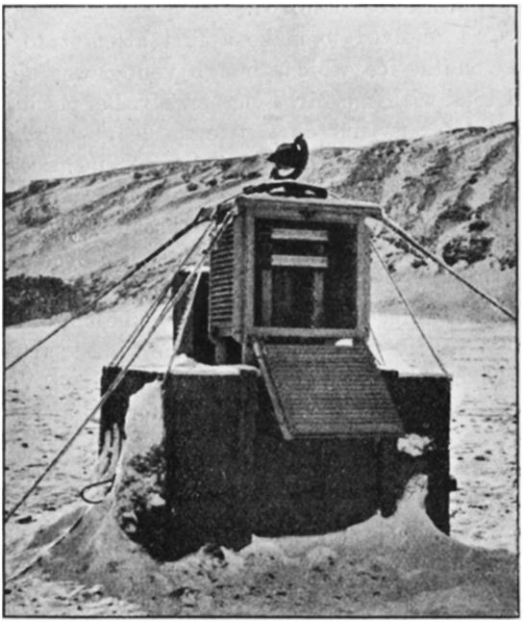


CAPE ADARE IN WINTER-TIME.

found vegetation of the very same kind as that seen on the lower rocks of Cape Adare in 1894, but none was seen above this height. The penguins had been up as far as 1000 feet.

About March 13 the temperature, which had previously kept about 22°, began to fall rapidly. Already on the 14th all the penguins had left us, while the skuas (*Lestris*), which were about in great numbers on our arrival, also began to get scarce. On this date Mr. Bernacchi and Mr. Colbeck completed their magnetic observatory in the large Finn tent, which was secured by stays of rope. The meteorological observatory, some 300 yards away from the huts, was also completed at the same time. On March 15 we saw the first Aurora Australis. On the

18th, having brought up all the stores to the house, we organized a preliminary expedition to the top of Cape Adare, whence I hoped to be able to reach the inner part of Robertson bay; but the very first night came on with a hurricane accompanied by driving snow, and we ran the risk of being blown over the cliffs with all our outfit. At camp Ridley the wind had a velocity of 87 miles an hour. At this date Robertson bay was beginning to freeze. The days were spent in frequent meteorological observations, which were taken every second hour, and whenever clear weather permitted, astronomical observations were made, the magnetic work going on whenever the magnetic conditions



THERMOMETER SCREEN.

were favourable. The snowstorms which plunged down from the cape wrapped Cape Ridley in a dense whirl of snow-drift, by which the dogs were completely buried. The ice in the bay was completely ground up, and waves of snow, ice, and water dashed up against the beach and sent the spray flying over the roof of our camp. On April 8, when a heavy gale had ceased, on going along the beach, Mr. Hanson and myself were surprised to find, washed on shore, numberless specimens of medusæ, hydroids, star-fish, and algæ. Can it be that, after all, an extensive shallow-water fauna exists within the antarctic circle?

The roof of our hut we gradually covered over with sealskins, and, in expectation of further gales from the south-east, the eastern sides of

the huts were fortified by a sloping roof of good canvas and seal-skins, weighted down by numberless bags of coal. On April 8 Hanson discovered a fish, and shot a seal, which had fragments of partially digested fish in its stomach. Our health up to that date had been excellent. It was remarkable to see the quick rise and fall in the temperatures, and, considering the near approach of the winter, the temperature was comparatively high. From time to time we caught many fish in the bay. Some were over 12 inches long and about 7 inches in girth. I had photographs taken of all the specimens, and, whenever opportunity offered, photographs were taken of the various peaks on the coast within sight, and cinematograph photos whenever active incidents of interest occurred.

On April 22 I resolved to make a first attempt to penetrate into Robertson bay on the ice, which, though young, was already about 2½ feet thick. I took with me Mr. Fougner, Mr. Bernacchi, and the Finn Savio, provisions for twenty days, twenty sledge-dogs, and one small canvas boat. We left Camp Ridley at 11 a.m., and proceeded over the pack until darkness began to set in. The pack along the cliffs was rather small, and the ice which bound the floes together thin, so we had to proceed with great caution, and, when I at last decided to camp on a small beach at the foot of the perpendicular wall of Victoria Land, I had great difficulty in reaching the spot. The beach, or slope, where we pitched our tent was not 30 yards broad at the widest part, and only some 4 feet above water. From the perpendicular wall of Victoria Land a kind of gravel slide had taken place, and formed a steep slope about 30 feet high from the wall of rocks to the beach. Above us the cliff rose to about 500 feet, at places overhanging the little beach, which seemed completely isolated except by way of the bay. Shortly after landing, a southerly wind rose, which continued to increase till it became a violent gale. At seven the ice began to break up, huge breakers washing over the beach, and we had only just time to save our provisions by carrying them to the top of the gravel slope, where drift snow and ice had formed a sort of gallery about 6 feet broad, close to the mountain wall. In this, after immense difficulty, we pitched our camp, all working calmly, although fully realizing the awkward position in which we were placed. On Monday night, the 23rd, the bay was completely free of ice, and was perfectly calm. I then sent Mr. Fougner and the Finn Savio towards Camp Ridley in the small collapsible boat, with emergency rations sufficient for a few days. Shortly afterwards heavy ice came drifting rapidly into the bay, and we became very anxious about them, while we were ourselves without any craft whatever to take us from our momentary place of refuge. For two days we remained in ignorance of Mr. Fougner's and Savio's fate; but on the 25th, in the evening, both appeared on a very steep ice slope, descending from the perpendicular wall of Victoria Land. By the help of a little axe and an

alpenstock they cut footholds in the ice, and came slowly towards us. I soon discovered that they were in a pretty weak condition, and while Mr. Bernacchi started to cook some warm food for them, I began to cut steps in the steep ice-slope to meet them. At night we were again all safe in our little camping-place. Our comrades had spent two days and nights under the shelter of the canvas boat, and thought that they had discovered a possible place for an ascent to the ridge of Victoria Land some 5000 feet above us. The first 500 feet would, however, involve great risk. On the 27th I decided to make the attempt. Following the route by which Mr. Fougner and Savio had descended, we were enabled to reach the place where these two had camped, and saw the place likely to offer the only chance of escape. It was a rough kind of groove in the perpendicular cliff of Victoria Land, partly covered with ice and

CAMP RIDLEY AFTER THE FIRST SNOWDRIFT.

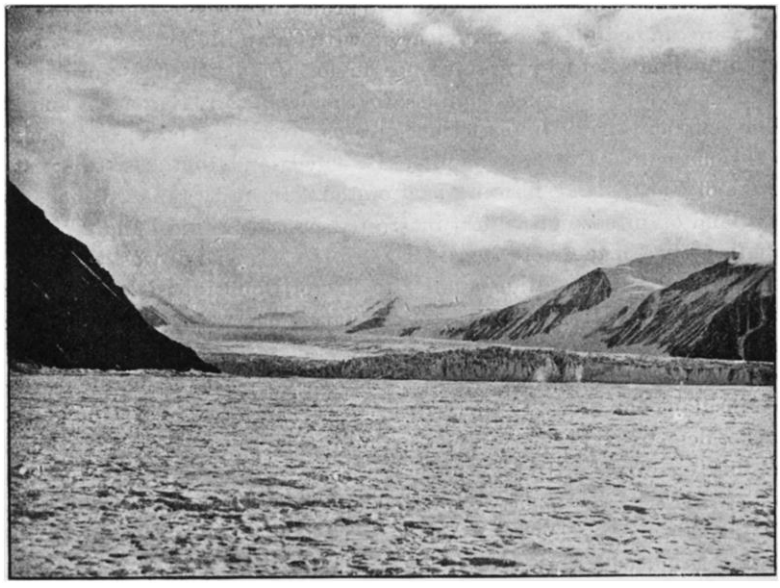
snow. After a good meal of seal beef, we began our ascent. Cautiously and slowly we climbed upwards, while the lesser slope some 400 feet above seemed continually to recede from us. All the night through we continued to climb, while the cold increased as we got up in the heights. By the ridge we were enabled to proceed to Camp Ridley, where great anxiety had prevailed, as our friends knew no place where we could possibly have camped.

We could now catch sufficient fish for our meals, thus gaining a valuable accession to our food supplies, and the knowledge that fish are to be caught will materially benefit future expeditions. The Aurora Australis was seen very often on clear nights. During May and June tremendous gales blew from the south-east, the wind often carrying stones with it. Great screwing also went on in the ice in the bay. The reading of the meteorological observations was often

carried out with great difficulty, and on one occasion Mr. Evans got lost in crossing from the thermometer screen to the house. We searched for three hours before finding him, and he was finally brought to the camp in an exhausted condition. However, under the careful treatment of the doctor he soon recovered. During the gradual shortening of the days we experienced great depression, as if watching ourselves growing old. We were getting tired of each other's company, and began to know every line in each other's faces. Chess, cards, and draughts were the most popular recreations. On June 3 the thermometer showed $-31°$, and some of my staff had the extremities badly frozen. As it was the Duke of York's birthday, the Union Jack, his present to the expedition, was hoisted, whilst a beautiful Aurora waved in mighty curtains over Camp Ridley. On June 15 another tremendous gale was blowing, lasting until the 17th, and making it impossible to collect the meteorological readings. Had we not had the sloping safety roof towards the east, I doubt whether the houses would have remained on *terra firma*. As will be seen from our meteorological observations, a great and sudden rise of temperature indicated the approaching gale. The days were now very dark, though the horizon towards the north-west was slightly crimson. The darkness and the silence in this solitude weigh heavily on one's mind. The silence roars in one's ears. It is centuries of heaped-up solitude. During the last sledge expeditions depôts had been made at several places along the coast in Robertson bay, and on the peninsula, in more elevated places than the camp, in case high water should at times rise above its level.

On July 26 I started on a fresh sledge journey, with the object of reaching the coast to the west of Robertson bay. At twelve mid-day I started with Mr. Evans and both of the Finns, taking provisions for thirty days, and twenty-nine dogs. For 12 miles we had very rough travelling, owing to the large ice-blocks heaped one upon another. At 4 p.m. we pitched our camp at the foot of an iceberg. As the ice conditions to the southward appeared very promising, I decided to send Mr. Evans back to Camp Ridley to tell Mr. Colbeck and Mr. Fougner to follow with more sledges and provisions, while I started southward, accompanied by the two Finns. We travelled all night without pitching camp, with a temperature of $-25°$. During the next two days it was misty. No land was to be seen, and I could get no observations. Towards evening on the 28th a gale came on with heavy drift, and we all remained inside the tent in our sleeping-bags. It was bitterly cold, and we suffered greatly from frost-bites, while the dogs froze fast to the ice. No land could be sighted anywhere. On July 31, having seen nothing of the party which was to have followed us up, we proceeded onwards on comparatively good ice. In the evening I discovered an island towards the south, and reached the western side of it an hour after dark. We were then very hungry and worn, the temperature was

−40° when we pitched the tent. I called this camp Midwinter camp, and the island Duke of York island.* On August 2 I resolved to investigate some of the coast-line of this island. I took with me the Finn Must, while I left Savio in camp to construct a kind of Finn tent out of provision bags, sealskins, and bags, which he proposed stretching over our sledges pitched on one end. Must and I proceeded along the northern shore of Duke of York island, and reached a bay which I named Crescent bay. During the succeeding days I made as thorough an investigation of the immediate surroundings of our camp as the cold and weather permitted. As I was getting anxious about the party



DUGDALE GLACIER (MOUTH OF).

which was to have assisted us, I began to take in stores of seal-beef and blubber. We suffered a great deal from cold and frost-bites, although we managed to keep up a blubber fire in the tent. However, both of my brave comrades kept up their courage, and were always cheerful. Having secured a valuable geological collection, in the middle of August we started back, and on this journey we experienced the lowest temperature we recorded—it reached −52°, or 84° of frost.

On our return to Camp Ridley, I decided to continue the explorations already begun in Robertson bay; partly from the great geological and other interest presented by that locality, and partly

* 71° 35′ S. lat., 170° 2¾′ E. long.

because I hoped to find there a likely place whence to penetrate further inland. Expeditions were therefore despatched during the remainder of August and September under the different members of my staff in turn, and valuable collections and observations were made. In the vicinity of Robertson bay, the great elevation of the land, which reached far above 12,000 feet, rendered it difficult to find a likely place for a journey into the interior. Glaciers thousands of feet in height precipitated themselves into the sea, sometimes at an angle of about 50°, and, being crossed by innumerable deep crevasses, rendered our expeditions on the coast both arduous and dangerous. The Finn Savio and myself worked in the vicinity of Mount Sabine for more than seven weeks, camping in a hut constructed of stones between two projecting rocks. During the time we were camped there communication with Camp Ridley was continually kept up, and stores brought thence to form a depôt at Duke of York island. While bringing supplies to the depôt, Mr. Bernacchi and Mr. Ellefsen had a frightful experience, being overtaken on the ice-pack by a furious gale. During this time I visited land to the south-west of Duke of York island, forming part of the Admiralty range, which, as it is a land of intense geological interest, I named Geikie Land. Moraine studies were made here, while Duke of York island was thoroughly investigated. Its position, similar to that of Doubtful island, discovered by Sir James Clark Ross, illustrates that remarkable formation which, in the close vicinity of great glaciers, makes it so difficult to decide whether the land really is an island or joined to the mainland as a peninsula. Duke of York island is cut through from east to west by broad, deep quartz reefs. Suffice it to say that minerals of value occur in this vicinity, justifying the belief that in time to come exploration will receive much support from commerce. I took formal possession of the island for Sir George Newnes by the hoisting of our Union Jack. Geikie Land, which we visited on several occasions, is likewise rich in minerals. A good deal of vegetation was found there, but we experienced great difficulty in penetrating further inland. Sledges with provisions were taken up ridges, across glaciers, and down precipices; and when we could bring them no further we loaded ourselves, and with ropes and alpenstocks we climbed the steep slopes. Exhausted and frozen, we returned to our stone hut after numberless attacks on these inaccessible ranges.

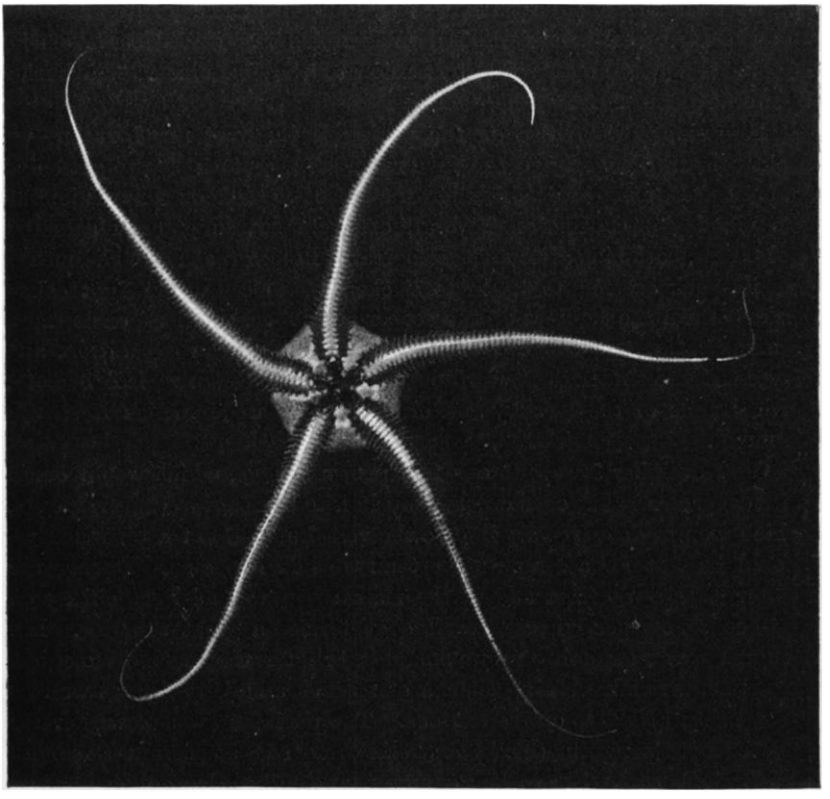
The last report from camp told that Mr. Hanson was in a low condition and under medical treatment, having lost feeling in his legs, and being only able to walk with difficulty. The Finn and myself began to suffer severely from rheumatism, and Mr. Colbeck suffered too with neuralgia. On October 4 I started back for Camp Ridley with Mr. Fougner, and on arrival found Mr. Hanson's condition very low indeed. In spite of all the doctor's care and attention, he daily grew worse. At two o'clock in the night of October 14, the doctor called me in my

sleeping-bag, and informed me officially that Mr. Hanson had not long to live, that he had informed him of his condition, when he expressed a wish to say good-bye to us all. I found him quiet, and without pain. He calmly bade me farewell, and confided to me his last wishes, choosing himself the place where he wished to be buried—at the foot of a big boulder some thousand feet up Cape Adare. The next day, about three in the afternoon, he died without pain, keeping conscious up to the very last. Half an hour before he died the first penguin came back. Enthusiastic as he had always been in his calling, Mr. Hanson asked to see the bird, and was delighted to examine it. The doctor's official report says that he died from occlusion of the intestines. We buried him on October 20.

Penguins now arrived on the peninsula in great numbers, and we looked forward eagerly to the time when we might expect to get eggs. I continued during the remainder of October to send out expeditions in the vicinity of Robertson bay, all of them bringing back splendid collections, both biological and geological. Before the end of the month the ice-pack seemed to begin to slacken. I placed water-tight oaken casks both in the hollows of the icebergs and on the floes, enclosing a communication, in which I stated the results of the expedition, and requested the finder to forward it to the Royal Geographical Society, with details of the locality and circumstances under which it should be found.

On November 3 we got our first penguin eggs, which we devoured with eagerness. I at once ordered my staff to commence collecting eggs, which we put down in salt in case the vessel should not return, and we should be left for a longer time than we had expected. During the winter, both away from and in the main camp, we had lived chiefly on seal-beef; now penguin flesh and eggs formed a great resource. Mr. Fougner was now doing very valuable work for the marine biological department, numberless specimens of starfish and jelly-fish, as well as algæ, being added to our collections. The peninsula was now literally covered with penguins (*Eudyptes adeliæ*), and still a constant stream of new arrivals could be seen far out on the ice, like a long endless black snake winding in between the ice-floes. As no open water was to be seen anywhere, not even a vapour-cloud indicating the near neighbourhood of any, these welcome travellers must have had a long walk. With short interruptions we had continually experienced heavy gales, some of which exceeded 90 miles an hour. These gales naturally considerably checked the progress of sledge expeditions. Nearly all the provisions had to be taken with us, as little bird-life was seen except on the coast-line, and the frequent gales always necessitate a great percentage of idle camping days, when much of the provisions for the inland journey will be eaten without a corresponding advance being made.

According to our meteorological observations, no one ought, in my opinion, to start a sledge journey in these latitudes without taking into consideration the likelihood of getting at least 20 per cent. of checking gales. We have not here those aids which are found in the north, in the bears, foxes, musk-oxen, and reindeer of the Arctic fauna. Life depends entirely upon a careful selection of the necessary provisions, and nearly double the quantity necessary for the distance to be



STARFISH FOUND IN 20 FATHOMS AT CAPE ADARE (HALF NATURAL SIZE).

travelled must be taken, because of these powerful gales, in which it is not only impossible to travel, but difficult even to exist. These facts, besides the great elevation of Victoria Land and its difficult glaciers, make travelling within the antarctic circle quite a different matter to that in the arctic regions. In the vicinity of Cape Adare, a position which corresponds to that of Northern Norway, the ice and meteorological conditions cause much greater danger to the traveller than in those higher latitudes in the north which are ruled by similar average

temperatures. It seems as though an early break-up of the ice in the bay eastwards of the land stretching from Cape Adare down to the active volcanoes Erebus and Terror takes place every year, and occasionally I presume that the ice even breaks up for a week at a time in late autumn and early spring; thus travelling at sea in the pack, as well as in Robertson bay and in the vast Ross bay to the east, will always be perilous undertakings. In my opinion, successful exploration within the antarctic circle must always be confined to one locality, for if too large a field for operations were chosen, the natural conditions and the variable antarctic climate would make failure probable. Necessarily also there ought to be close co-operation between expeditions on land and at sea—between vessels and sledges.

These facts soon became evident to me as the season drew onwards. Up to the middle of November very little change was to be seen in the general ice-pack, although some open canals were met with on a sledge journey which the Finn Must and myself carried out to the east of Cape Adare. The canals closed again, and not until the end of November did noticeable changes take place in the ice-pack. Although the penguin colony seemed to fill the very ground of the peninsula, new arrivals continued even after the birds which arrived first had been sitting on their eggs for a fortnight. The skuas (*Lestris*) had by this time come back. The boldness of these birds is such that on several occasions I saw them attack the dogs, and nearly all of us were also attacked on more than one occasion. The *Pagodroma nivea* and the giant petrel also arrived, and we watched their movements with great interest to discover the places where they intended to nest. Our efforts were rewarded, and the extensive egg-collection which the expedition brings back is the result of sledge journeys to Duke of York island, to Geikie Land, and to the vicinity of Mount Adam and Mount Sabine.

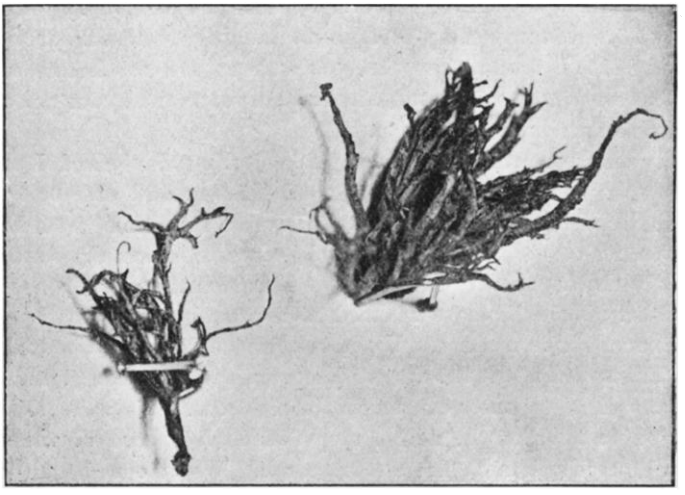
After the middle of November dark vapour clouds were continually to be seen towards the eastern horizon, and on one occasion the temperature rose to $+18°$. I went with the doctor towards the cape and found a large sheet of water, in which a strong current was running at a rate of from 5 to 6 knots. The ice was evidently wearing rapidly by this time, the current increasing perceptibly in strength from day to day. It seemed improbable that those abnormally violent gales would blow again before the autumn, the summer being so far advanced. As the bulk of the immense ice-pack still remained with very few interruptions, we began seriously to contemplate the possibility that the ice-conditions of the previous season had been exceptionally favourable, and that the *Southern Cross* might be unable to reach us. Strict precautions were therefore taken against using more than the necessary food, while we continually added to our provisions by seal-beef, penguins, and eggs. Clear, calm, comparatively warm days became now frequent. Mr.

Bernacchi and Lieut. Colbeck were now making the final arrangements for observations of the total eclipse which was to take place on December 3. However, our expectations were doomed to disappointment, the day proving overcast. Some interesting temperature records and time observations were, however, registered in connection with the eclipse. The ice now began to break up in earnest. It is clear that all the pack-ice must needs take a westerly course under the influence of the prevailing wind, and northerly under that of the current. It was therefore likely that my instructions to Captain Jensen not to go further west than 170° would cause the *Southern Cross* to reach open water at a comparatively early part of the antarctic summer.

PART OF THE MEDIAL MORAINE AT GEIKIE LAND.

On December 10 I started on my last sledge journey into Robertson bay, principally for the purpose of securing eggs of the different birds. On this journey a remarkable discovery was made by the doctor. I had sent him on a short expedition into Admiralty range for the purpose of collecting specimens of the vegetation on Geikie Land. When he came back, he was proud to show me several insects of three distinct types, which he had found in the mosses. This discovery is naturally very far-reaching. The existence of insects throws a satisfactory light on our meteorological work, and it is improbable that the temperatures about Geikie Land will fall much below those we had experienced, otherwise the life of insects would not be possible. It may be that we had experienced a comparatively cold winter. From Crescent bay, on

Duke of York island, we entered a bay to the south-east—an arm of Robertson bay—at the end of which I found a very low and easily accessible land, the beach rising from the water to the height of about 30 feet. The land was formed partly by the glacier, and partly through stone-shoots from the mountain side to the north-east. As a dividing line between this work of the glacier and that of the mountain ravines, a small stream came rippling down among the boulders and rocks from two small lakes, formed through the melting of the great glacier, which I named the Murray glacier. Before we returned to Camp Ridley, we explored this neighbourhood to the height of 1700 feet, at which height we found vegetation. When travelling back, we



REINDEER MOSS (LICHEN).

found that a good deal of water had accumulated near the coast-line and made the landing with sledges and gear difficult.

As I remarked in 1895, after my first antarctic journey, it must strike any one with an eye for geological science how the nature of Victoria Land speaks of evolution. One need only look at the moraines, the empty glacier beds, and the worn rocks of Victoria Land to be convinced that these lands must have changed during periods comparatively not very distant.

On the 27th the report from the top was to the effect that no ice was to be seen towards the north, even through the telescope. To the north-west and west much ice was, however, in view. Along the beaches of our peninsula the ice was getting unsafe for travelling. Several young penguins were out of their shells, and Mr. Evans, who had taken over Mr. Hanson's department, collected specimens of the

young ones from day to day in order to get the series in their growth. Mr. Fougner secured a magnificent specimen of a jelly-fish.

New Year's Day broke bright and clear, with the Union Jack flying merrily at the flag-staff, and we looked back with feelings of pardonable pride on the work accomplished by us during the year just sped. On January 5 there was open water as far as the eye could reach towards north and east. We swept the horizon, but no signs of the returning vessel were to be seen. Although there was open water everywhere, many huge icebergs were now seen to drift northwards past the cape. Some few seemed to be influenced by a strong under-current, which brought them into Robertson bay, where the larger ones ran aground. It was an interesting sight to witness these bergs sail into the bay straight against a heavy gale, and against the upper current. On January 23, the anniversary of my first landing on the antarctic continent in 1894, I found that the season in regard to climate and ice conditions were not so favourable as in that year. The young penguins were not so far advanced as then.

Early on the morning of January 28, the Finn Savio and I paddled back to Camp Ridley from a kayak expedition; and at 8.30 on that day Captain Jensen entered Camp Ridley with the mail from Europe, while the ice-covered masts and yards of the *Southern Cross* stood out sharply in the frosty air. Gradually we heard all the news, both private and public. Never had we realized more what a large part the daily newspaper plays in our life. We learnt for the first time about the war in the Transvaal, about the recent discoveries in telegraphy, and found how many changes one year might bring about. We were especially interested to hear of the active steps which had been taken to continue the prosecution of antarctic research. We at once began to take on board from Camp Ridley such stores as were wanted for our southward journey. The dogs, sledges, instruments, and fur were likewise brought on board; and after visiting Mr. Hanson's grave, we all embarked, leaving at Camp Ridley the huts, a quantity of coal which would have kept us for another year, a considerable amount of provisions, and a small note from myself to the commander of the next expedition. In the evening of February 2 we steamed away from Camp Ridley, and I had again the united expedition of thirty souls under my command.

Taking repeated bearings of Victoria Land for mapping purposes, we arrived at Possession island at 6 a.m. on February 3. Instruments and cameras were put into a boat, and I effected a successful landing with the whole of my staff. On Possession island we found the post with the iron box left there by the antarctic expedition of 1895. I left a letter in that box with the names of those who had landed with me, and after collecting specimens of rocks and vegetation, and securing as many photos as possible, we reached the vessel without mishap. On February 4 we had a fine day, each undulation and white peak of Victoria

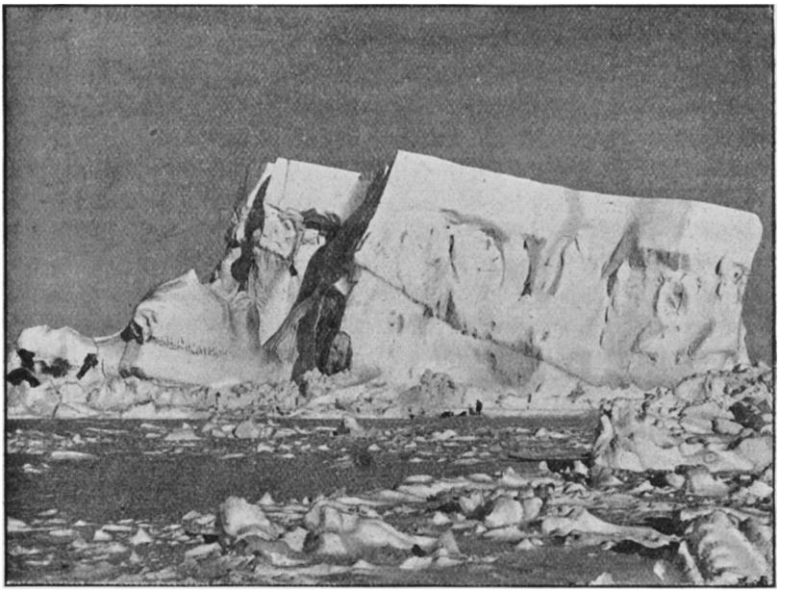
Land standing out clearly defined against the blue sky. At Coulman island I again effected a landing, after which, principally on account of the magnetic observations which would be invaluable in this locality, the course of the *Southern Cross* was laid westwards. Since leaving Cape Adare the temperature of the water had risen from 28° to 30°. The land for some 40 miles inland appeared considerably lower than the ranges near Cape Adare, but in my opinion even here there would be no opportunity for a sledge party to proceed successfully far inland. However, having penetrated as far as possible towards the land to the west of Coulman island, and to the south of a conspicuous cape, which I named Cape Constance, after my wife, we found a bay in an ice barrier, or rather in the seaward edge of the ice-sheet, descending from Victoria Land. We found an admirable place for the magnetic observations, which were made on the ice by Mr. Bernacchi and Lieut. Colbeck, and which were of the greatest value for the location of the present position of the south magnetic pole. The dip taken here was 87° 18′. With the aid of sledges we reached the end of the bay, where we found very many seals. On leaving this locality on the 4th, we had considerable difficulty from drift-ice. On the 5th we steamed southwards, and saw a great deal of pack-ice towards the west, so the coast-line here could not be distinctly mapped for some distance. On the 6th we were in lat. 74° 32′. We sighted continuous land towards the west, and as little pack-ice was seen, I decided to risk an investigation of the fjord, to the north of the range which terminates in Cape Washington, as here also I hoped to be able to afford my magnetic observers the necessary opportunity. Proceeding westwards for about 20 miles from the cape, we discovered a promontory almost clear of ice and snow, with a beach of about 100 acres. There I effected a landing with the whole of my staff, including Captain Jensen, and two sailors. The promontory runs north-west, leaving a cove, apparently a splendid winter harbour, to the southward, where Mount Melbourne rises to a height of about 12,000 feet. Its conical volcanic top was distinctly reflected into the clear cove, and reminded me of Mount Etna; while the midnight sun surpassed itself in splendour. To the south-east the peninsula or promontory was undulating, and rose in wonderfully worn shapes to the height of about 700 feet, affording wild and magnificent scenery. Large pieces of brimstone and lava covered the ground. A sharply defined ice-line intervened between this dark peninsula and the foot of Mount Melbourne. Evidently this promontory was formed by a volcanic eruption of Mount Melbourne, the side of which, however, was covered with a thick sheet of ice and snow. We found vegetation here of two different kinds, very many skuas, plenty of seals, and a small penguin rookery.

On the 7th, at 8.30 a.m., we passed Cape Washington, the coast-line towards the south-west gradually appearing lower. Here and there dark conspicuous rocks protrude from enormous glaciers. At midnight on the

7th, Lieut. Colbeck and Mr. Bernacchi were again able to take a dip observation on the ice. Mount Melbourne could still be distinguished to the north-west through the misty air, while ahead of us Franklin island rapidly grew more distinct. At 5 p.m. we effected a landing on its western side, on a pebbly beach very like the peninsula at Cape Adare. There were very many penguins on the peninsula, many more than were left at Cape Adare when we last sail farewell to Camp Ridley. The most interesting discovery, however, was made in the marine zoological department, Mr. Fougner securing a rich collection of the shallow-water fauna. On the 10th, at twelve o'clock noon, the *Southern Cross* was in 77° 17′ S. lat., and 168° E. long. We had, immediately towards the south, Mount Erebus and Mount Terror, some misty clouds hanging round their tops. The coast-line is ice-bound, with a barrier about 7 feet thick, and only here and there broken by a projecting rocky promontory. Cape Crozier is comparatively free from ice and snow. We secured photos of Mounts Erebus and Terror, the former volcano being in activity. I effected a landing at the foot of Mount Terror, taking with me Lieut. Colbeck, Captain Jensen, and two sailors. The beach was formed by *débris* from an overhanging rock about 500 feet above, and did not exceed 10 feet in width and about 4 feet in height.

Shortly after landing, Lieut. Colbeck, at my request, went back with the two sailors in the boat to fetch a camera, while Captain Jensen and I busied ourselves in collecting. Suddenly a tremendous roar commenced overhead. At the first moment the thought passed through my mind that the overhanging rock was coming down upon us. In the next I realized the dangerous fact, and communicated it to Captain Jensen, who simultaneously recognized that the glacier immediately to the west of our little beach was giving birth to an iceberg. Quick as thought the event followed. With a deafening roar a huge body of ice plunged into the sea, and a white cloud of water and snow hid everything from our view. There was absolutely nothing to be done, and we both foresaw what immediately afterwards followed. A tidal wave—if I so may term it, because of its similarity to such—a raging, rushing wave, rose like a wall from the plunge of this million-ton mass of ice. It seemed rapidly to grow as it hurried towards our low ledge. We instinctively rushed to the highest part of our beach and stood close to the perpendicular mountain wall. The wave, which must have had a height of from 15 to 20 feet, seemed long in reaching us. It struck me first; lumps of ice dashed against my back, and I clung to the rock until I felt that the blood rushed from beneath my nails. I had just time to call out to Captain Jensen to cling to the rock, when the icy water closed over my head. When it had passed Jensen was still at my side. The next few waves were several feet smaller, and only washed about us up to our arm-pits, but the drag of

the water when it returned from the cliff tried us almost beyond our strength. Had it not been for a projecting ice-slope, which seemed to break the wave in its advance, we should undoubtedly have been smashed against the rock; for where the wave, unchecked, hit the wall some 10 yards beyond us, it tore away stones and left a mark of moisture some 20 feet above our heads, while marks of spray were to be seen still further up. Far out at sea the boat was returning with Lieut. Colbeck and the two sailors: they saw all that had happened to greater advantage, and of course realized the full extent of the danger we were in, Lieut. Colbeck having saved his boat from being swamped



A TYPICAL ANTARCTIC ICEBERG.

only by the exercise of considerable presence of mind. As it was, both Captain Jensen and myself escaped with a good deal of knocking about, and of course wet to the skin and chilled by the icy bath; but a splendid collection of rocks and vegetation soon made us forget the incident, which might have ended disastrously for us.

I now decided to steam southwards. To the south-east Mount Terror runs into the ocean with a rather gentle slope, and this part, curiously enough, is free from ice and snow, though the cone is covered in a mail of ice. No evidence of activity was noticed in this volcano. The eastern quarter of the coast-line of Mount Terror is not ice-bound, but from the south-east cape a high continuous ice-barrier stretches to the east-south-east, apparently about 60 feet high. From the crater of Mount Erebus a smoke-cloud was from time to time shot up into the

frosty air. A very biting breeze from the south was blowing; the thermometer marked several degrees below zero, and the deck, rigging, and sides of the vessel were all covered with ice. We proceeded along the barrier, slowly gaining some southing. On the 12th we were in 78° 4′; the barrier was still unbroken, but it seemed now inclined to take a somewhat southerly bend. In the evening we must have been in about 78° 10′. On the 13th a strong gale, with heavy seas and thick snow-drift, commenced. The *Southern Cross* had several feet of ice on her decks, bulwarks, and sides, and crew and staff suffered severely from the cold. In the intervals between the thick snow squalls tremendous icebergs hove in sight. On the 14th the gale somewhat lessened. On the 16th we were still proceeding southwards, with plenty of pancake ice around us. On the 17th, while in lat. 78° 34′, and E. long. 195° 50′, I discovered a break in the barrier with low ice towards the east. At this place I effected a landing with sledges, dogs, provisions, and instruments; and leaving the vessel with the rest of the expedition in charge of Captain Jensen, I myself, accompanied by Lieut. Colbeck and the Finn Savio, proceeded southwards, reaching 78° 50′, the furthest south ever reached by man.

On the 19th the voyage towards civilization commenced. On March 30 the *Southern Cross* dropped her anchor at Stewart island, New Zealand, where fresh food was brought on board. Here I left the *Southern Cross*, with instructions to Captain Jensen to proceed to Hobart, while I gained the Bluff, New Zealand, in a small fore-and-aft schooner. We arrived there at midnight, and I was enabled to send the following communication to Sir George Newnes: "Object of expedition carried out. South magnetic pole located. Furthest south with sledge, record, 78° 50′. Zoologist Hanson dead. All well on board.—BORCHGREVINK."

APPENDIX.

PHYSICAL GEOGRAPHY AND GEOLOGY.

The general aspect of Victoria Land is that of a wide, elevated, mountainous country, with peaks rising to the height of between 10,000 and 12,000 feet above the sea-level, precipitating into the antarctic ocean innumerable broad glaciers, traversed by deep yawning crevasses, which present an almost insurmountable barrier to the progress of the traveller. It is remarkable how free from ice and snow Victoria Land is at places near the coast. Cape Adare, Duke of York island, Geikie Land, Doubtful island, Possession island, parts of Coulman island, Cape Constance, Newnes Land, Cape Crozier, and numerous places between these conspicuous antarctic landmarks, are all bare of ice, most of them producing vegetation in the summer. At Newnes Land a minor eruption at the side of Mount Melbourne may account to some extent for the hospitable appearance in this locality; but the presence of the penguin colony there in their old nests, and the vegetation, indicates that the place for a considerable time past has been undisturbed by the forces within Mount Melbourne. Gales of course sweep the snow

away from many places, but this cannot be the general explanation, for some of the features mentioned, especially the camping-ground at Newnes Land, are rather sheltered. The land seemed to get somewhat lower south of Newnes Land, although through the telescope immense peaks were discovered in a chain far inland; but pack-ice prevented us from pushing close up to the land between Cape Washington and Mount Erebus. However, I regard Newnes Land and the vicinity of Cape Neumayer and Cape Gauss as of special geographical interest, apart from the desirability of these places as magnetic stations. At Newnes Land a party ought to winter. We observed many fjords penetrating Victoria Land from the coast, especially in the vicinity of Newnes Land, where the inner part of Southern Cross fjord still remains to be explored. It, as well as Wood bay, was blocked by ice at the time of our visit, but I consider it a particularly suitable place for the establishment of a winter station.

The geological and mineralogical specimens collected are to a great extent a more complete series of the rocks which I secured at Victoria Land in 1894. Most of the rocks are of volcanic origin, and represent basaltic lava-flows which have taken place during late geological epochs. The specimens I brought from the South Victoria continent differ but little from those I found on Possession island, but distinctly new features are to be found in Duke of York island and in Franklin island. I also collected this time a rock with indistinct granular structure which much resembles the garnet sandstone of Broken hill. The particular specimen is composed of quartz, garnet, and felspar fragments. On Duke of York island broad quartz reefs are to be found; but a complete report upon the geological and mineralogical conditions of South Victoria Land can of course only be made when microscopical and chemical tests have been applied. The moraine studies will, I think, prove of considerable value, both in regard to the geological formations near the coast and to the movement of the glaciers.

Ice Conditions.

The antarctic icebergs are in appearance of two distinct kinds, although, in my opinion, they have a similar origin. They are either discharged from what is ordinarily understood as glacier, or broken from the big barrier in the extreme south. However, to my mind, this barrier is merely the northern extremity of a great ice-sheet sloping northwards from land near the South pole, which is really nothing more or less than an immense glacier. The bergs discharged from a glacier, which has descended from a great elevation and been squeezed between immense peaks, will naturally have a more rugged appearance than those discharged from the gently sloping ice-sheet. The former are often overturned when forced into the sea, the latter break gently off through the great but steady pressure of the ice-sheet; and the iceberg will, even after the calving has taken place, maintain the character of the barrier or ice-sheet from which it was derived. The uppermost part of the bergs broken from the barrier is generally formed by a horizontal layer, from 30 to 40 feet thick, of ice due to snow-fall, which, under the pressure of the wind, has quickly taken the nature of ice, but remains easily distinguishable, by its white colour and soft structure, from that of the under part, the clear green and blue stratified glacier ice. Under the influence of the prevailing under-current these monarchs moved north-eastwards. The pack shows distinctly two kinds of ice, with different origins: on the one hand, that which is formed by the freezing of the sea; and on the other, the smaller ice broken from glaciers or from the extremity of the ice-sheet in the south. The difference between the two is not always so marked as to be distinguished without careful observation, the pressure and screw in the sea-ice near the coast of the

antarctic continent being so great that the blocks are reared on end, and would, to a casual observer, appear like glacier ice; but a nearer investigation will show two distinct structures. It is the land ice, or glacier ice, in the pack which, being harder and more angular, is most dangerous for ice navigation. The general movement of the antarctic ice-pack is apparently north-easterly, this direction being determined both by current and wind. The open water to the east of Victoria Land is undoubtedly due to the heavy south-easterly gales, as also to currents setting east of Victoria Land, and to the comparatively warm water in that locality. Active volcanoes above and below the sea-level probably play a considerable part in altering ice conditions. In travelling towards my furthest south on the southern ice-sheet, I noticed that here and there the surface rose in small cones, which at places were broken into rough walls of about 30 feet. Sometimes the ice-sheet suddenly took a terrace form, but this was always local, and the general nature of the surface was that of an immense white unbroken flat, with a scarcely noticeable rise towards the south. With a sufficient number of reindeer, sledges, and dogs, and a very small party of scientific men, I believe that a high southern latitude may be reached on this ice-sheet in the proper longitude.

A vessel bound for Victoria Land ought not, without special reason, to proceed west of 170° long. E. November and December is, I believe, the best time at which to approach the ice-pack. A general break-up of the ice does not take place before the end of January, and I do not think that under normal conditions a vessel would succeed in reaching Victoria Land much before the beginning of February. I regard the success of Sir James Clark Ross, without the help of steam, unquestionably as a sign of exceptionally favourable ice conditions in the year when the *Erebus* and the *Terror* penetrated into the antarctic ice-pack. In ice-pack similar to that encountered by the *Southern Cross*, sailing vessels would be entirely helpless and at the mercy of the pack. The progress of a vessel in the antarctic pack depends, according to my experience, very much upon the locality in which the pack is attacked, and also on the meteorological conditions. In the absence of land to the north, the big swell of the south-westerly trades reaches the antarctic pack, causing great pressure, under which a very heavy screw takes place and threatens to crush the staunchest of vessels, while sledge journeys become at times impossible. It also happens that even after the ice is 2 or 3 feet thick, a gale of 100 miles an hour begins to blow, and the ice which may have been absolutely safe for travelling one hour, has the next been ground up into furious rolling waves. In Robertson bay the ice did not attain a thickness of more than 5 feet, and at places it was only 2 feet thick throughout the winter. I believe this to be greatly due to the strong currents which prevailed in and near Robertson bay.

Zoology.

Birds.—The common penguin of Victoria Land is the *Eudyptes adeliæ*. As in 1894, the rookery of these birds at Cape Adare covered the whole peninsula of Camp Ridley, their nests, placed above the guano deposits, being formed of small pebbles, probably blown from the top of the cape by the gales. In 1894, the colony was inhabited almost entirely by white-throated penguins, whereas those met with on our outward voyage in 1899 had nearly all black throats. I was able to prove that both are of the same species, the young birds, which are left behind when the old ones go to sea, having more or less white throats. It was curious to see the penguins as they invaded the peninsula in the spring, one continual stream passing over the ice from October 14 onwards. They at once started nest-making, taking possession of their old places, and bringing new pebbles to the nest. During the time of love-making they had many hard fights. As a general rule two eggs are

laid, but very seldom three are found in one nest; the period of incubation, during which both birds take their turn in the nest, lasted in 1899 from the beginning of November to early in December. During heavy gales, the birds, which ordinarily sit upright or lie facing various directions, all turned with their beaks to the south-east, the direction from which we had the heaviest gales. The skua is the worst enemy of the penguin, constantly soaring over the nests and watching an opportunity to steal an egg or young bird.

We saw comparatively few of the emperor penguin (*Aptenodytes forsteri*), nor were we able to find their nesting-place. In the autumn of 1900, we for the first time saw several together, and even then only in small numbers. They came swimming like the small penguins, with which, however, they did not mix.

No specimens of the king penguin (*A. pennanti*) were seen.

The skuas (*Lestris*) arrived somewhat later than the penguins, and their eggs were also laid later. They made their nests in the heights, up to 1000 feet on Cape Adare.

Of petrels, the *Oceanites oceanicus* also hatched on Victoria Land, the nests being found in cracks of the rocks and under boulders. The elegant white petrel (*Pagodroma nivea*), with black eyes, beak, and feet, likewise builds in cavities of the rocks. These birds are attractive both in appearance and habits. The pairs show deep attachment, and the courage of the male is indomitable when his mate is in danger. The brown-backed and giant petrels were seen, but their nests were not discovered. I believe the former nest on Geikie Land. The giant petrels seemed to arrive before the approach of gales, and I attributed their visits to strong gales at sea, which drove them towards the shore for shelter. In their flight they much resemble the albatross.

Seals.—The seals we encountered in the pack on the southward voyage were, as they always have been found in the antarctic regions, scarce, all of them being hair-seals. Besides the sea-leopard, Weddell's seal was the best represented. We found the characteristic white seal of the antarctic in greater numbers than in 1894; and Mr. Hanson made, at my special request, as good a study of this interesting species as time, specimens, and opportunity allowed. As we proceeded southwards, the number of seals basking together increased considerably, and in the vicinity of Coulman island and Cape Constance, in Lady Newnes bay, we saw as many as 300 together. These were Weddell's seal. The new species of seal discovered by Mr. Hanson in the pack was very poorly represented, and we only secured four specimens of them altogether. These were three males and one female. In the vicinity of Cape Adare seals were to be found nearly all the winter; either on the ice near their blow-holes, or in the water at these holes, which they managed to keep open in Robertson bay nearly all the winter. I had hoped to have found that the white seal would breed in Robertson bay, but was disappointed at finding that this was not the case. The Weddell's seal and sea-leopard both bred in Robertson bay, and we frequently found the young ones on the sledge journeys. The seals, like the penguins, provided us with fresh food.

The Shallow-water Fauna.—In Robertson bay there is an abundance of fish, and in all we discovered about five different kinds. One particular species was often over 12 inches in length. The most remarkable form was a fish about 9 to 10 inches long, with a body much like that of the jack, with a very long under-jaw reaching beyond the upper, and armed with two very sharp, comparatively long teeth inclined backwards. The head occupies nearly one-third of the entire length of the fish. It is a greenish-grey colour above, and lighter underneath. Another remarkable fish is absolutely white. It has much the shape of a herring. Of lower organisms, caught principally by the dredge, medusæ were well

represented. One large jelly-fish was caught near the peninsula with arms about 12 yards long. Its weight was 90 lbs. Smaller jelly-fish, several kinds of star-fish, shells, sponges, and a variety of shrimps and crustacea were secured. All along the coast as far as Franklin island a very fine coral was found.

Insects.—Perhaps the most remarkable biological discovery is the finding of insects of three distinct types. They were found in the lichen. Although very minute they are easily distinguished by the naked eye as they move about in the lichen. Their presence naturally indicates an average temperature in the locality in which we found them, not varying greatly from that observed by us.

Vegetation.

Besides abundance of the lichen which I discovered in 1894, we now found five different kinds of lichen, including the ordinary reindeer moss. Specimens were obtained as high up as 3000 feet, and as far south as 78°, at the foot of Mount Terror. On the coast, from Cape Adare onwards, seaweed of many different kinds was found in large quantities.

Meteorology.

The following is an outline of the meteorological and magnetic observations taken by the expedition in southern latitudes. The observations being still unreduced, it is impossible to discuss them fully at present, and for this reason no readings of the barometer can be given in this report. These meteorological observations were taken at Cape Adare in lat. 71° 18′ S., during an entire year, from February, 1899, to February, 1900. They were conducted on nearly the same lines as at a station of the first order, and as accurately and regularly as possible. During nine months of the year readings were taken two-hourly, from 9 a.m. to 9 p.m.; and during the three winter months, June, July, and August, two-hourly observations were made day and night. Besides these readings, and those of maximum and minimum thermometers, the self-registering instruments furnished barograph and thermograph curves for the whole period, and records of the amount of sunshine were made by the Campbell-Stokes sunshine recorder. The tables given below, although only first approximations, are sufficiently exact to indicate the general nature of the climate. Observations taken at Cape Adare are possibly affected to a certain degree by local accidents, such as the contour of the country and proximity to the sea; but the record for the year has the great advantage of being taken at one spot.

Meteorological observations were taken on board ship every two hours, night and day, during the month (January, 1899) she was beset in the ice-pack. The geographical area over which the observations were taken was between the parallels of 63° 38′ S. and 66° 46′ S., and the meridians of 160° 6′ E., and 166° 56′ E.

The mean temperature of the air for January was 29°·94 Fahr., and of the sea 29°·64 Fahr.; the mean temperature for the second week being the highest in both cases, as is shown by the following table:—

Table I.—*Weekly Mean Temperatures for January*, 1899.

	Mean temperature of air.	Mean temperature of sea.
	° F.	° F.
First week	30·2	29·8
Second week	31·9	30·1
Third week	29·4	29·5
Fourth week	28·4	29·2

The lowest temperature or the month, which occurred on the 29th, at 3 a.m., was 16°·8 Fahr. (− 8°·8 C.) in lat. 66° 45′, and long. 165° 25′ E., off one of the Balleny islands. The highest temperature for the month was 36°·4 at 5 p.m. on the 12th, lat. 65° 3′, and long. 161° 42′ E. The mean diurnal oscillation of temperature for the month was 5°·20 Fahr. The greatest range between the maximum and the minimum of one day was 16° Fahr., the least 1° Fahr.

Light and variable winds prevailed during most of the month; the force was rarely greater than 4, Beaufort's scale. Gales blew on the 9th, 16th, 22nd, and 23rd, when the velocity of the wind exceeded 30 miles an hour. The weather may be summarized as 5 days' clear bright sunshine; 13 days' snow and sleet; 2 days' rain, when the temperature rose above 32°; 4 days' mists and fogs; and the rest overcast.

As will be seen from the table given below, the mean temperature at Cape Adare is above zero for six months in the year, and for six months below zero.

TABLE II.—*Monthly Mean Temperatures.**

Month.	Mean temperature.	Date of maximum.	Maximum.	Date of minimum.	Minimum.	Range.
1899.	° F.		° F.		° F.	° F.
February	26·4†	—		—	—	—
March	17·7	5th	31·1	25th	− 2·5	33·6
April	10·3	2nd	30·0	19th	− 10·0	40·0
May	− 4·6	4th	23·2	13th	− 31·1	54·3
June	− 11·8	11th	14·1	3rd	− 36·0	50·1
July	− 8·6	18th	23·8	9th	− 39·9	63·7
August	− 13·4	15th	18·9	4th	− 43·1	62·0
September	− 11·9	7th	11·5	30th	− 36·1	47·6
October	− 1·8	15th	19·6	2nd	− 35·5	55·1
November	+ 17·8	28 h	45·7	1st	− 4·0	49·7
December	31·8	25th	42·2	11th	+ 20·4	21·8
1900.						
January	33·0	23rd	48 9	10th	22·5	26 4

Mean temperature for the year = 7°·05 Fahr.

August was the coldest month, the mean temperature being −13°·4 Fahr. (−25°·2 C.). The extreme minimum temperature occurred on August 4, at 9 p.m., during perfectly calm and clear weather. Table 3 shows the fall of temperature during the afternoon of that day, with the accompanying barometric pressure:—

TABLE III.

Time.	Temperature.	Temperature.	Barometer (Corr.).
	° F.	° C.	Inches.
1 p.m.	− 36·0	− 37 8	29·292
3 „	− 40·0	− 40·0	29·312
5 „	− 41·5	− 40·8	29·324
7 „	− 42·0	− 41·1	29·344
9 „	− 43·1	− 41·7	29·355

At these temperatures the mercury froze in the ordinary thermometers, and spirit ones had to be used. The above temperatures are means derived from three

* Obtained by taking the means of maximum and minimum daily temperatures.

† Based on twelve days' observations, 16th to 28th.

thermometers. At these low temperatures there was a slight diversity in the indications of the respective thermometers, even after applying the corrections as given upon the Kew certificates. The maximum temperature observed at Cape Adare, 48°·9 Fahr., occurred during a very heavy storm from the east-south-east, on January 23, 1900; but this is quite exceptional. The mean monthly temperature is above freezing-point during one month of the year, viz. January.

The relatively high mean temperature for July is due to the number of gales from east-south-east and south-east during that month, the temperature invariably rising with these winds. The extreme range of temperature was 92° Fahr., and the mean temperature for the year +7°·056 Fahr. (−13°·9 C.), which, compared to the mean annual temperature for the same northern latitude, is extremely low. The mean temperature for Lapland, in 71° N., is about 32° Fahr., and the mean temperature for the north of Spitsbergen, which extends as far north as 82° N., is about 10° Fahr.

The temperature of the sea during the greater part of the year, that is, while the surface of the sea was frozen over, remained constant at 27°·8 Fahr. In the summer months, December, January, and February, it rarely rose above 32° Fahr.

During the winter months, or at least during the seventy-one days that the sun remained constantly below the horizon, the diurnal variations of the thermometer and barometer were scarcely perceptible, being almost, if not quite, concealed by the oscillations due to the passage of storms.

The intensity of solar radiation was measured with the black-bulb thermometer *in vacuo*. This instrument was freely exposed to the sun by fixing it horizontally above the ground at the same height as the thermometer screen, viz. 4 feet 6 inches.

A temperature above 80° Fahr. was frequently recorded by this thermometer, whilst the temperature in the shade remained below freezing-point. These high readings were probably due to the hygrometric conditions of the atmosphere, the air, on account of the intense cold, being extremely dry.

Table IV. gives some of the highest readings with the solar radiation thermometer and the temperature of air in the shade observed at the same time.

TABLE IV.

Date.	Solar thermometer.	Temperature in shade.
	° F.	° F.
March 3	88·0	24·0
„ 6	92·0	22·4
„ 14	88·3	20·9
„ 16	92·2	24·5
„ 26	104·2	8·0

Relative humidity between 40 and 50 per cent.

The most remarkable feature in the meteorological conditions of the antarctic is the wind. The prevailing east-south-east and south-east winds at Cape Adare, which is within the area of abnormally low pressure, tend to prove the existence of a great anti-cyclone stretching over the polar area, which in its turn necessarily implies the existence of upper currents from the northward, blowing towards and in upon the polar regions to make good the drain caused by the surface outblowing south-easterly winds. The frequency and force of these gales, and the persistency with which they blew—always from the same direction, east-south-east—the invariably high rise in the temperature, and the sudden fall and rise of the barometer,

the dryness of the winds—the relative humidity generally between 40 and 50 per cent.—and the motion of the upper clouds from the north-west, point to the fact that the south pole is covered by what may be regarded practically as a great permanent anti-cyclone, more extensive in the winter months than in the summer. Nothing more appalling than these frightful winds, accompanied by tons of drift-snow from the mountains above, can be imagined. On ninety-two days, or 26 per cent. of the time spent at Cape Adare, the wind blew from the east-south-east and south-east with a velocity above 40 miles an hour, and on one or two occasions above 90 miles an hour, at which stage our Robinson anemometers were demolished. A proper table of wind directions, velocities, and thermal windroses is not available, but the following tables will suffice to convey some idea of the conditions.

TABLE V.—*Number of Days in each Month when Velocity of the Wind was above* 40 *Miles an Hour.*

Month.	Number of days.
1899.	
February	5
March	11
April	8
May	7
June	7
July	12
August	6
September	6
October	7
November	5
December	9
1900.	
January	9

TABLE VI.—*Conditions during a Storm on April* 2, 1899.

Time.	Barometer (corrected).	Temperature of air.	Direction of wind.	Velocity of wind.
April 1—	Inches.	° F.		Miles per hour.
9 p.m.	29·599	12·2	W.	5·7
April 2—				
9 a.m.	29·199	17·0	Whirlwinds	—
11 a.m.	29·064	22·6	E.S.E.	82
1 p.m.	28·919	24·0	E S.E.	83
3 p.m.	28·916	26·9	E.S.E.	102 ?
5 p.m.	28·880	24·3	E.S.E.	88
7 p.m.	28·880	25·3	E.S.E.	90
9 p.m.	28·917	27·9	E.S.E.	82·5
April 3—				
9 a.m.	29 208	19·5	S.	40·6

The maximum temperature during the gale was 31·5° Fahr. During a gale on March 19 a Robinson anemometer was demolished, the velocity of the wind exceeding 90 miles an hour; and another was destroyed on the night of May 18, when it was impossible to estimate the velocity of the wind. The anemometers used were tested at the Kew Observatory prior to the departure of the expedition from England, and were found to give results within 97 per cent. of the Kew instruments. It is evident, however, that the action of wear and tear on the instrument by these gales must have a very material influence on its indications.

The barograph and thermograph curves during a storm from the east-south-east on May 14, 1899, show very clearly that the temperature commences to rise before the barometer commences to fall; indeed, it was often possible to predict an approaching gale by the thermometer alone, long before the barometer showed any sign of the disturbance.

The mean barometric pressure for the winter months is much lower than the mean for the summer, but the means have not yet been determined. The highest barometric pressure occurred on July 22, 1899, when the barometer registered 30·182 inches, and the lowest, 27·860 inches, on September 9, 1899.

On the journey from Cape Adare southwards, some remarkably low temperatures were observed for the time of the year. Thus, off Mount Erebus on February 11, 1900, the temperature sank to $-6°$ Fahr. with a wind from the south straight off the great ice barrier. Again, on February 19, the minimum temperature was $-12°$ Fahr. ($-24°{\cdot}4$ C.) with clear sky and light wind from the south. It is possible to form an idea from these temperatures what one would be likely to encounter in the way of cold on a sledge journey southwards from the edge of the great ice barrier in the middle of the antarctic summer.

Magnetism.

Magnetic observations taken in the vicinity of the south magnetic poles will always present great difficulties, unless taken on board ship at some distance from the coast-line, and with instruments of the nature of the Fox circle. The highly magnetic character of the rocks of the shores of Victoria Land not only renders the taking of magnetic observations extremely difficult, but the observations are themselves untrustworthy. Even far inland, where the ice-cap is some thousands of feet thick, the influence of the rocks, if magnetic, as is most probable, would certainly be felt. Under such circumstances, the unifilar magnetometer is the worst instrument that could possibly be taken to the antarctic regions for the determination of intensity. Besides being a most delicate instrument, and therefore difficult for transport across ice, it is heavy, inconvenient to manage in a cold climate, and most sensitive to any form of disturbance. The ordinary dip circle, fitted with Lloyd needles for the observation of total intensity, would possibly be the best instrument to use for isolated observations on shore; whilst differential instruments fitted up in a small house built expressly for the purpose, and erected in Wood bay, would doubtless be of considerable value, although the erection of the instruments would involve much trouble. A detailed magnetic survey of Victoria Land would, of course, be of immense value—of infinitely greater value than the determination of the spot where the needle stands vertical. In order to make such a survey, it would be necessary to take a number of observations surrounding the magnetic pole. The work would have to be done during the summer months by careful and determined observers, who must be fully prepared to meet with innumerable difficulties, and be physically capable of wrestling with them.

The magnetic observations taken at Cape Adare during 1899–1900 involved the three elements, declination, inclination, and intensity, and were conducted in an open Lapp tent with great personal inconvenience, sometimes even at a temperature of $-25°$ C. This tent was situated at a distance of about 2000 yards from the base of a volcanic and highly magnetic range of mountains, which undoubtedly had considerable influence upon the magnets. The disturbances due to the occurrence of the aurora were also very great, so that very few of the observations taken with the unifilar magnetometer are entirely free from its influence. On account of the weak

horizontal intensity in the deflection observations for the moment of the vibrating magnet, distances 39 cms. and 52 cms. had to be used instead of 30 cms. and 40 cms., and as we had no correction to our deflexion bar for these distances, it was not possible to reduce the observations on the spot. In the vibration observations, every third transit was observed instead of every fifth, and in many cases it was impossible to observe torsion of the suspension thread on account of the agitation of the magnet. The horizontal force derived from a single observation taken on May 11, 1899, assuming errors at 39 cms. and 52 cms. to be the same as at 40, was 0·04086 C.G.S., dip at the same time being −86° 35′ 20″ and declination 55° 46′ 55″ E. at 5.30 p.m.

The mean of some forty dip observations taken at Cape Adare gives −86° 34′ 13″, while the mean of some eighty declinations gives 56° 2′ 0″ E. The diurnal variations of the magnetic conditions at Cape Adare appear to be very great, but the sudden and relatively large disturbances make the determination of the normal daily variations a difficult matter. Although it is not possible to eliminate errors due to the influence of magnetic rocks, one may presume them to be constant.

On April 10, 1899, the declination was observed every twenty minutes right through the twenty-four hours. The maximum declination occurred at 4.5 a.m., and the minimum at a little after noon, the difference between maximum and minimum being 3° 2′ 5″. Again, on January 2, 1900, declination was observed every fifteen minutes. The maximum occurred at 6 p.m., and the minimum a little after noon; the difference between maximum and minimum being 1° 38′ 10″. The change in declination takes place in long oscillations or system of pulls from fifteen to twenty scale-divisions to right and left of the centre, the interval of time being rather irregular. In order to give an idea of a disturbance, the following is an extract from the Magnetic Journal:—

"*November* 29, 1899.—Impossible to take set of magnetic observations, on account of the extraordinarily disturbed state of the magnets. Vibration magnet drawn as much as twenty and thirty on each side of the central division, and the whole scale would disappear from the field of view. At 4.10 p.m. the circle reading for declination was 157° 44′ 50″; at 4.17 it was 156° 32′ 30″, the magnet being in the same position (erect) for both readings. Thus there is a difference of 1° 12′ 20″ in the declination for an interval of 7 minutes. The utter impossibility of taking observations under such conditions is obvious."

TABLE VII.—*Magnetic Dip at Eight Geographical Positions.*

Date.	Latitude.	Longitude.	Dip.	Remarks.
1899.	° ′	° ′	° ′ ″	
January 2 ...	63 41 S.	160 16 E.	−83 18 53	Taken in the ice-pack.
„ 3 ...	63 40 „	160 36 „	−83 7 41	„ „
March to Feb. 1900.	71 18 „	170 9 „	−86 34 13	Mean of 40 (Cape Adare).
February 4 ...	73 17 „	168 31 „	−87 18 28	14 miles due west of Colman island.
„ 6 ...	74 23 „	164 3 „	−88 1 31	Taken at foot of Mount Melbourne.
„ 8 ...	75 18 „	163 32 „	−87 47 15	Taken on the ice-barrier.
„ 8 ...	75 42 „	163 29 „	−87 34 51	„ „
„ 9 ...	76 12 „	168 20 „	−86 52 13	On Franklin island, west side.

Sir James Clarke Ross, in 1841, observed a dip of −88° 24′ some 12 miles to the north of Franklin island, so that the decrease in fifty-nine years amounts to 1° 32′, or an annual decrease of 1′·56. There is very little doubt that the magnetic pole is much further north and west than in 1841.

The Aurora Australis or Polaris.

The aurora, as is well known, is a phenomenon at the same time cosmic and terrestrial, which on the one hand is confined within the atmosphere of our globe, and stands in close connection with terrestrial magnetism, and on the other hand is dependent on certain changes in the envelope of the sun, the nature of which is as yet little known. At Cape Adare, which is probably within the circle of greatest aurora intensity in the southern hemisphere, particularly favourable opportunities are afforded for its study. During the cold months the atmospheric conditions are most favourable, the amount of cloud being small. During the winter the phenomenon was observed nearly every night, so it was possible to establish the diurnal period, for it usually manifested itself between 6 p.m. and 3 a.m., its maximum intensity being generally reached between 8 and 9 p.m. Of course there were exceptional cases. The intensity also appears to be much greater at the time of the equinoxes than during the mid-winter months, the displays being more brilliant and more rapid in motion at the former time. At Cape Adare (lat. 71° 18′) the aurora was always observed in the north, never in the south, and it always manifested itself in exactly the same manner. Diffused aurora light would first appear in the north about 3° above the horizon; soon afterwards a gigantic luminous arc would form above the diffused aurora, the extremities resting on the horizon, while the apex was situated a little to the west of the magnetic meridian.

The luminous arc generally formed the starting-point for the radiant draperies of rays, of variegated colours and with indescribably beautiful and graceful folds, which moved laterally and most rapidly from east to west, and bodily towards the zenith. Long shafts of light would shoot down towards the earth with incredible rapidity, the colour being of a much deeper red at the lower part of these shafts than at the upper. The intensity of the colour appears to have some connection with the altitude of the phenomenon, varying greatly with the density of the atmosphere. In other words, the colour of the aurora beams is an indication of its height above the surface of the earth, being deep red at a low altitude, and of a pale nebulous whiteness at great altitudes. But what was of greatest interest in the observation of the aurora was the connection which appeared to exist between it and an approaching atmospheric disturbance. A strong gale from the south-east was almost invariably preceded by a most brilliant and rapid aurora display. This was not a mere coincidence, but a fact repeatedly observed. It was also possible to predict an approaching storm many hours beforehand by the extreme agitation of the magnetic needle, both possibly being manifestations of the same cause.

As mentioned before, the immense influence of the aurora upon the magnetic needle made the taking of magnetic observations extremely difficult. In order to form an idea of the extent of these disturbances, the table on the following page is given, showing the relative position of the aurora in the sky observed simultaneously during an aurora display of very weak intensity.

During the appearance of the aurora the disturbance of the magnet lasted more than one hour. At no time was it brilliant or rapid in its movement. It was of quite an ordinary type as seen nearly every night. When it moved towards the west the disturbance appeared to be greatest. At times the aurora was fairly strong, but concentrated near the magnetic north. The needle was but little disturbed when the aurora became diffused.

May 31, 1900.—

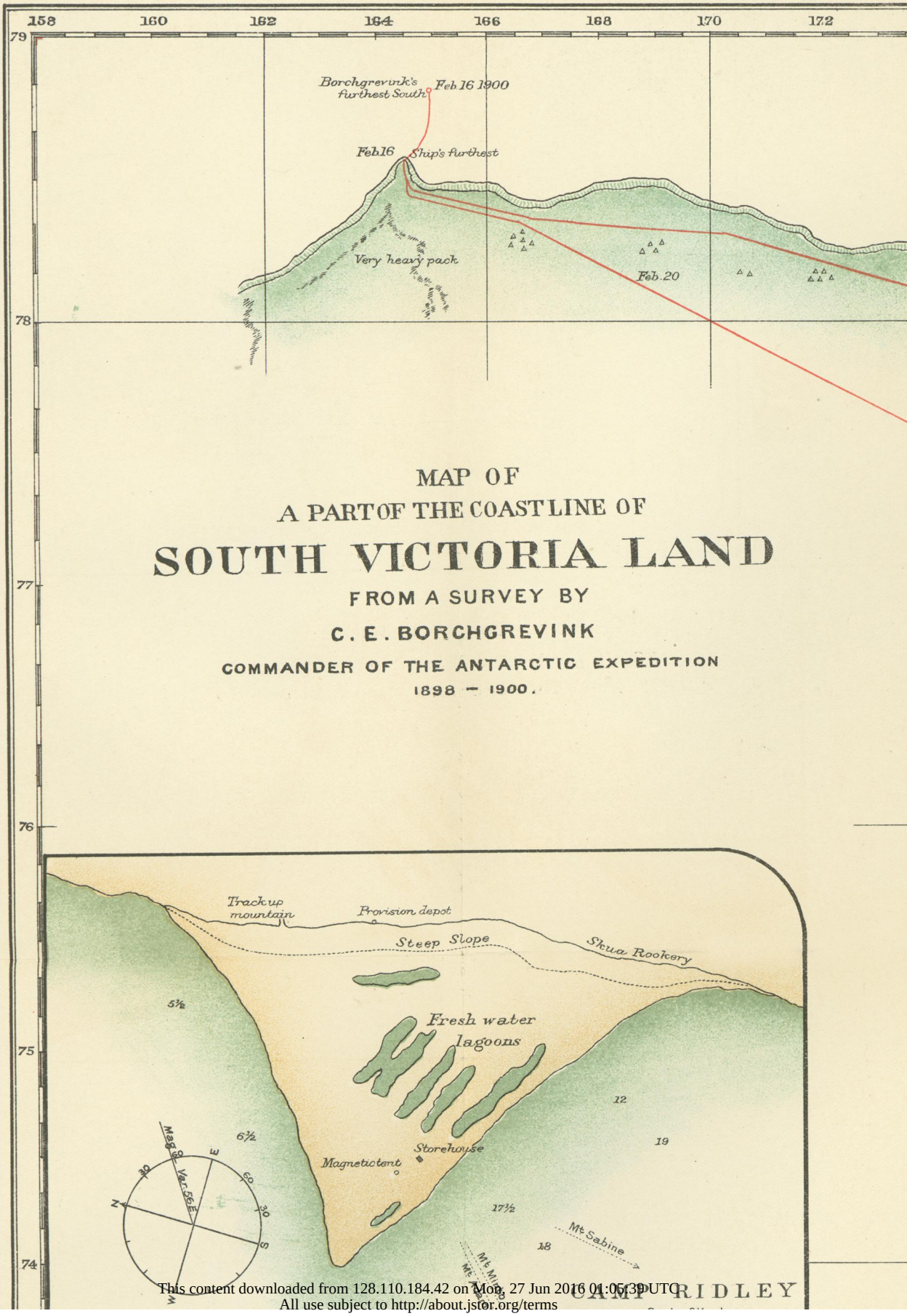
Astronomical time.	Temperature. C.	Scale-div.	Value in arc.	Remarks.
H. M.	°		′	
6 45	−8·3	40 0	80·0	Magnet in meridian and steady. At 6.50 diffused aurora in north.
7 0	−7·8	47 5	95·0	Aurora becoming brighter, magnet oscillating between 47 and 48.
7 7	—	52·0	104·0	Beam of aurora shot up towards zenith, and magnet moved to 52.
7 10	—	53·8	107·6	Aurora becoming much brighter in magnetic north.
7 12	—	56·0	112·0	Beam shot up from arc towards zenith.
7 15	—	57·5	115·0	Aurora arc from north by east to west (magnetic).
7 18	−8 0	58·0	116·0	Aurora stronger, curtain of aurora with slow motion.
7 22	−8·0	52·0	104·0	Arc and curtain in north and north-west becoming faint.
7 25	−8·7	55·0	110·0	Aurora arc becoming stronger in north-west.
7 27	−9·1	50·0	100·0	Aurora faded away in west.
7 30	−9·8	47·0	94·0	Becoming diffused.
8 0	−8·8	42·0	84 0	No sign of any aurora.

The following are extracts from the Meteorological Journal:—

May 6, 1889.—Very fine Aurora Australis first visible at 6 p.m. in the form of an arc of light in the north. The centre of the arc was about 3° above horizon, and bore about north by east. The arc was of large radius, the inner side or base being of much greater intensity than the outer; much yellow and red in the base part. Curtains of vertical beams of light, always parallel to the original arc, commenced to move slowly and bodily towards the south. The lateral movement was very rapid, and always east and west, and the bottom part of the beams denser and redder than the top. The curtains of light advanced no farther than about 15° north of the zenith, the limit in the east being the planet Jupiter and in the west the star Sirius. As the curtain of light moved south, the original arc became diffused but stationary, and had little movement. The display reached its greatest intensity at about 6.30 p.m. and ended at 7 p.m. A kind of diffused after-glow remained in the north for many hours. Temperature of air = 12° Fahr; barometer, 29·262 inches.

August 4, 1899.—An aurora was observed at a little before 6 p.m. in the form of a double luminous arc in the north. The arcs were separated from one another by about 2°, the inner one being about 8° above the horizon. The west extremity of the arc bore about north-north-west. The east extremity was invisible, being hidden behind the cape. The arcs lay in the same plane, and had a common centre. Winding curtains of aurora afterwards manifested themselves in the usual way, moving towards the zenith and forming coronæ there. Temperature of air − 41·5° Fahr; barometer, 29·200 inches.

Before the reading of the paper, the PRESIDENT said: At the International Geographical Congress in 1895, I had the pleasure of welcoming Mr. Borchgrevink on his return from his first voyage to the antarctic regions. From that time until Sir George Newnes undertook to send out an expedition under Mr. Borchgrevink, he worked incessantly—I will not say obstinately, but untiringly—to get an



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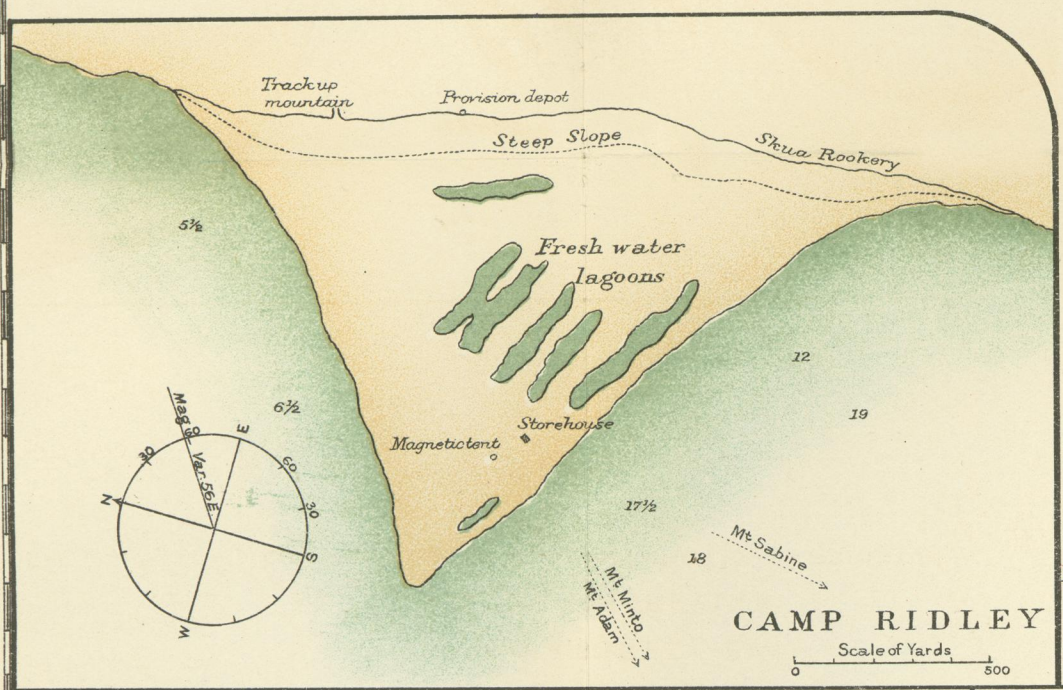

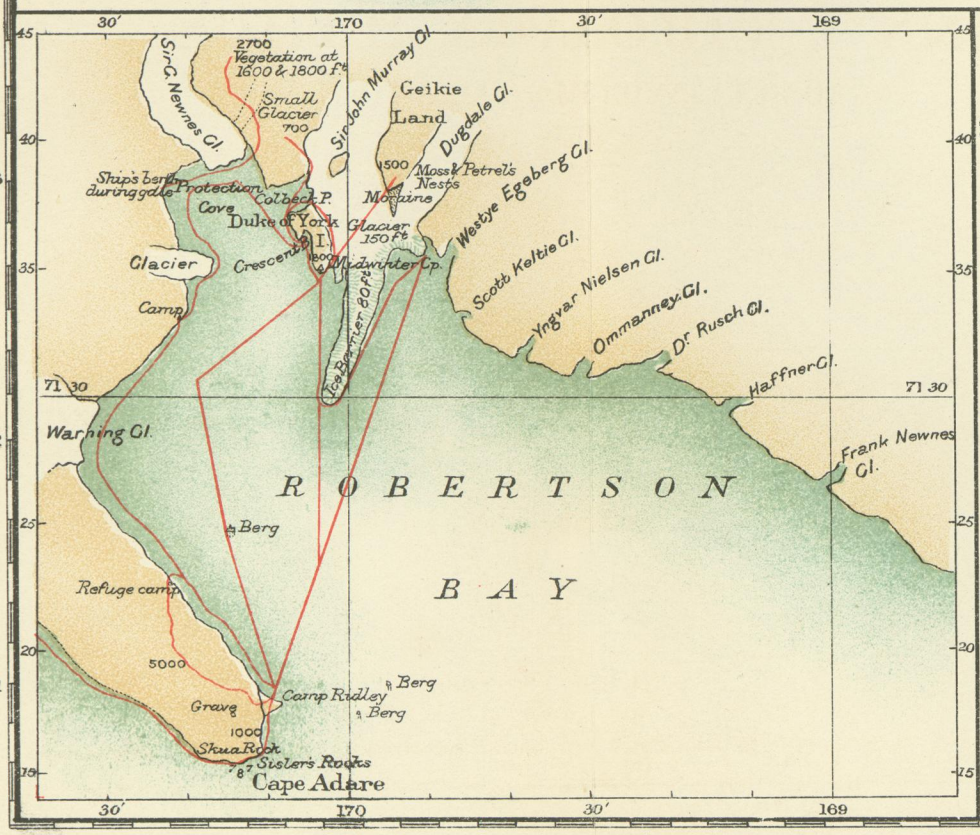

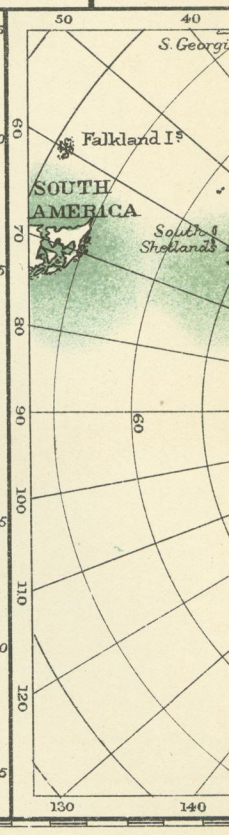

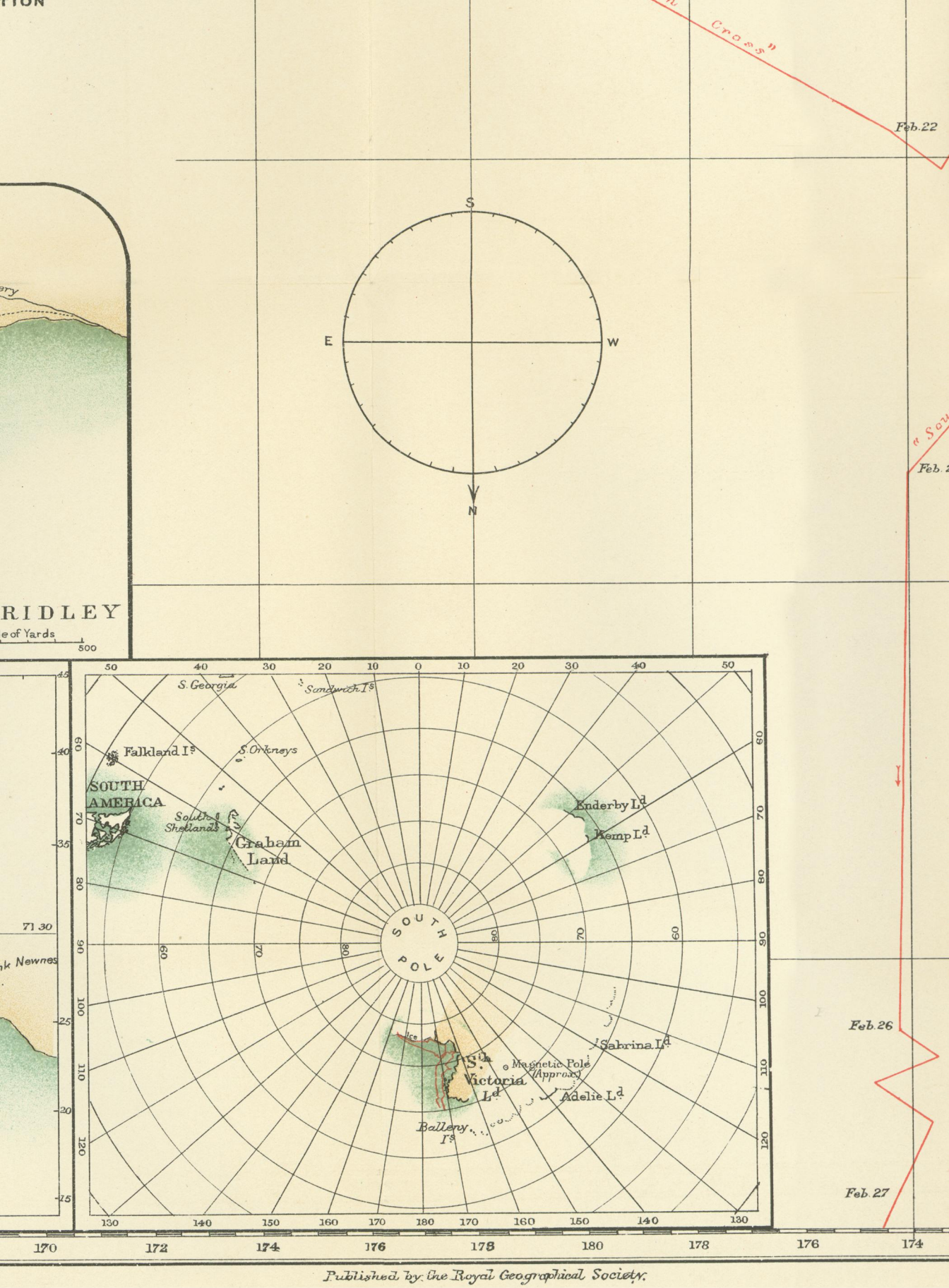

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