

MEDICAL ASPECTS OF THE SWEDISH ANTARCTIC
EXPEDITION, OCTOBER 1901—JANUARY 1904.

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THE object of the Swedish Antarctic Expedition was to conduct researches relating to the geography and natural history of the Antarctic regions south of Cape Horn. The expedition was to start from Sweden during the autumn of 1901. On the approach of the Antarctic winter, in February or March 1902, some of the party were to be landed in a suitable place in the Antarctic regions, with the object of wintering there. The members remaining on board the ship "Antarctic," were to carry on investigations in the regions around Cape Horn, the Falkland Islands and South Georgia. The next summer, *i.e.* in December 1902 or January 1903, the ship was to return in order to pick up the wintering party at their station; and, thus reunited, the whole expedition was to go back to Sweden, where, as we had calculated, we should arrive in the spring of 1903.

According to this plan the equipment of the winter party was of the greatest importance, as it was expected that this party would be quite isolated for one, perhaps several years, without a chance during this time of renewing their stores. On the other hand the portion of the expedition remaining on shipboard was during the greater part of this time to cruise in regions where new supplies of provisions and other necessary articles could easily be procured.

The issue of the expedition was, however, quite contrary to what had been calculated, and in order to give a clear picture of the conditions under which the different parties of the expedition were afterwards reduced to live, it is necessary to give a short account of the expedition.

Everything went on for the most part as we had calculated up to the southern summer of 1902—1903, when the "Antarctic," as agreed upon, was to fetch off the winter-party. But owing to unfavourable

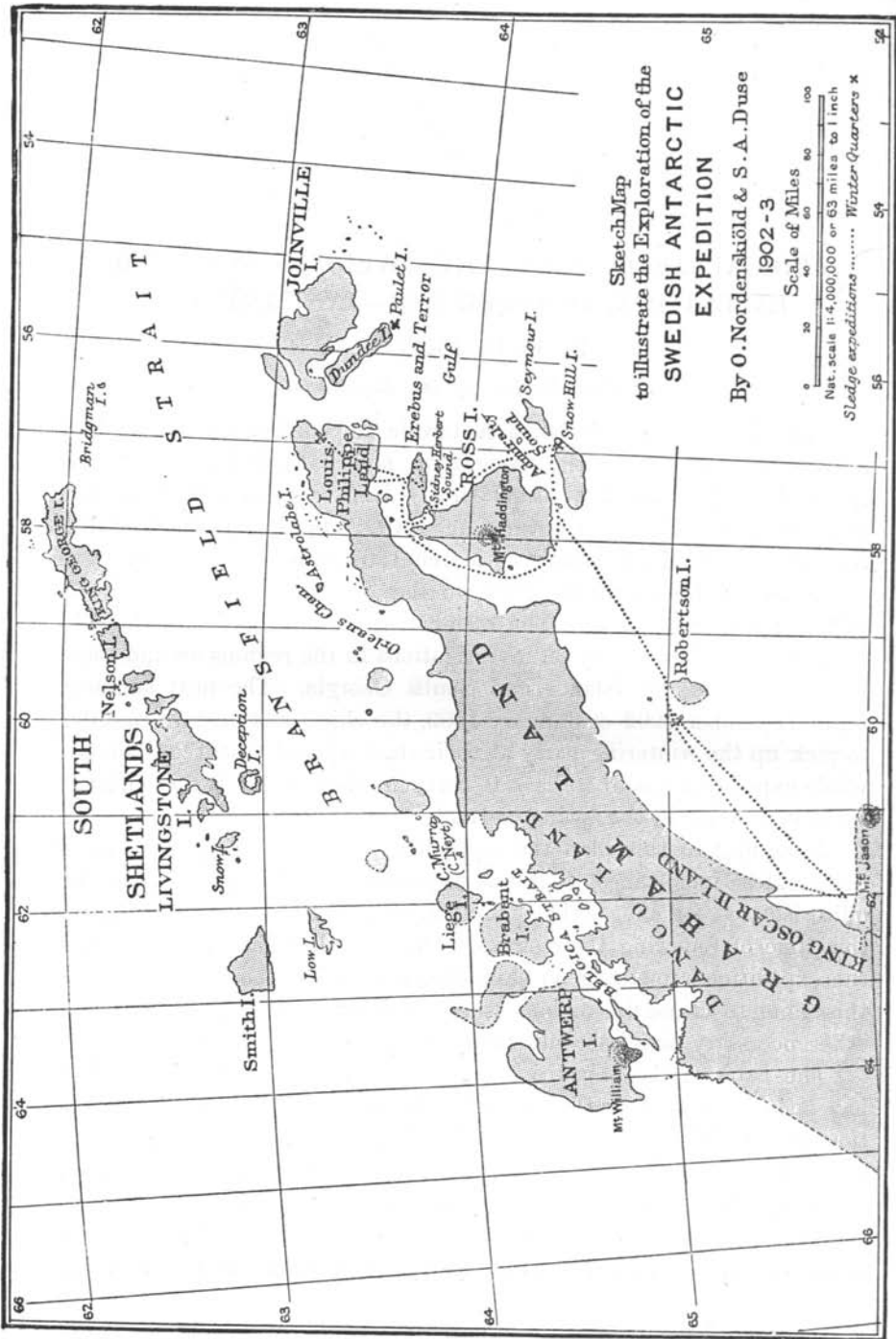


Fig. 1.

conditions of the ice, the "Antarctic" could not, as it had done the previous summer, take the route to the winter station on Snow Hill through the sound between Joinville Island and Louis-Philippe Land. Consequently it was determined to try to reach the winter station simultaneously by two separate ways. Firstly, starting from the vicinity of Mount Bransfield, on the north-east coast of Louis-Philippe Land, a party of three persons, travelling on foot, was to try to reach the winter station, which lay at a distance of about 120 (English) miles. A tent, provisions and other necessities were to be transported on a sledge; the plan being that if the conditions of the ice in the neighbourhood of the winter station appeared too unfavourable to allow of a vessel forcing a passage, the party at the station should join the three men from the "Antarctic," returning with these to the place at Mount Bransfield, where, according to agreement, the "Antarctic" could be expected to fetch off all of them in the course of one or two months. Secondly and at the same time the "Antarctic" was to try to force her way along the north coast of Joinville Island in order to enter Erebus and Terror Gulf to the east of this island, thus making an attempt to reach the winter station in this way. But both of these enterprises failed. The sledge-party met with the most insuperable physical obstacles, and, after marching a week, it was compelled to return to the starting-point. The "Antarctic" on the other hand really succeeded in entering Erebus and Terror Gulf, but was here caught by the drifting ice, sprang a leak during a severe pressure of the ice, and finally sank on the 12th of February 1902. The people on board escaped with difficulty to Paulet Island in the north-east of Erebus and Terror Gulf.

As the winter was rapidly approaching and there was no possibility at this season of reaching the winter station on Snow Hill they could only prepare for wintering on the spot. The sledge-party waited in vain for the return of the "Antarctic," and when the time of waiting, previously agreed upon, was at an end, this party, too, went into winter quarters. In this way the expedition became divided into three different parties, each wintering by itself during the southern winter of 1903. At the winter station, the only one of the three places having resources for establishing communication with the other parties during the winter, nothing was known about the attempts to bring relief and the unfortunate result of these endeavours.

In October 1903 two persons from the party on Snow Hill, during a sledge-journey to the north, accidentally met the three persons who

had wintered in the neighbourhood of Mount Bransfield and who were now making a second attempt to reach the winter station, an attempt, the result of which would have been rather uncertain, if they had not received this lucky help. Frost-bite which had attacked two of the party made the march so slow, that, without succour, it would have been impossible to reach the winter station before the breaking up of the ice shortly afterwards in Sidney Herbert Sound. On the 16th of October 1903 two of the wintering parties were in this way united at the station on Snow Hill.

On the 8th of November the Argentine Relief Expedition under the command of Captain Irizar, on board the gunboat "Uruguay," approached the vicinity of this station, and it was determined that the embarkation should take place on the evening of the following day. In the night between the 8th and 9th of November, however, six men of the party on Paulet Island came to the winter station. On the 10th of November everyone on Snow Hill went on board the "Uruguay," and the following day the 13 persons still on Paulet Island were fetched on board. Thus, on the 11th of November 1903, the whole expedition was reunited, and the journey home was immediately commenced. The expedition arrived at Buenos-Ayres on the 2nd of December 1903, and Stockholm was reached on the 10th of January 1904.

As seen from the foregoing account, the expedition was divided into several separate parties which during well-defined periods were living under somewhat different conditions. In the following pages I shall treat separately the matters of hygienic and medical interest relating to each of these periods.

1. *From leaving Gothenburg, 16 Oct. 1901—to the debarkation of the party which was to winter on Snow Hill, 15 Feb. 1902.*

The crew, consisting of Swedes, Norwegians and two Englishmen, numbered, together with the officers, 20 men; while there were 9 scientific members. The average age of those on board was $27\frac{1}{2}$ years; the 2 oldest were 45, the 2 youngest 18 years old.

About the vessel of the expedition, the "Antarctic," there is little to say; it was rather old (built 1871), but still strong and of the common whaler type. The persons in the gunroom had pretty comfortable quarters; each one had his own cabin. The fore-castle on the contrary was small and narrow, in the tropical regions unendurably hot, and in the polar difficult to warm. In the tropics most of the members

of the expedition slept on deck. As usual on such vessels there was much damp which caused considerable discomfort, especially in the Antarctic regions; ice was formed on the inner sides of the hull of the ship, the bedclothes froze fast to the wood and became wet and mouldy.

On the journey out we touched at: Sandefjord (17—19 Oct.), Falmouth (27—28 Oct.), St Vincent, Cape Verde Islands (14 Nov.), Buenos-Ayres (16—21 Dec.), Port Stanley, Falkland Islands (1 Jan. 1902) and lastly (16 Jan.), at Observatory Island also (situated close to the north side of Staaten Island, the projection to the south-east of Tierra del Fuego). We touched at the last-mentioned place in order to compare our magnetical instruments with those in the Argentine observatory on this island.

Very few cases of sickness occurred during the voyage out. We may mention, among others, a case of scabies, probably acquired in Falmouth. In the tropical regions, especially after having begun to use water taken on board at St Vincent, most of the members suffered from diarrhoea, which was happily of a harmless kind and only in few cases needed any treatment. We may also note a case of synovitis (of bursa olecrani). From now on a great number of trivial accidents happened to the personnel: contusions, burns etc., few of which called for treatment, none of those injured being rendered unfit for duty. The health of the human members of the expedition remained on the whole very satisfactory, but this unfortunately cannot be said of the 14 Greenland dogs, taken on board in Gothenburg and intended for use at the future winter station. Through one of these dogs there came distemper into the whole pack, all the dogs with one exception became infected, and 10 died. The rolling of the vessel, the lack of sufficient room for isolating the different individuals, and, lastly and principally, the warmth of the tropics, combined to cause this loss, which was a most severe one for us. Owing to these causes only 4 dogs were left us: 2 males and 2 females. In order to augment the stock of dogs, 8 Falkland dogs were taken on board in Port Stanley, an experiment, however, that totally failed. True enough, these dogs were strong, hardy animals (but still not so good for their special purpose as the Greenland dogs), but they were soon all killed by their four savage relatives from the other side of the globe. These on the other hand later on rapidly increased in number, and on the journey home 9 fullgrown and 6 young dogs of pure Esquimaux-dog race were presented to our reliever, the Argentine Government. The provisions,

brought with us for the dogs, consisted of bread, dried fish, dog-pemmican and "fedte-græves," a kind of very greasy, cheap pemmican, made of offal from slaughter-houses etc.

The wintering party with its stores was put on shore on the island of Snow Hill on the 15th of February 1902. Six days later the "Antarctic" left this place, never more to be seen by those left on shore.

2. *The "Antarctic" Party, 15 Feb. 1902—12 Feb. 1903.*

During the greater part of this time the "Antarctic" remained in the stormy and chilly regions in the vicinity of South Georgia, the Falkland Islands and the southern part of Tierra del Fuego. Part of the medical and surgical stores had been brought on shore at Snow Hill; another part was left on board of the "Antarctic," where the captain, Mr C. A. Larsen, undertook the medical duties during my absence from the vessel. This going on shore of the doctor to live among a party consisting of 6 persons only, may at first glance perhaps seem improper. The cause was however, partly, that the "Antarctic," according to the plan made, was in contradistinction to the land-party to stay in regions where in case of any grave accident or illness medical assistance could be had in 2, or at the utmost in 3 weeks (such places are Ushuaia in the southern part of Tierra del Fuego, Observatory Island, where an Argentine man-of-war is usually stationed, and lastly at the Falkland Islands). Another reason for my leaving the ship was that I should make bacteriological studies which, in accordance with our scheme, had to be made on the Antarctic *terra firma*.

During the sojourn of the "Antarctic" in the aforesaid regions the provisions were sometimes renewed at Port Stanley and Ushuaia. Sometimes the flesh of seals and birds was used for food as well as eggs of penguins and other sea-birds, this especially during the stay in the neighbourhood of South Georgia, during the southern winter 1902. Fish, too, taken during the journey, entered during this period rather liberally into the diet. Plenty of excellent fresh water was to be had everywhere in these regions; in the real Antarctic regions fresh water was procured by melting down glacier-ice or old sea-ice that had lost its salinity.

Captain Larsen only reported one grave case of sickness as occurring during this period, that of our lamented friend and comrade Dr A. Ohlin, the first zoologist of the expedition. He had not been in perfectly good

health at the beginning of the voyage. In the neighbourhood of South Georgia he caught cold, and his illness from this time commenced to grow worse rapidly. He was sent home from Port Stanley on the 22nd of August 1902, and died of consumption in Sweden in the month of July 1903.

3. *The party on Paulet Island, 12 Feb. 1903—11 Nov. 1903.*

This party consisted of Captain Larsen, Mr K. A. Andersson (zoologist), Mr C. F. Skottsberg (botanist) and the whole crew, with the exception of 3 men,—20 persons in all. While the "Antarctic" drifted in the ice in Erebus and Terror Gulf after having been damaged, there was plenty of time to make preparations for all eventualities. All on board tried to render their clothing more suitable for wintering in these regions: sleeping-bags of canvas were sewn; and the provisions were fetched on deck and divided in small packs, convenient for carriage during a journey over the ice. At the date of the sinking of the "Antarctic," on the 12th of February 1903, most of the provisions and a great many other articles, serviceable for the future, had been taken on to the ice, together with two big boats and a smaller one. After struggling against current and drifting ice for 16 days all at last succeeded in reaching Paulet Island (lat. $63\frac{3}{8}^{\circ}$ S. and long. 56° W.), but during this struggle against storm and ice the greater part of the things brought from the "Antarctic" were unfortunately lost.

Of the provisions thus safely brought to Paulet Island, there were during the following winter given to each man daily the following rations: 22·3 gm. dried vegetables, 46·2 centilit. tinned fresh vegetables, 1·5 gm. tinned fruit, 18·4 gm. margarine, 108·7 gm. ship-biscuits, 22·9 beans, peas, barley etc., 2·9 gm. coffee, 1·9 gm. tea, 4·8 gm. cocoa, 4·8 gm. sugar; in addition to this also a little syrup, citric acid, lime-juice, and mustard was consumed. Part of the people had small quantities of tobacco. As may be seen from these figures, the provisions brought on shore from the vessel were in themselves far from sufficient. All had tried, according to agreement, to bring on shore in the first place dried and tinned vegetables, biscuits, coffee, tea and cocoa; it being hoped that animal food could be got on the spot, if necessary. Fortunately Paulet Island was found to be the breeding place of a great colony of Adelië-penguins, shags (cormorants), and also seals. Soon stores of penguin-meat, sufficient for the winter, had been collected, which stores were buried in the snow to preserve them and to prevent them

from being blown away. But of seals only relatively few were found. This was very unfortunate, the only fuel that was to be had in these regions being the blubber of these animals. The result was that it became necessary during the 3 or 4 coldest winter months to restrict the preparation of boiled food to but one meal a day. During this period a very light breakfast was taken about noon-time, this meal consisting only of tea or cocoa and one ships-biscuit. The chief meal of the day was not served before 6 p.m.; it consisted principally of soup, made with seal or penguin-meat, seal-blubber and dried vegetables. During the first part of the winter, as well as after the beginning of August, the seals became more numerous and the diet accordingly more generous; two such daily meals of meat and seal-blubber, with tea, cocoa or coffee, being then taken. During the winter fishing was carried on with good result as often as the weather permitted, the catch making an excellent change in the rather monotonous diet. During the last part of the stay on Paulet Island the penguins had begun laying their eggs, which are said to have been consumed in almost incredible quantities. Excellent fresh water was obtained during the whole winter from a little lake in an old extinct crater; a hole was always kept open here, sometimes through a layer of ice about 1.5 metre thick. For want of salt, sea-water was used in preparing the food. Immediately after arriving at

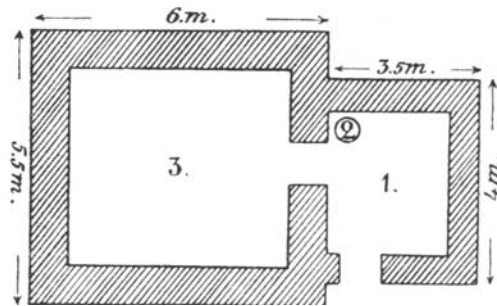


Fig. 2. House of the party at Paulet Island.

1. Store-room and kitchen.
2. Forge used as fire-place.
3. Sleeping-room.

Paulet Island, a house was built. The walls were made double with an intermediate layer of sand and guano. The roof consisted of a sail from the "Antarctic"; later on it was also covered with seal-skins, in the same degree as these were procured by hunting. The house consisted

of two rooms: a smaller, outer one, used as kitchen and store-room, and a larger, inner one, along the walls of which were arranged the sleeping places. In order to keep these free from the water which gathered on the floor from drippings from the ceiling etc., they were raised a little above the level of the floor by a layer of stones, upon which the sleeping-bags were spread. The greater number of these sleeping-bags were made of canvas, a few of guanaco-skin. The sleeping-bags were also made warmer and more comfortable by some woollen blankets which had been saved from the "Antarctic." Furs were not used, but only common woollen clothes.

Want of shoes occasioned great inconvenience, and every possible makeshift had to be resorted to. For instance, galoshes, lined and legged with skin of penguins, were used by some of the men. The cold being severe out of doors as well as in the stone-hut, and most persons *being short of clothes, most of the time was passed in the sleeping-bags.* Train-oil lamps were used for illumination, making it possible to read some books which had been brought with the party. Playing at cards was a most popular method of killing time.

The cooking was done with the help of seal-blubber, a small forge from the "Antarctic" being used as a fire-place. This forge was a most useful thing, saving time as well as fuel. The greatest inconveniences of the stone hut were damp and darkness. The great amount of hoarfrost formed on the inside of the roof melted when the sun shone outside in calm weather or when cooking was going on indoors, drenching through the men's sleeping-bags as well as their clothes.

In spite of all these most unfavourable conditions a remarkably good state of health was maintained during the whole time. Nevertheless amongst this party, as well as with the two others, there occurred frequent digestive disturbances, such as diarrhoea and colic; everybody being more or less attacked by these symptoms. Rheumatic muscular pains were rather common as well as *frost-bitten toes, fingers and parts of the face; and a few cases of snow-blindness also occurred.* Only a few of the men having snow-glasses, some protection for the eyes had to be improvised; small frames of wood or wire were made and covered with the thin blue cloth from a Swedish flag. These improvised "snow-glasses" proved to be of very great use.

A peculiar circumstance, which ought also to be mentioned, was the abnormally frequent occurrence amongst all the party of the need of urination. It lasted the whole time and was especially inconvenient during the nights. There may have been some degree of polyuria, but

at all events not in any higher degree. No other symptoms of illness showed themselves in connection with this. As soon as the members of the expedition returned to a more civilized diet, these symptoms at once disappeared. I presume that they stood in connection, partly at least, with certain dietetical conditions of which more will be said later on.

The only grave case of illness among this party was that of the Norwegian sailor Wennergard, who, at the time of our departure from Sweden, was a strong healthy man about 20 years of age. This person was attacked by acute articular rheumatism during the stay in the vicinity of South Georgia, August 1902. In March 1903, on Paulet Island, he had a fresh attack. In addition to the other symptoms there also appeared insufficiency of the heart, and after severe sufferings, lasting about six weeks, Wennergard at last died on the 7th of June 1903. He was buried in a cairn on an open place on the beach of the island, a simple wooden cross bearing his name and the day of his death being erected over the grave on the arrival of the Argentine Relief-Expedition at the island.

4. *The party at Mount Bransfield, 29 Dec. 1902—16 Oct. 1903.*

This party consisted of only three men: Mr S. Duse, Lieutenant of the Royal Swedish Artillery, cartographer, Mr J. G. Andersson, Lecturer at Upsala University, geologist, and one sailor.

After having vainly tried to reach the winter station on Snow Hill, this party had to return to the place of embarkation. This was situated at Bransfield Strait, near Mount Bransfield, on the north-eastern shore of Louis-Philippe Land (c. 63·3° S. lat. and 57° W. long.) and is now named Hope Bay. During the first weeks of their stay there the three men lived pretty comfortably upon the provisions brought on land, having no uneasiness about the "Antarctic." But the weeks passed on, and, no news having been received by the end of February 1903, it became evident that some misfortune had occurred, and the party prepared to pass the winter at the place. When leaving the "Antarctic" none of the party had thought it possible for them to be separated both from the vessel and the party at the winter station. The equipment was consequently rather scanty. As a great part of the provisions had been lost in a heavy snow-storm during their efforts to reach Snow Hill, the three men were now at the beginning of the winter in a rather critical situation.

The clothes were not suitable for wintering, but they were improved by being lined with penguin-skins and small pieces of woollen stuff etc. Their sleeping-bags were made of guanaco-skins. A small stone hut was built. The walls were rather thick, 1.3 metres near the ground and at the roof 0.75 metres, while the height of the hut was about that of a man. For roof they had only an old tarpaulin, which unfortunately

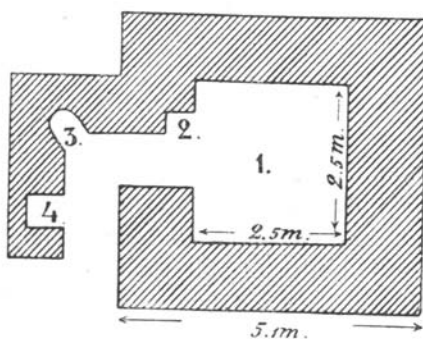


Fig. 3. House of the party at Mount Bransfield.

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|-------------------|-------------------------|
| 1. Sleeping-room. | 2. Fire-place. |
| 3. W. C. | 4. Depository for meat. |

proved not to be water-tight. They had brought a tent from the "Antarctic," and this tent was raised inside the stone hut; the ground under the sleeping-bags was covered with penguin-skins. A small porch was erected, and in this porch the stove was built. A chimney, or venthole for the escape of the smoke, was made of empty tin-boxes, the bottoms of which had been taken out, the boxes being then pushed into each other. A wood-shutter was used as the outer door, and a seal-skin was suspended as a curtain for the inner part of the hut.

This party too was obliged to use seal-blubber for fuel and lighting, but, happier than the party at Paulet Island, these three men had an abundance of seal during the greater part of the winter. Not far off there was also a colony of penguins, and these two fortunate circumstances saved them from starvation. Here, as at Paulet Island, the party had not a sufficient quantity of salt, sea-water being used for cooking instead. At first the use of this sea-water caused very severe attacks of diarrhoea and colic; these attacks, however, ceased by degrees. On returning to more civilized diet, no constipation or other disturbances of the digestive organs occurred.

The provisions brought on shore from the "Antarctic" were as follows: 225 kg. biscuits, 30 kg. margarine, 95 kg. tinned meat, 105 kg. tinned fish and herring, 10 kg. sugar, 5 kg. coffee, 5 kg. cocoa, 1 kg. tea, 35 kg. tinned soups, 3 kg. dried fruit, 8 kg. condensed milk, 25 kg. barley, 12 kg. dried vegetables, 7 kg. salt. A great part of these provisions having been consumed during the first two months, when the men still expected the return of the "Antarctic," and a rather large quantity being spared for the sledge journey to Snow Hill, no exact information can be given as to the daily rations. Every day during the winter, however, each man was given three biscuits, *i.e.* about 200 gm., and some dried vegetables. Penguin- and seal-meat, together with seal-blubber, was the chief article of diet. A small quantity of fish was also caught.

In spite of all the unfavourable circumstances: damp, cold, darkness, monotonous diet, absence of cleanliness and want of physical and psychical occupation, the state of health of this party too was very satisfactory. No case of severe illness occurred, but only rheumatic muscular pains, slight disturbances of the digestion, snow-blindness and cases of frost-bite. To prevent snow-blindness this party used spectacles like those employed by the Esquimaux, the light being admitted to the eye by a narrow horizontal opening only. This kind of spectacles protected the eyes very well. The appetite and sleep of this party, too, were very good, but the members of this party also complained of the need of frequent urination. At the last successful attempt to reach the winter station, two of the men got their feet frost-bitten, both of them were in a rather bad condition on their arrival at Snow Hill; the frost-bitten feet being much swollen and with large suppurating wounds. After some weeks' treatment they were both quite restored.

5. *The party at the winter station on Snow Hill,*
15 Feb. 1902—10 Nov. 1903.

This party consisted of six persons: Mr O. Nordenskjöld, the leader of the expedition, Lecturer at Upsala University, geologist, Mr G. Bodman, our meteorologist, who had charge also of the magnetical observations, Mr E. Ekelöf, medical officer and bacteriologist, Sr. J. Sobral, Lieutenant of the Argentine Navy, and two sailors.

The winter station was situated in an open space, free from snow, on the island of Snow Hill (c. 64° 22' S. lat. and 57° W. long.).

Materials for the house were brought from Sweden, and its erection was completed after two weeks. The dimensions of the house may be seen from the following plan. The walls were composed of a double

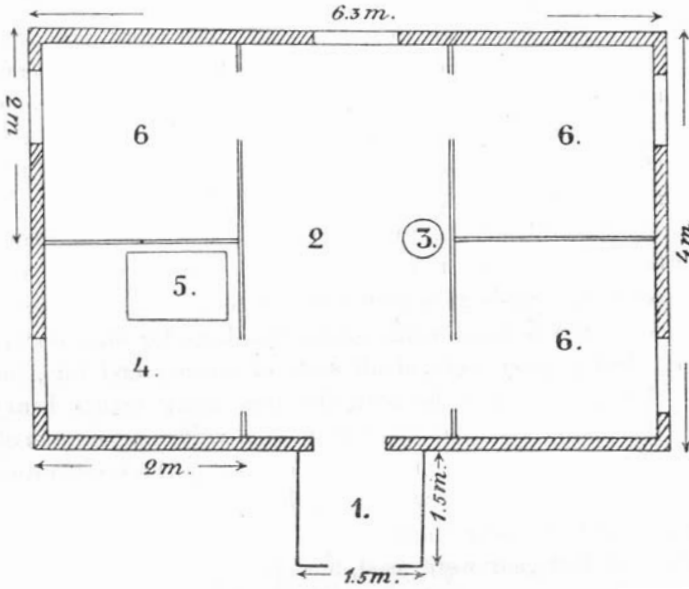


Fig. 4. The house on Snow Hill.

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| 1. Entrance. | 2. Working- and dining-room. |
| 3. Stove. | 4. Kitchen. |
| 5. Kitchen-range. | 6. Cabins. |

The height of the rooms = 2.2 m.

layer of rebated planks, with an intervening space about 1.5 cm. in width. The outer as well as the inner side was covered with thick black paste-board, the roof with asphalted paste-board. The floor consisted of the following layers, reckoned from the bottom upwards as follows: first, floor-timbers with a layer of rebated planks, paste-board, and rebated planks again, and upon these latter a thick felt carpet with, finally, a linoleum carpet. A small porch or entrance was built on one of the long sides of the house. The interior of the house was divided into five rooms, there being two small cabins at each gable of the house and a larger room in the middle. This larger room was used as the dining- and working-room; three of the cabins served as bedrooms and the fourth as kitchen. A kitchen-range was placed in the kitchen and

a small stove in the larger room. This stove, as well as the fire-place in the kitchen, was heated with coal during the first year; but later on, when the coal supply was exhausted, with seal-blubber. In the upper part of the house was a small garret, serving as store room. The entrance to this garret was through a hole in the ceiling of the larger room. There was a window to each room. The house was stayed at each of the four corners by thick ropes, and by two thick beams and a large number of provision-boxes, piled up at the lee side of the building (the storms generally blowing in the same direction). The house was built on a small hill, sloping in all directions, so that the gathering of snow and water was avoided.

In the house during the nights everyone used sleeping-bags lined with cotton-wool and covered with guanaco-skin. On sledge-expeditions we used sleeping-bags of reindeer-skin for two or three persons, or sometimes of canvas lined with double blankets for only one person. The party had a good store of all sorts of clothes and furs, but the woollen clothes proved to be best, the furs being rather heavy and clumsy. The furs were used only exceptionally, if someone was obliged to make prolonged observations out of doors, when the temperature was very low; but generally good woollen clothes with special "wind-clothes," as they were called, above them, were sufficient and most comfortable. Many kinds of foot-gear were used, but on long excursions "komager" or shoes made of reindeer skin proved to be best. When living at the station we used reindeer-skin shoes, soled with wood or birch-bark. These latter shoes especially were very warm and flexible; within them we had socks of goat-hair or dried grass. For head-gear, skin-caps (so-called Helsingör-caps) were mostly used. In hard wind or severe cold these caps were pulled down over the ears, and a small piece of woollen stuff could be tied over the face, sheltering nose and cheeks and leaving only small openings for the eyes and mouth.

During the day-time the temperature in the house was generally about $+13^{\circ}$ to 15° C., but during the nights the temperature went down to freezing-point or even lower. The great difference in temperature between the higher and the lower parts of the rooms was rather unpleasant. Close to the floor the temperature was very seldom above the freezing-point, while only 2 metres higher the thermometer stood at $+15^{\circ}$ to 20° C. Thick layers of ice soon were formed on the floor near the walls. In the springtime this ice melted, drenching the whole house, the water standing sometimes several centimetres deep on the floor. To avoid this inconvenience some holes were made in

different parts of the floor to let the water out. In the winter the walls in the mornings were usually covered with hoar-frost, which, melting during the day, soaked through the paste-board, in which there began to grow great quantities of mould. In a very short time the whole house was infected with this mould, destroying clothes, mattresses, books and provisions, and also causing some difficulty in the carrying out of scientific work, as, for example, in the bacteriological researches. At last we were obliged to take away the paste-board; but the mould having gained a firm footing nearly everywhere, it soon became necessary to remove all provisions out of the house into the open air. Paste-board has consequently proved to be unsuitable for lining the inner walls of such a house as ours. The best thing would perhaps be to have the walls merely varnished and without inner covering.

The station being situated at lat. $64^{\circ} 22'$ S. we never had any real polar night. But the cloudy sky and the heavy storms with their drifting snow darkened the atmosphere very much, and as, at the dark part of the year, we could pass only very little time out of doors, we had not much use of the few hours of feeble daylight.

The meteorological conditions were most trying and dangerous. It is true, that no extreme degree of cold was observed, the lowest temperature being about -41° C., and the mean temperature of the year only -11.8° C.; but day after day, sometimes for weeks at a time, there were continuous storms blowing during the winter with a velocity of 15 to 30 metres per second. The greatest velocity observed was 34.7 metres per second. The mean velocity of the wind during the whole year was 8.2 metres per second. At a temperature below -25° C. with a simultaneous wind-velocity of 20 to 25 metres per second, it was practically impossible to remain in the open air for more than a few minutes without getting parts of the face frostbitten. During such severe storms and cold there was nothing else to do but to remain in the little narrow dark house: when overtaken by them in sledging-excursions there was no other resource than camping and waiting, sheltered in the sleeping-bags, until the storm ceased. Uncommonly great and rapid changes of temperature and of barometrical pressure were observed. The greatest difference of temperature in one day amounted to 33.9° C. The barometrical maximum was 761.3 mm., the minimum 708.6 mm. The mean barometrical pressure of the year was 739.9 mm. During about $\frac{2}{3}$ of all the days of the year there was either rain or snow, and we had consequently very little sunshine. During the whole month of June 1902, by the help of a Campbell-Stokes

"sunshine-recorder," we could register only 4.5 hours of sunshine. The humidity of the air was generally rather great.

Very pure fresh water was procured from ice taken from a glacier in the vicinity of the house. During the short period of the year when there was running water this was taken on account of convenience, although it was for the most part rather muddy from clay and sand.

The place for the winter station being from the beginning undetermined, it might have happened that it had been fixed in a place where no, or, in any case, very few seals and penguins were to be found. Therefore the provisions taken on shore from the "Antarctic" were intended to last, without counting upon any possible supplies of seal-flesh etc., for two full years. As was however soon evident, there was a rather scanty supply of several of the most necessary articles of food, and therefore we were compelled to try to make good the deficiency. Fortunately at a distance of about 12 miles from the station there existed two colonies of penguins, and during the lighter season we also found a fair number of seals. As was the case with the other two wintering parties, seal- and penguin-meat also formed one of the principal articles of diet during the second winter. The provisions were supplied by several firms and were generally of excellent quality. The greater part of the tinned meat, soups and vegetables were supplied by Beauvais of Copenhagen and by "The United tinned-foods Factory of Sweden" of Gothenburg; the dried vegetables were supplied by Beauvais and H. Rönaasen, Christiania; the dried potatoes by the latter firm and also by C. Bödiker & Comp., Bremerhaven; the salted meat and pork was delivered by Lilljequist & Son of Gothenburg. Danish and Argentine butter and Pellerin's margarine were also amongst our supplies. The biscuits were supplied by Beauvais. Of all other articles I can here only mention a part, as dried and salted fish, salted herring, cloud-berries, cow-berries, dried bilberries (the latter are especially recommended as being both very good, easy to preserve, and requiring very little room), wheat and rye flour, beans and peas, shelled oats and barley. Of condiments we had plenty, as for instance dried onions (Beauvais), pepper, mustard and salt; these condiments proving to be invaluable when seal- and penguin-meat began to form part of our daily diet. Of lime-juice there had been taken only a little, this being principally intended to be used during sledge-trips and boat voyages. Of spirits we had brandy, Swedish punch, Bordeaux wines and also some cognac and whisky, the greater part of this being consumed during the first year. For the second year there were only very

few bottles left, which were reserved for festive occasions or for medical use.

The following tables show the consumption of the principal articles of food during the six winter-months (1st of March—1st of Sept.) of the year 1902 and for the same period during the year 1903. I give reports of consumption only during these periods, as a clearer and more uniform idea of our consumption of food can be most easily obtained from these periods; during the rest of the year some of the members were often away from the station on sledge-trips etc., and hunting was eagerly prosecuted, the spoils forming a somewhat irregular part of our diet. Of a great part of these spoils of nature, consumed during this time, I am not able to give any exact figures as to weight, *e.g.* concerning shags (cormorants), *Megalestris*, seal-cubs, penguin-eggs etc.

The consumption of the principal articles of provision at the winter station on Snow Hill.

	1st of March—1st of Sept. 1902		1st of March—1st of Sept. 1903	
	Total consumption for 6 men in kg.	Per man per day in gm.	Total consumption for 6 men in kg.	Per man per day in gm.
Biscuits	112·7	102·0	112·7	102·0
Hard baked rye-bread ...	80·0	72·4	—	—
Beans	46·0	41·6	18·6	16·8
Peas	20·0	18·1	40·0	36·2
Dried potatoes	43·5	39·4	—	—
Grit and macaroni	28·5	25·8	36·6	33·1
Flour	150·0	135·8	380·0	344·2
Sugar	122·5	110·9	53·3	48·2
Butter and margarine ...	99·0	89·6	78·6	71·1
American bacon	24·5	22·1	—	—
Salted meat	135·0	122·0	—	—
Salted pork	67·5	61·1	—	—
Seal- and penguin-meat	—	—	532·0	481·8
Tinned meat and fish ...	204·6	185·3	71·7	64·9
Salted herring	75·0	67·9	—	—
Salted fish	31·5	28·5	24·6	22·2
Dried fish	17·0	15·3	10·6	9·6
Condensed milk	47·5	43·0	33·3	30·1
Cheese	30·7	27·8	—	—
Tinned vegetables	86·0	77·8	63·4	57·4
Dried vegetables	35·0	31·7	50·6	45·8
Dried fruit	33·5	30·3	14·0	12·6
Cloud-berries	30·0	27·1	33·3	30·1
Cow-berry-jam	30·0	27·1	—	—
Coffee (not roasted) ...	26·6	24·0	11·2	10·1
Cocoa and chocolate ...	7·8	7·0	6·4	5·7
Tea	2·5	2·2	4·3	3·8
Tinned soups	c ^a 80·0 lit.	72·4 centilit.	c ^a 22·5 lit.	20·3 centilit.

The transition from the dietary regulations of the 1st to those of the 2nd winter was made little by little during the southern summer, 1902—1903. During the last months of our stay at the station we had commenced—butter and margarine by this time beginning to run short—to use seal-blubber on a larger scale, both for the preparation of the food and as food itself. A scheme of provisioning for the following winter had been made, penguin-eggs having already been collected for this purpose, when the expedition was relieved. The eggs were partly kept in salt and partly loose in boxes, which were placed in a shady spot; they kept well. During the second summer a great number of penguins were collected; about three-quarters of these were salted, the rest being suspended, without any other preparation, on a wire on the exterior walls of the house. Here they hung the whole year, the last being used a short time before the arrival of the relief-expedition. No signs of putrefaction could ever be observed. Besides the meat, the blood, liver and kidneys of seals were also used; of shags, besides the flesh which is very good, the liver, heart and kidneys were eaten. The penguin-eggs each weighed about 120 gm.; they would certainly have been considered a delicacy even in a civilized community.

In order to give a clear view of our dietary conditions I here also produce two bills of fare, one from the winter 1902, and the other from the winter 1903, these bills of fare, too, making evident the great difference of the diet during the first and the second year at the station.

There was also consumed a great amount of other kinds of food in smaller quantities, such as pies, sardines, dried mutton, a kind of blood-puddings, tinned fruit, fruit-syrups, apple-cake and other desserts etc. With respect to the above-named figures I wish to remark, that the weight of the salted meat and pork consumed is based on the figures given by the purveyor (weight per barrel). If, however, the weight of bones, sinews etc., here included, be subtracted, I think that the net weight of the meat cannot have amounted even to half of that given. In calculating the seal- and penguin-meat, I have, on the contrary, only counted the flesh which was free from bones and also, macroscopically at least, free from fat. Thus the figures are very approximate. Still I think it is evident, that we used during both years a relatively large amount of carbohydrates; of fat, at least during the winter 1903, a somewhat small quantity, and that albuminous food, especially during the last year, entered rather largely into the rations. From the table it will also be seen, that during the first six months we lived exclusively

Bill of fare, 8. vi. 1902—24. x. 1902.

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
<i>Breakfast</i> (9 a.m.)	Salted herring and potatoes.	Porridge and milk.	Blood pudding and pork.	Porridge and milk.	Salted herring and potatoes.	Tinned meat and potatoes.	Porridge and milk.
<i>Dinner</i> (2.30 p.m.)	Beans and salted meat. Soup of dried fruit.	Blood pudding. Tinned soup.	Salted or dried or tinned fish. Bouillon. Dessert.	Peasoup with pork. Pancake with jam.	Tinned meat and vegetables. Soup of dried fruit.	Beans and salted meat. Chocolate soup or gruel.	Tinned soup. Tinned meat and vegetables. Dessert.
<i>Supper</i> (9 p.m.)	Pancake with jam.	Boiled dried fruit.	Laps-couse.	Laps-couse.	Porridge.	Pancake with jam.	Laps-couse.

Moreover at *breakfast* and at 5 p.m. coffee, sugar, bread and butter; at *supper* tea or cocoa, bread and butter.

E. EKELÖF

Bill of fare, 22. ii. 1903—15. viii. 1903.

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
<i>Breakfast</i>	Dried or salted fish and vegetables. Porridge and milk.	Salted meat (penguin) and vegetables.	Porridge and milk.	Salted meat (penguin) and vegetables.	Porridge and milk.	Seal-meat and vegetables.	Laps-couse of penguin-meat and vegetables.
<i>Dinner</i>	Penguin- or seal-meat and vegetables. Pancake with jam.	Blood pudding. Tinned soup. Dessert.	Penguin- or seal-meat and beans. Soup of dried fruit.	Peasoup with salted penguin. Pancake with jam.	Penguin-meat with rice or macaroni. Bouillon.	Salted or dried fish with vegetables. Chocolate soup.	Tinned meat and vegetables. Tinned soup. Dessert.
<i>Supper</i>	Cold seal-meat or fowl, tea or cocoa, sugar, bread and butter.						

At *breakfast* also coffee, sugar, bread and butter. At 5 p.m. coffee and bread, but no butter.

upon provisions brought from home, without any addition of fresh meat.

Bread was baked during the first year 2 or 3 times a week with the help of baking-powder. During the southern summer 1902—1903, however, it became evident that our store of baking-powder was not sufficient for the coming winter. By a mere chance, however, I succeeded during March 1903 in finding yeast in the last remains of our dried potatoes¹. By infecting a mixture of wheat-flour and water in a high, narrow glass pot with this yeast, I succeeded in getting good fermentation. Part of the contents of the glass pot were mixed with a large quantity of dough, which was afterwards kept at room-temperature for 24 hours, good fermentation arising during this time. The bread thus baked was at first a little sour, probably a result of a bacillus which grew abundantly in the dough at the same time. By means of repeated re-cultivations in the high narrow glass pot I have mentioned, these bacteria, however, were made to disappear almost entirely, the bread prepared with the contents of the glass pot afterwards giving an excellently fermented, well-tasting bread, having no signs at all of sourness. Afterwards the process was simplified for long stretches of time by part of a large piece of fermented dough being kneaded into the new dough, which became sufficiently fermented after 12 to 24 hours. Now and then, however, this yeast had to be purified from the increasing bacteria by cultivation in the glass pot. Bread fermented in this manner was baked each day of the last winter at the station.

Regarding personal cleanliness it must be mentioned that bathing, *i.e.* washing of the whole body with hot water and soap, had been ordered to be done every 3rd or 4th week, an order that was, as a rule, well observed by the members of the station.

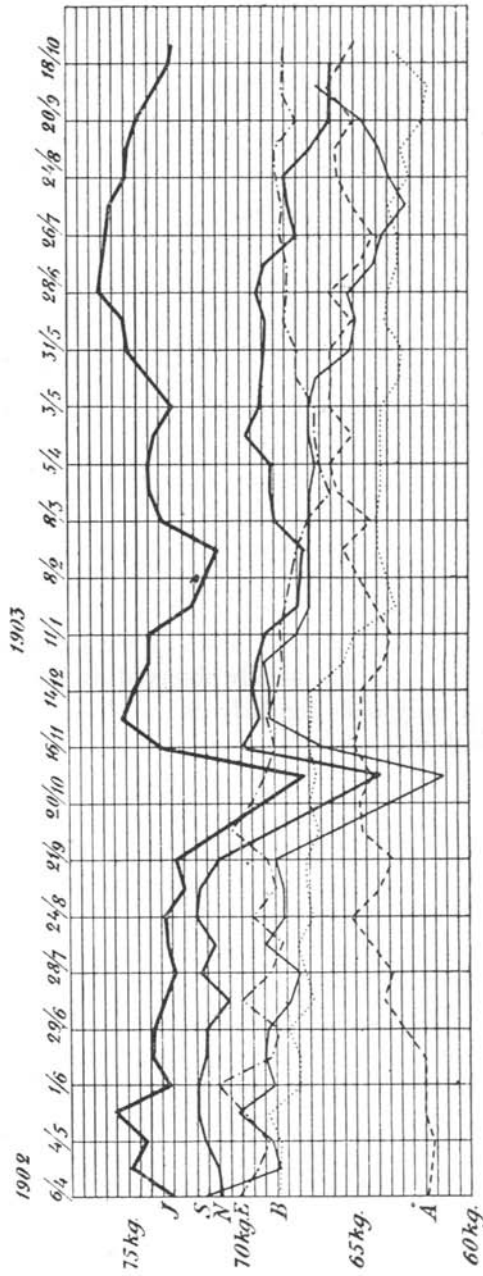
At the winter station the state of health was during the whole time very satisfactory. Now and then, of course, there were complaints of some ailments of a transitory and not at all dangerous nature, such as muscular-rheumatism, colic, diarrhoea, dyspepsia, etc., etc., none of the party being however ever compelled to take to bed for 24 hours at a time. A few cases may here be mentioned which might easily have taken a grave turn. One of the members of a long sledge-trip, October 1902, over-exerted himself during the journey. On returning to the station, after a very long and trying march and exposed to a full storm,

¹ Though a rather rich bacterial flora existed in the superficial layers of the earth of Snow Hill, I never found any yeast there.

this man became unconscious for about 5 minutes, the heart being at the same time considerably dilated with a systolic murmur over the apex; the pulse being rapid, unequal and intermittent. At the same time the patient was snow-blind in both eyes. He recovered completely however. Another of the members was taken ill with Otitis media. After treatment by Politzer's method etc., the symptoms fortunately disappeared. A great many insignificant external injuries, such as contusions, burns, frost-bites and snow-blindness also occurred. No really severe case of snow-blindness ever occurred, we being soon induced by experience to use snow-glasses, when the light out of doors was such that snow-blindness was to be feared. As has been noticed by several other polar expeditions, we too observed that the greatest danger of snow-blindness was not when there was bright sunshine and clear air, but when the atmosphere was misty or when a low fog made the sunlight spread diffusely, thus obliterating all shadows. As with the other parties, sleep and appetite were generally excellent. An important fact is, that none of the wintering parties suffered from any of the common forms of "colds," such as catarrhs of the nose, larynx, trachea and bronchi, articular rheumatism etc., and this in spite of the numerous occasions (if compared with ordinary conditions) that occurred for the contraction of such "colds." As with the other parties, instances of irritable bladder were also occasionally observed at the winter station, though not so generally and regularly as in the other parties. As nothing pathological was observed, and nothing abnormal could be noticed in the urine (the quantity was, perhaps, a little increased), I am inclined to attribute these symptoms to certain dietetical conditions, having myself observed that such desire to urinate set in especially after eating the liver and, possibly, the kidneys of seals. These organs were often used by the two other parties, but more seldom at the winter station, circumstances which may perhaps explain the difference in the occurrence of the symptoms. Probably the cold and a certain degree of increased nervous irritability contributed to excite the symptoms mentioned.

As regards psychical conditions we have to note a certain degree of depression and increased irritability, exhibited by the greater part of the members of the three wintering parties, especially during the dark season; these disturbances in no case, however, taking the form of melancholia or any other mental disease.

The members of the party at Snow Hill were usually weighed every fortnight during the stay at the station. As shown by the adjoined



weight-curves the greater part showed a very gradual diminution in weight. The most typical feature in the weight-curves is a distinctly marked falling during the summer (Dec., Jan., Febr.). The curve Å refers to a young man of 18, who grew rapidly during his stay at the station, this causing the incongruity of his curve. The sharp sinking of the curves J, S, and N during the month of October 1902 was caused by a sledge-trip, performed during this time by the persons in question. In order to show the rapidity of the increase of weight, which may take place after a decrease due to severe bodily exertion, I give the following figures :

Persons	4. xi. 1902 8 a.m.	4. xi. 1902 11 p.m.	5. xi. 1902 11 p.m.	16. xi. 1902 10 p.m.
N.	63·9 kg.	68·0 kg.	69·2 kg.	69·8 kg.
J.	67·2 ,,	70·8 ,,	—	73·3 ,,
S.	61·1 ,,	65·0 ,,	67·0 ,,	66·4 ,,

The blood of the persons at the winter station was occasionally examined during the whole period of their stay; the percentage of haemoglobin and the number of red corpuscles were never lower than under normal conditions; on the contrary, changes in the other direction developed themselves during the 2nd winter, the blood becoming deeper coloured than normal and the number of red corpuscles increasing to 6,000,000 per cubic mm. during the latter part of our stay on Snow Hill. Microcytes were often present, but normo- or megaloblasts never occurred. Simultaneously there was observed a considerable diminution in the absolute number of the white corpuscles, a total of only 4 to 5000 per cubic mm. being not seldom met with. A detailed account of these haematological analyses, as well as of the bacteriological researches which were made during the whole of my stay at the station, will be published later.

6. *The return of the expedition, 11 Nov. 1903—10 Jan. 1904.*

The expedition returned on board the Argentine relief-vessel, the gunboat *Uruguay*, which arrived at Buenos-Ayres on the 2nd of Dec. 1903. On the 10th of the same month we left this city on board the German steamer *Tijuca*, arriving at Hamburg on the 7th of Jan. 1904,

and at Stockholm on the 10th of the same month, after an absence of $2\frac{1}{4}$ years from Sweden. During the voyage home there occurred no grave cases of illness. We need only notice a case of gonorrhoea (acquired in Buenos-Ayres), this being the sole case of venereal disease during the whole expedition. During our stay in Buenos-Ayres and in the tropics there occurred several slight cases of diarrhoea. There were also some complaints during this time of rheumatic muscular and neuralgic affections.

I wish to draw some conclusions regarding the influence of food upon health during polar-expeditions; conclusions to which I have been led, partly through experience of this expedition, partly through the study of what has been observed regarding these matters during many other expeditions. That the food is the determining factor as regards outbreaks of scurvy during polar-expeditions, sea-voyages, sieges etc., has long been acknowledged, but we are still in ignorance concerning the particular fault in the food which is the ultimate cause of the disease. Without entering upon any detailed criticism of all the different theories in the matter, I will here merely cite the one propounded by Mr Sophus Torup, Professor of Physiology at the University of Christiania, as it is in my opinion the only one giving an intelligible explanation which, in its leading features at least, is compatible with the actual circumstances. The essential principle which distinguishes Torup's theory from those commonly adopted is his not assuming the cause of the foods producing scurvy to be absence in this food of certain elements existing in common fresh food and indispensable for the body, but, on the contrary, that the cause of disease is to be ascribed to the *introduction into the body of some non-organized matter, foreign to, and dangerous for the human organism*. After having examined what has been written on the subject Torup has arrived at the conclusion, that "scurvy must be caused by a kind of poisoning: that, by a peculiar and slow decomposition, taking place in badly preserved (*e.g.* badly salted) meat and fish, there are formed poisons, nearly related to the ptomaines, through the continued consumption of which the disease is created." (*Over the Polar Sea*, by F. Nansen, Swedish edition, Part 2, p. 566.) I wish, however, at once to remark that this theory cannot be true in its entirety, there being unquestionable examples of expeditions having been attacked by scurvy, where, as far as can be judged, the provisions have been of first-rate quality, and the blame cannot be ascribed to *bad* preservation of the food. To be able to show the legitimacy of the above-mentioned

theory, it would also be necessary amongst other things to quote particulars from a great many expeditions, a procedure which cannot now be attempted. It is enough to state that having examined the accounts of these voyages, as regards the conditions of the food and the state of health, I have ascertained that scurvy (the typical form) has broken out only during expeditions using preserved animal food (salted, dried, or tinned); the disease having broken out, whether food of so-called antiscorbutic qualities (*e.g.* dried and tinned fresh vegetables, juices of fruit, potatoes, tinned unsalted meat, perfectly fresh meat, etc.) was issued simultaneously or not.

As an example of such an expedition, where, in spite of varied and abundant provisions, in which there cannot be any question of want of different nutritive elements, salts, etc., scurvy has still broken out, I will only refer to the Austro-Hungarian North-Polar-Expedition of 1872-1874; where scurvy broke out, in spite of the presence in the food of, amongst other things, a rather abundant supply of tinned vegetables, lime-juice, tinned unsalted and even perfectly fresh meat etc. etc.; salted meat however formed part of the diet. Similar conditions existed in the case of the Swedish Expedition to Spitzbergen under Nordenskiöld, 1872-1873; in this case 41.7% of the whole party being attacked by scurvy. Although there was a great variety in the provisions, the supply was here, however, a little scanty.

On the other hand, several instances can be found of expeditions escaping entirely from scurvy in spite of extremely unfavourable hygienic conditions, the provisions consisting, however, entirely, or nearly so, of fresh meat (obtained by hunting). Such, for instance, was the case during the wintering of Nansen and Johanssen on Frans-Joseph Land; here they lived for 9 months solely upon the meat and blubber of ice-bears and walrus, and during the whole time were in perfectly good health; this fact being of itself sufficient to exclude the theory that want of vegetables is the cause of scurvy. To this example I think I might also add that of two of the wintering parties of the Swedish Antarctic Expedition.

The conviction that the cause of scurvy lies in the consumption of salted meat and fish (possibly also the lack of fresh vegetables) has led to a more or less total provisioning of expeditions etc. with tinned meat and vegetables, under the belief that the possession of these tinned foods constituted an unfailing guarantee against the outbreak of scurvy. Even if this should be the case as regards scurvy (the typical form), experience, however, has taught us, that other patho-

logical symptoms (these possibly nearly related to scurvy) might arise with such a diet, the results being quite as fatal as those of scurvy. We have a very recent example of this in the Belgian Antarctic Expedition under de Gerlache 1898-1899. The question of provisioning with tinned foods being of the greatest practical importance and the condition of things during the aforesaid Belgian expedition being a good illustration of this, I will take the liberty of dwelling a little on the voyage.

The Belgian expedition wintered on its vessel, the "Belgica," in the ice between 70° and 72° S. lat., corresponding to a polar night from the 15th of May to the 22nd of July. The greater part of the provisions consisted of tinned fresh foods (meat, fish and vegetables), supplied by well-known large tinned-food firms (Belgian, French and Norwegian). During the winter all the members of this expedition were taken ill, the symptoms being in every case very similar; one died and several nearly met with the same fate. I shall now give some extracts from the description of the journey, made by the surgeon of the expedition, Dr F. Cook (*Through the first Antarctic Night*, London, 1900). Unfortunately however the data of interest from a medical point of view, given in this account, are rather defective and unscientific.

As early as the 31st of May Dr Cook writes: "We became pale with a kind of greenish hue; our secretions were more or less suppressed. The stomach and all the organs were sluggish and refused to work. Most dangerous of all were the cardiac and cerebral symptoms. The heart acted as if it had lost its regulating influence. Its action was feeble, but its beats were not increased until other dangerous symptoms appeared. Its action was weak, irregular and entirely unreliable throughout the night. The mental symptoms were not so noticeable. The men were incapable of concentration and unable to continue prolonged thought. One sailor was forced to the verge of insanity, but he recovered with the returning sun..." June 3rd: "We are all eating appreciably less now than during the bright season—and either there is a constant inclination to sleep or persistent insomnia. There is much indigestion now,—fermentation, gastric inertia, intestinal and gastric pains, imperfect hepatic action, and a general suppression of all the digestive secretions. The heart is unsteady, easily disturbed and mitral murmurs, which I have not heard before, are audible. Temperatures, almost without exception, are subnormal. The breathing is often difficult, the blood retreats from the skin, but the larger veins are abnormally full. Piles, haemorrhoids, headache, neuralgia, rheumatism,

are the systematic complaints." June 19th: "Anaemia, or a condition allied to it, in one form or another and under various descriptions, is always found if sought for by an experienced eye. This malady we have had in by far the severest form which I have noticed in any Arctic experiences, and more severely than is recorded in the literature of polar exploration. We have lost one officer, and a second barely escaped death. The marines are all afflicted; the condition is truly alarming," etc. On July 12th it is reported that the second in command, who had remained quite well until this date, after having made some scientific observations out of doors, had, on leaving the open air, suddenly been taken ill. "But to-day I have to record the saddening news that L. is suddenly failing. Not that he has complained of any ill feeling, for he still maintains that he feels well; but in the usual daily examination I notice that his pulse is intermitting, the first sign of coming debility. He is assuming a deathly pallor, does not eat, and finds it difficult to either sleep or breathe. There is a puffiness under the eyes, his ankles are swollen, and the entire skin has a dry, glossy appearance." Dr Cook then speaks about the treatment of this form of "polar anaemia" (analyses of the blood, however, have not been made, as far as I can see). Several remedies were used, producing, however, no effect or but a temporary one; thus iron and arsenic were given. By and by these remedies were given up as being totally inoperative. "Fresh food, artificial heat, a buoyant humor, judicious clothing and the least possible humidity are the conditions which suggest a rational treatment. The plan of treatment in brief is as follows: As soon as the pulse becomes irregular and rises to 100 beats per minute, with a puffiness of the eyes, and swollen ankles, the man is stripped and placed close to a fire for one hour each day. I prohibit all food except milk, cranberry sauce, and fresh meat, either penguin- or seal-steaks fried in oleo-margarine. The patient is not allowed to do anything which will seriously tax his heart. Laxatives are generally necessary and vegetable bitters with mineral acids are a decided help. Strychnine is the only remedy which has been of service in regulating the heart, and this I have used as routine."

The patient just named (L.) was treated in this manner and recovered after about 2 weeks' treatment. On the 15th of July we read: "We are still very feeble. An exercise of one hour sends the pulse up to 130, but we have all learned to like and crave penguin-meat." 17th of July: "If we had not fresh meat to eat and an abundance of fuel to give heat, I am sure we would have an alarming mortality in less than a month. Several lives have certainly been saved by eating penguins,

and we shall always owe them a debt of gratitude." The writer further states that alcohol, until the outbreak of this disease commonly used in the form of wines to the dinner, could no longer be borne, the action of the heart being disturbed by its employment. Nothing in the external appearance of the patients indicated the sickness with the exception of the aforesaid paleness; no decrease in the weight of body was observed during the winter. By and by the whole party recovered, seal- and penguin-meat having been almost exclusively introduced into the diet instead of the tinned meats.

It is thus seen that the disease was characterised by several symptoms, disturbances of digestion and feebleness of heart being the chief amongst them; in the case of some persons the disease even showed itself solely through symptoms affecting the heart. (Compare this disease with the special form of scurvy called the "pure scorbutic anaemia.") The cause of the disease indicated in the above account probably was some sort of poisoning, by the tinned meats. These being carefully sterilized and kept in hermetically closed tins, the supposition at once offers itself, that the poisons in question had been formed by autolytical processes, a conclusion which, to my mind, ought also to be applied to the poisons present (according to Torup) in certain salted meats and fish, the consumption of which is said to have resulted in scurvy.

I will only adduce one more example, to which however I attach the greatest importance, *viz.*, the recently returned British Antarctic Expedition (which operated simultaneously with the Swedish one), an expedition where, as well known, no expense had been spared, all modern resources being utilized. Unfortunately I have not been able to get more particulars than those given by the leader of the expedition, Commander Scott, in the July number 1903 of the Royal Geographical Journal. Here it is mentioned, that during the winter of 1902 the whole party had been attacked (though slightly) by a disease that was "undoubtedly scurvy." During the winter fresh seal-meat three times and fresh (?) mutton once a week had been added to the dietary in addition to the provisions brought from home. About one month before the outbreak of the disease the stock of seal-meat had begun to run short, the fresh meat being thenceforward given not so often as before. The measures which were here taken, and with the help of which everybody soon recovered, were the following: all tinned meats were laid aside, fresh seal-meat being given instead; and extra rations of tinned fruit were distributed and lime-juice prescribed. In addition the holds and

store rooms were thoroughly overhauled and disinfected. After the outbreak of the disease the contents of the tins were always examined by the surgeon of the expedition before being used; but nothing remarkable could ever be observed.

Whatever may have been the origin of the above-named cases, still it seems to be a fact that grave disease may arise as a consequence of the consumption not only of salted, but also of tinned unsalted, meats and fish. Furthermore these diseases have proved avoidable (or curable) by the eating (as far as regards animal food) of fresh meat exclusively or nearly so. Fortunately nature nearly everywhere in the Arctic and Antarctic regions, and especially during the light season, offers an abundance of game, from which expeditions may, without any great difficulty, procure stores of meat for the winter, the climate and the bacterial conditions being such that no difficulty exists as to the preservation and keeping of the food; and, finally, it has been proved that the food, in this way derived from the polar animals, is not at all repugnant to the taste, such an idea being quite an unjustifiable prejudice, which has gradually died out during the expeditions of the last few years. In consequence of what has here been stated I take the liberty of proposing the following principles to be followed as to the provisioning of polar expeditions (partly also applicable to provisioning under other circumstances):

A complete provisioning with vegetable as well as with animal food ought to be made before the starting of an expedition for the polar regions. The utmost caution must be observed when choosing the provisions, especially the animal food: this should be taken only from well-known firms. The greater part at least of the tinned meat and fish ought to consist only of such kinds of food as have proved to be harmless during previous expeditions. Further, I consider that it may be of the utmost importance that the *tinning and the salting of meat and fish be undertaken as late as possible* before the starting of the expedition, in order to escape in the greatest possible degree autolytical poisons which may possibly arise; as autolytical processes continue, as far as is known, for long periods (it may be several years)¹, I think it may also be assumed, that out of two similar barrels or tins of meat or fish, in which autolytical processes are going on, the autolytical

¹ These opinions of mine as to the influence of time and temperature upon the autolyses are founded upon examinations made by Dr S. Schmidt-Nielsen of Christiania. ("Ueber den Reifungsvorgang beim Pökeln von Häringen," *Det Kongl. Norske Videnskabers Selskabs Skrifter*, 1901, No. 5.)

products are found more abundantly in those prepared earlier than in those prepared later on. The animal provisions ought also always to be kept in a cold place, upon ice, if possible, analyses having proved, that autolytical processes go on considerably more slowly at lower temperatures than at higher.

A large amount of condiments ought also to be brought, especially dried onions, pepper, mustard and, of course, salt. Dried vegetables and potatoes have proved to be excellent to keep, easily preserved, and they occupy little space.

All tinned or salted animal food ought to be considered principally as provisions in reserve. In the polar regions provisioning with meat for the coming winter ought to be made in good time. The greater part, at least, of this meat should be kept unsalted and unprepared, either suspended in the open air in a shady place, for instance on the walls of the house or the sides of the ship, in the rigging etc., or buried in the snow. The condiments we have just mentioned are intended to give variety to the dishes prepared from this meat. The preserved animal foods should be used only exceptionally and as a variation in the diet, or if the stock of fresh meat, collected on the spot, should turn out to be insufficient.

The Map accompanying this paper (p. 512) appeared in *The Geographical Journal* for February, 1904.