

# The tragedy at Kapp Thordsen, Spitsbergen, 1872–1873. Could lead poisoning have been the cause?

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**ABSTRACT.** A group of 17 Norwegian sealers died in Svenskhuset, the Swedish House at Kapp Thordsen, Spitsbergen during the winter and spring of 1872–1873. The Swedish House was built by a mining company, but was left deserted as there were poor prospects for mining in the area. The house was well stocked with food, fuel and hunting gear. The death of these men has been a mystery for 135 years although the usual interpretation has been that they died from scurvy. In an effort to challenge this historical diagnosis, the authors applied for permission to open the graves to sample the bone for lead analysis, and, if possible, to examine the skeletons for evidence of scurvy. This was granted. No objective signs of scurvy were found. The level of lead in bone, however, was very high, indicating that lead poisoning very probably played a part in the tragedy. This article reveals the historical facts behind the tragedy, the excavation of the sealers' graves in 2008, and presents a discussion of the medical evidence.

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### The establishment of Svenskhuset and the Swedish 'colony' at Kapp Thordsen

In May 1870 Andreas Ebeltoft, merchant and lawyer in Tromsø and an agent in Norway of the Arctic explorer Adolf Nordenskiöld, advertised for a sloop that could take an expedition to Kapp Thordsen (Fig. 1) in July–August of that year. The vessel selected was the sealing smack *Lydianna*, captained by the experienced sealing master Nils Johnsen. The expedition was paid for by a group of Swedish businessmen who intended to extract fertilizer from the coprolite that Nordenskiöld had discovered there in 1864. Coprolite is a rock consisting mostly of calcium phosphate and it is in fact compressed layers of guano. Kapp Thordsen was named after Nordenskiöld's expedition ship, *Axel Thorsen* (Kjær 2007).

The purpose of the expedition was to carry out further investigation of the deposits there. *Lydianna* sailed from

Tromsø on 4 July 1870 with two young Swedish geologists, Hjalmar Wilander and Alfred Nathorst, onboard. The latter was soon to become a famous Arctic explorer. The expedition reached Kapp Thordsen on 24 July but left almost as soon as the investigations began because of a gale. The geologists returned on 5 August. In the meantime *Lydianna* went sealing. Nathorst and Wilander were picked up on 17 July (Ebeltoft 1870–1873) and *Lydianna* sailed to Sørkapp where the young scientists wanted to hunt polar bears. On 8 September *Lydianna* returned to Tromsø with 8 polar bears, 42 walrus and some 100 bearded seals (Tromsø Tollsted Vaktjournal 1870).

The report from this expedition led to the establishment of the mining company AB Isfjorden in Stockholm in 1872 (Sæther 1932). Early in the summer of that year AB Isfjorden chartered two steam vessels, the sealer *Fiskeren* of Tromsø and the cargo ship *Mimer* of Stockholm. They sailed north carrying building material sufficient for two houses, as well as 14 live pigs, two horses, hens, provisions and equipment. The expedition comprised nineteen men and three women, some of whom intended to overwinter there under the leadership of J. Thieberg, a mining engineer, and even to establish a 'colony' at Kapp Thordsen. The following information is based on Thieberg's diary (Thieberg 1872).

Mr. Graham, the chairman of AB Isfjorden, Dr. P. Öberg, a geologist, eight carpenters (four Norwegians and four Swedes), two British 'sportsmen', a Mr. Weed and a Mr. Acton, also sailed with the expedition. The owner and master of *Fiskeren*, had for years advertised in British newspapers for 'sportsmen' to sail with him to Svalbard. The expedition arrived at Kapp Thordsen on 3 July 1872 but had difficulty in landing owing to the

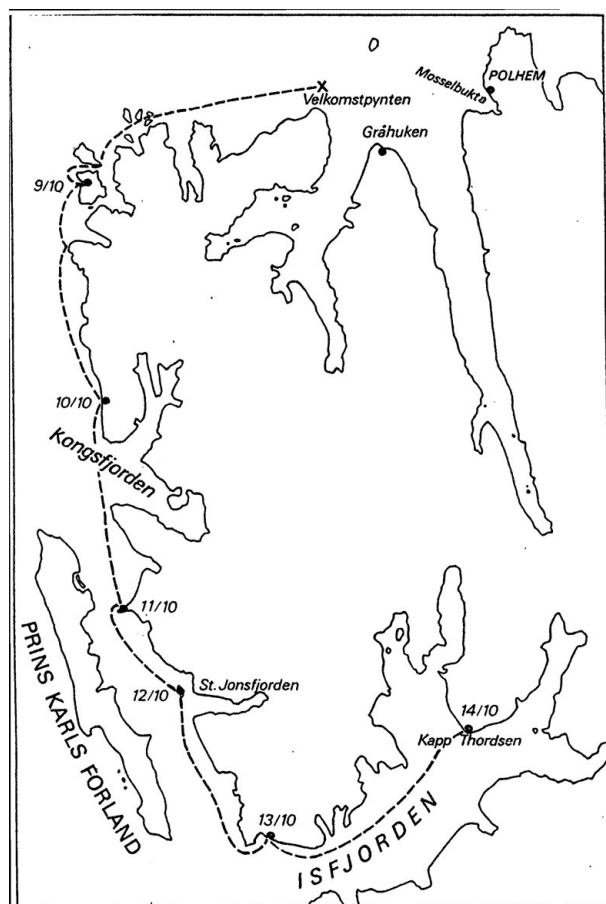


Fig. 1. Map of Svalbard showing the place names mentioned in the text.

poor anchorage there. They began by building a light railway and within a few weeks six men were able to make 48 shuttles a day from the cliff at the shoreline up to where the house was built. It took six men with 'a weight equal [to] three barrels of salted meat' to push the railcar (Thieberg 1872).

As soon as the building material had been carried to the site, 'the expedition started to build the dwelling-house for the members of the "Colony"' (Liljequist 1993). From Thieberg's diary it is evident that the project was doomed from the beginning firstly, because there was not enough coprolite to make the mine profitable and secondly, because the anchorage was so poor. However, Thieberg and his family moved into Svenskhuset and prepared to build a second house.

Thieberg met Graham from time to time and tried to persuade him to give up the project. He evidently succeeded because in the autumn the 'colony' left Kapp Thordsen and sailed home. Öberg and Graham had concluded that the area was unsuitable for the extraction of fertilizer chiefly because of the anchorage. They left behind a solidly built house and stores including some 25 sacks of flour, grain, barrels of preserved potatoes and meat, condensed milk, meat extract, dried vegetables, bacon, building material for a second house, coal, paraffin



Fig. 2. Svenskhuset, The Swedish House in 2008. Photo: Karl Emil Rikardsen.

oil and a railway with rail car trolleys. Thieberg prepared a full statement of the situation at Kapp Thordsen with regard to buildings and supplies and this was sent to the local newspaper in Tromsø.

Although most people know that the house has been properly built, I would like to explain that on the ground floor there are four rooms of  $5 \times 4$  m with stoves and an attic with a kitchen stove in the middle. For fuel there are 2–300 barrels of coal mixed with coke and some firewood. There are some 800 cans of petroleum, a box of candles, lamps and lamp wick. There is more than enough food for 18 men. There is no butter but smoked pork can be used instead. There is salted pork, smoked mutton and a large quantity of salted meat in barrels and several tins of meat in preservative based on boric acid. There is not enough bread, but there is a plentiful supply of rye, barley and wheat flour and also yeast. There are lots of grain of different sorts, including, barley, rolled oats, rice and peas. There are several sacks of salt, a large quantity of preserved potatoes, lots of vegetables, coffee, sugar, tea and chicory, a barrel of syrup, a barrel of vinegar, a small barrel of lemon juice, cheeses of various sorts and 600 kg of dried fish. There is also a store of more expensive provisions including dried apples, prunes, raisins, currants, cherries etc., and an assortment of spices. There is also some tobacco (Thieberg 1873).

Graham had concluded that dismantling the house for transport back to Sweden would be too expensive. He hoped that the Norwegian government would purchase it as a shelter for wrecked sealers (*Tromsø Stiftstidende* 1872). It is ironical that later in the same year it served exactly that function and lodged 17 Norwegian sealers all of whom subsequently died there.

The Swedish establishment of a 'colony' at Kapp Thordsen was not only an economic project, it also had a political aspect. The Swedes intended to make Svalbard a part of the Union between Sweden and Norway. This political plan failed, however, owing to objections from Russia (Liljequist 1993). Norwegian sealers and trappers named the house Svenskhuset (Swedish House). The house, still called by this name, stands there to this day (Fig. 2)

### Adolf Nordenskiöld's expedition at Mosselbukta in 1872

In November 1871 the Swedish Academy of Science decided to send a wintering expedition to the north of Spitsbergen. The expedition, which was led by Adolf Nordenskiöld, intended to travel as far north as possible in 1873 using reindeer. Nordenskiöld's planned overwintering in 1872 was the first on Spitsbergen since 1844. The only house on Spitsbergen at the time, according to the polar veteran Paul Bjørvig, was a little Russian cottage in Red Bay in northwest Spitsbergen (Bjørvig 1933).

Nordenskiöld's expedition ship *Polhem* sailed into the harbour at Tromsø on 13 July 1872 the same day as that on which the *Tegetthof*, with the Austrian-Hungarian North Pole expedition onboard, sailed out of the harbour (Kjellman 1875). Four scientists sailed with *Polhem* to carry out a comprehensive programme in meteorology, earth magnetism, northern lights and astronomy and to collect zoological and botanical material. A medical officer, Axel Envall, was on board and wintered with the expedition. Envall was also the expedition's photographer.

Nordenskiöld had two expedition ships at his disposal in addition to *Polhem*. These were the newly launched steamer *Onkel Adam*, the navy brig *Gladan*. *Polhem* was sheathed against ice and had sailed in the Baltic Sea during the winter and it was intended that she would remain in Svalbard throughout the winter while the other two were to return south. On 15 September the ships were at Mosselbukta (Fig. 1) and a farewell party was held onboard *Polhem* for the crews of *Onkel Adam* and *Gladan*. These vessels were ready to sail the next day but an icy wind from the north moved masses of ice into Mosselbukta effectively blocking it completely. The temperature fell below  $-20^{\circ}\text{C}$  and the sea froze. The three ships became trapped in the ice. The same thing happened to six Norwegian sealers off Graahuken (Fig. 1).

Nordenskiöld's expedition was equipped for 28 men but the wintering party was increased by 25 men from *Gladan* and 12 men and one woman (the cook Amanda Wennberg) from *Onkel Adam*. The storm lasted for several days and the reindeer escaped, only one of them returning.

Thus, in October 1872 two expeditions were trapped north of Spitsbergen with inadequate provision. These were the Swedish scientific expedition at Mosselbukta and a Norwegian sealing expedition further west off Graahuken. Seventeen men from the Norwegian sealing expedition rowed 350 km to the Swedish House hoping to spend the winter there. All of them died there within a few months.

### The Norwegian sealers at Graahuken

In the spring of 1872 the Tromsø sealing fleet sent out 44 vessels. Some of these sailed east to Novaya Zemlya while the rest sailed first north along the west coast of Spitsbergen and then eastwards to the entrance of Hinlopen Stretet between Spitsbergen and Nordaustlandet.

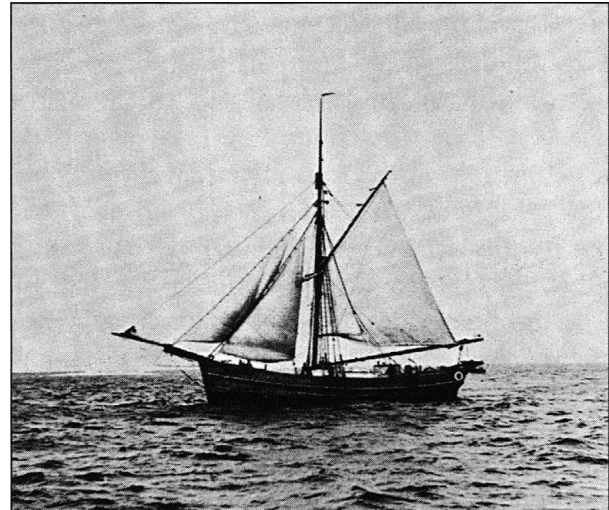


Fig. 3. The Tromsø sealing fleet consisted mostly of sloops in 1872.

Seven vessels failed to return home that autumn. Among these were the sloops *Freja* with a crew of 11, trapped in Novaya Zemlya, and *Jacobine Fredrikke* and *Pepita* trapped in Velkomspynten, and *Dragedukken*, *Elida*, *Helene*, and the smack *Svanen* (Fig. 3) all of which were at Graahuken north of Spitsbergen. Some 70 men were involved and many people in Tromsø became seriously worried for their safety. The vessels that had returned home from Spitsbergen reported severe ice including much north of the island.

The sealers' families in Tromsø and the local press demanded that the Norwegian government send a relief expedition to Spitsbergen to rescue the crews of the sealers trapped there. In November the government sent the steam ship *Albert* of Tønsberg to Tromsø under the command of Lt-Cdr. Fredrik von Otto. Four experienced sealing masters joined the expedition but just as *Albert* was about to sail news arrived that *Pepita* had docked at Hammerfest with some 20 men in addition to her own crew. Moreover she had sunk in the harbour shortly after arrival. The county governor ordered *Albert* to sail to Hammerfest to interview Captain Nils Johansen of *Pepita* before sailing north to Spitsbergen (Bjørvig 1933).

Johansen had sailed from Hinlopen but was stopped by ice off Velkomspynten. Here he made contact with *Jacobine Fredrikke*, captained by Amandus Knudsen, that was one of four vessels beset at Graahuken. The sealers were equipped for a voyage of only five months and were about to run out of food. The crews knew about Nordenskiöld's expedition at Mosselbukta and seven men walked 50 km over the ice to visit him. Nordenskiöld, however, could offer little help. Because his two tenders, *Gladan* and *Onkel Adam*, had also frozen in before they could return to Sweden, he had 38 more people than his expedition was equipped for. He strongly advised the sealers to continue hunting and to gather as much food as possible. He also suggested that some of them should try to reach the Swedish House at Kapp Thorsden



in Isfjord. The seven men returned to their ships with a written statement. ‘A clarifying note to the masters of the icebound sealers at Graahuken and Welcome Point’ signed by Nordenskiöld and the masters of *Polhem* and *Gladan* (Kjellman 1875). Nordenskiöld stated the situation of his own expedition. He would help the sealers with food, he wrote, on condition that 1/3 of them rowed to Kapp Thorsden. He mentioned the provisions in the Swedish House, including tinned products, grain, pears etc. Nordenskiöld also insisted that the sealing masters should agree to pay whatever claim of compensation which His Majesty the King saw fit to make. They also had to carry out tasks for the expedition (Kjellman 1875).

On 7 October, 17 men from the beset sealers started to row westwards from Graahuken in two boats. They continued south along the west coast and eventually reached Isfjord having made a journey of some 350 km. They brought with them letters from the Swedish expedition in Mosselbukta that were to be posted in Norway.

On 20 October, Nordenskiöld sent Captain Louis Palander of *Polhem* and five men to Graahuken to inspect the icebound sealers. They walked over the ice and reached Graahuken in 48 hours. Palander was informed that 17 men had left for Kapp Thorsden in two boats. The sealers were undamaged and their masters had decided to overwinter in an attempt to save them. The sealing masters and Palander agreed that on 10 November the remaining crews should walk to Mosselbukta and spend the winter there, although on much reduced rations. This was the last contact between the Norwegian sealing expedition at Graahuken and the Swedish expedition.

In the meantime, in early November, after the 17 had safely reached Kapp Thorsden, on 14 October 1872, the ice at Velkomspynten had been broken up by a southwesterly storm and *Pepita* and *Jacobine Fredrikke* managed to get free. The crews of *Dragedukken*, *Elida*, *Helene* and *Svanen*, altogether some 39 men, transferred to *Pepita* and *Jacobine Fredrikke* but the skipper, Johannes Mathillas, and the cook, Gabriel Andersen, remained behind having decided to overwinter at Graahuken in an attempt to save *Elida*. *Pepita* and *Jacobine Fredrikke* sailed at once for Norway.

Captain Johansen lost sight of *Jacobine Fredrikke* shortly after they started homeward but later in the month she reached Tromsø safely. Captain Knudsen reported that they had sailed directly to Isfjord in an attempt to reach the 17 men at Kapp Thorsden but had been stopped by drifting ice and dreadful weather in which *Jacobine Fredrikke* lost her bowsprit, a sail was blown to tatters and the rigging was damaged. Without drinking water they had to melt ice that they collected off the rigging and sails and, lacking food, they had no choice but to leave for Tromsø at once.

The two vessels had returned safely to the Norwegian mainland, but Andersen and Mathillas suffered hard conditions in Graahuken. *Elida* was washed ashore during Christmas. Mathillas and Andersen died in a primitive hut made from driftwood, tarpaulin and a boat. The last note in the diary they left behind was recorded on 18 February.

‘To-night I have not been able to cut firewood for tomorrow’ (Andersen and Mathillas 1872–1873). Envall diagnosed their cause of death as scurvy.

### 17 men at Kapp Thorsden

The following are the sources for the study of the events at the Swedish House during the period in which the men were alive there. Of greatest importance is Carl Albrigtsen’s diary (Albrigtsen 1872–1873) that was found at the site by Ole Barth Tellefsen, whose diary is also of interest. There is also a diary of stores consumed between 14 October 1872 and 10 February 1873 (Dag Bog 1872–1873). Finally there is a report by Fritz Mack, captain of the sloop *Tromsø* (Mack 1873). He arrived at Kapp Thorsden on 17 June 1873 and prepared a full report to the director of the Norwegian meteorological institute concerning what he saw there.

In all likelihood it was not an exhausted crew that reached Kapp Thorsden at noon on 14 October 1872 and ‘put up at the house built by the Swedes’ because one week later harpooner Carl Albrigtsen recorded in the diary. ‘Our health is good. All well’ (Albrigtsen 1872–1873). This is remarkable because not only had they rowed for 7 days through the twilight of the late Arctic autumn to reach Kapp Thorsden but they had suffered a series of mishaps right from the start. Tønnes Pedersen, aged 27, an experienced sealer and fisherman, had been appointed leader of the expedition by the masters of the beset vessels. There were two harpooners, Carl Albrigtsen and Peder Andreas Nilsen, both aged 26. None of the 17 was married. The masters had presumably picked out men among the crews who had no family at home. Their average age was 23 years (*Tromsø Stiftstidende* 1873).

According to the diary, and the sealing masters who found the men dead nine months later, they rowed two ‘fangstbaater’, literally translated as ‘hunting boats’. These were rowing boats about 6.3 m (19 ft) long and 1.5 m (5 ft), carvel-built and strong enough to resist ice and walrus tusks. When sealing, the hunting boats were equipped for five men under the command of a harpooner. The boats normally returned to the ship each evening but carried stores sufficient to enable them to spend up to a week sealing independently if necessary. Hunting boats had six thwarts but only five pairs of oarlocks and no rudder. The helmsman rowed while facing the bow and used his oars as rudder. Each of the five men in the crew had a specific task and responsibility such as cooking, bailing, maintaining the ropes and even the harpoon handles. The crew worked as a team.

The journey began early in the morning of 8 October. That evening, they left their boats on the ice and returned to the ships and spent the night there. On the second day they had some problem with their drinking water derived from melted ice that was contaminated with seawater. On the third night they slept on a large ice floe that drifted north for several kilometres. Despite this, they were able to kill two walrus and one bearded seal for food and kept

the blubber, which was shared equally between the two boats, and used it instead of firewood for cooking and completed their journey of 350 km without any serious difficulties.

The expedition seems to have been well organised and disciplined from the start. They started the row at 5 am each day and continued until 6 pm, when they landed and spent the night on a beach. They broke their journey in the middle of each day for food and rest. The sealing masters had given them a long pole with a piece of cloth attached and had instructed them to put it up at Amsterdam Island with a bottle containing information about their journey. However, rough seas prevented their landing and the flag was erected instead 'at an island between Magdalena Bay and Bjørne Bay' (Albrigtsen 1872–1873).

Envall had talked to the men before they started and had explained, among other things, how to avoid scurvy (Envall 1874). Nordenskiöld had probably given them equipment with which to make weather observations consisting of windspeed and air temperature. It is evident from the diary that they had such instruments 'the wind speed is about the same as at 8 am'. They made weather observations five times a day from when they arrived until 5 April 1873 when there were only four men still left alive.

Two days after they arrived at Kapp Thorsen the weather changed from a gentle breeze to snow and wind but they went out hunting in the mountains from 17 October until 8 November after which Albrigtsen recorded in the diary: [h]unting is difficult because of the darkness. All's well. Our health is good' (Albrigtsen 1872–1873). They killed two polar bears on 18 October, two foxes on 19 October and on 24 October they followed reindeer tracks and killed two reindeer the following day and another two on 29 October.

They carefully recorded what food and other necessities they took from the store at the house from 14 October 1872 until 10 February 1873. There is one last record on 3 March: '13 pounds of rolled oats' (Dag Bog 1872–1873).

At first they seemed to have had a diet of fresh meat because according to the diary they did not take meat or pork from the store between 24 October and 1 November, when they killed reindeer, with the exception of 28 October. They even stored food. Among the possessions found the following year, the crew of *Ellida* found a barrel of salted polar bear and reindeer meat (Larsen 1931).

The first sign of an illness was recorded on 9 December 1872. 'All's well with the exception of one of the crew who became ill eight days ago' and on 19 December: '[n]o improvement in the sick, two men in the sickbed'. There are no symptoms recorded in the diary, only sick or dead. The first people who entered the house after the disaster noted that blood had been running from the dead sitting on the box, but not specifying from where. Illness struck them all later that month. 'The condition of health is very poor, almost everybody is struck by the disease' and then on New Years Eve: 'I have to point out that on Christmas



Fig. 4. The grave of two men that was rediscovered by the expedition in August 2007 (Svenskhuset in the background). Photo: Ragnhild Gustad.

Eve we had to use one room for the sick with two men on watch day and night.' Two men died on 19 January. The first to die was the expedition leader Tønnes Pedersen: 'God called Tønnes O. Pedersen to his home at 3.30 this morning. He was laid in sickbed on 5th with a painful illness. Henrik Henriksen was carried home to God and to his eternal rest at 4.30 this morning. He was laid in sickbed at 19th December' (Albrigtsen 1872–1873). The diaries do not mention any funeral arrangements but the following record appeared on 20 January. 'To make coffins used 38 feet of planks 10 inches wide and 96 feet of planks 6 inches wide, four dozen nails of 3 cm and a dozen 5 inch nails' (Dag Bog 1872–1873).

Probably the dead were not buried before 22 January because Albrigtsen recorded in his diary on 20 and 21 January 'SE blizzard'. 'On 22nd January the weather improved but Jacob Olai Israelsen of Meløyvaagen and Peder Pedersen Ørnes of Balsfjord are in their sickbed. The disease is worse then ever' (Albrigtsen 1872–1873).

Tønnes Pedersen and Henrik Henriksen were buried some 500 m from Svenskhuset. The ground was frozen but they managed to dig a hollow 20 cm deep, 210 cm long and 140 cm wide, placed the bodies inside a solid frame and nailed on a wooden lid as a cover. Their comrades had managed to dig some soil that covered the lid and over the grave they erected a cross. This grave was discovered by the authors' expedition in August 2007 (Fig. 4).

The remaining men at Kapp Thorsen saw the sun for the first time on 20 February 1873. The weather was fine for weeks but everyone was ill. The diary continues in different handwriting on 22 February. Albrigtsen had become seriously ill and had died on 13 March. It was probably Peder Andreas Nilsen, the other harpooner, who continued the diary. The entry for 25 February reads: 'I will hereby record the sad statement that I have only one man who is well and he has to look after the entire house. Lord, help us in our distress'.

Amazingly, weather observations were recorded every day until 5 April.

Two men died in February, eight in March and one in early April. The last record is on 19 April: ‘Martin Hansen died on 19th April at 6 o’clock in the morning’. On this date only Nilsen and two others were still alive.

Besides Pedersen and Henriksen who were buried by their comrades, five men were carried outside and put in a frame covered with tarpaulin, six men were carried across the corridor and locked inside a room. Harpooner Nilsen, Martin Hansen and two others were found in the day room.

Three relief expeditions were sent from Norway to Isfjord during the autumn of 1872 and the spring of 1873 to relieve the men at Kapp Thorsden but none of them succeeded (Holland 1994: 288, 289, 291). However when the last one in the steamer *Groenland*, finally failed to reach Kapp Thorsden on 18 February 1873, 15 men were still alive there.

#### After the disaster

The first to arrive at the Swedish House in 1873 was Captain Ole Barth Tellefsen of *Ellida* of Bergen. He was hunting reindeer in Isfjord and wished to visit the 17 Norwegians on 16 June 1873. As he walked up to the house he observed a mound in the snow covered by a tarpaulin. ‘I lifted a part of it and found 5 dead men lying under it’ (Tellefsen 1873).

Tellefsen recorded that he at first he would not break open the door because it was locked from the inside and ‘fixed to it was a notice prohibiting people from entering the house’. Inside Tellefsen found three dead men lying in their beds while a fourth was sitting dead on a box. A room across the corridor was locked. Tellefsen found the key on the dead man on the box. He opened the room and found six men lying dead on the floor.

Tellefsen investigated the house ‘which had been badly looked after. I found that there had not been a lack of food. On the contrary, there was food in abundance. They had consumed everything that could have improved their health’ (Tellefsen 1873). Tellefsen picked up letters which had been written to the families in Norway and other letters which they had carried with them to Kapp Thorsden from Mosselbukta and Graahuken to be mailed in Norway.

Two days later Tellefsen returned in company with two masters, R. Halvorsen of the *Spitsbergen* and F. Mack of the sealing sloop *Tromsø*. Sixteen men started to dig a grave ‘that could accommodate all the corpses.’ ‘The beds served as coffins and they were buried in their clothes and on their bedding’ (Mack 1873). One of the sailors reported: [w]e carried the corpses out in their beds and put them side by side in the grave. We covered them with planks and a tarpaulin because there was not much soil in the frozen earth’ (Larsen 1931).

Mack confirmed that there was plentiful food, that they had eaten a lot of meat extract directly from the tins, and that they had consumed a great quantity of tinned

milk. ‘Nobody who has sailed to the Arctic Ocean has had the advantages of these people: Food of all kinds in abundance, a lovely house, fuel enough, all kinds of tools, a carpenter’s bench etc.’ (Mack 1873). Tellefsen noted: ‘Capt Mack and Capt Halvorsen made a copy of the Journal, while I kept the original, so that whomever of us first arrived in Norway could give a precise account of these events’ (Tellefsen 1873). The original diary was handed over to Tromsø Museum by Tellefsen, but it has disappeared, while Mack’s copy was published in July 1873.

#### The medical considerations

This project was stimulated by a paper by R. Meadows in *Chemical Matter* in 1994 about the 1845 Franklin expedition, and the findings of the autopsies performed on the bodies preserved in permafrost (Meadows 1994). There seemed to be parallels and contrasts with the situation at the Swedish House.

#### The Franklin expedition

In the early 1980s, a team lead by O. Beattie, an anthropologist, set out to investigate the fate of the Franklin expedition. They obtained permission to exhume the 3 bodies from the permafrost of Beechey Island, and perform autopsies. They were submitted to extensive medical examination, including full body x-ray, autopsy with biopsy of vital organs and chemical analysis in a central laboratory in the aftermath. The bodies were nearly perfectly preserved by the permafrost (Beattie and Geiger 2004).

The results showed evidence of severe emaciation (despite a ship fully stocked with food). One had had an autopsy performed and was clearly an unexplained death. They also showed evidence of tuberculosis and pneumonia. The chemical analysis showed surprisingly high levels of lead in hair and bone. Lead analyses were also performed on bones of Inuit origin and these did not show the high levels. Furthermore, analysis of hair, showed that the lead concentration was particularly high in ‘the proximal part of the hair’, indicating that the poisoning must have occurred on board the ship (Amy and others 1986). Battersby has offered an alternative explanation for the lead poisoning on the Franklin expedition (Battersby 2008), blaming the lead plumbing on the ships. The vessels used by the Norwegians did not have lead plumbing.

#### Scurvy

Scurvy, a disease arising from a lack of ascorbic acid, or vitamin C, was the plague of all seafarers until its treatment and prevention was discovered. Scurvy was a particularly awful disease, and also because of the myths that followed it. It has been described as ‘skin black as ink, ulcers, difficult respiration, rictus of the limbs, teeth falling out, perhaps most revolting of all, a strange plethora of gum tissue sprouting out of the mouth, which immediately rotted and lent the victim’s



breath an abominable odour' (Lamb 2002). All this is due to the decomposition of connective tissue that supports all organs in the body, bones, gums, blood vessels, and joints. There is bleeding under the periosteum (the lining covering the bones) of the long bones where the muscles and tendons are fastened, leading to new bone formation in these areas. This is the typical macroscopic finding in the bones of patients dying of scurvy. It was therefore of utmost importance to inspect the bones in our case.

Dr James Lind, a naval medical officer, offered the explanation of scurvy in a treatise in 1753, and the Royal Navy implemented this in 1795 thereby nearly eliminating scurvy from seafaring (Lind 1953). Vitamin C, which was not identified as such until 1932, is plentiful in fruit, vegetables and fresh meat. Lime juice was therefore recommended to seafarers and to those overwintering in polar areas. Inuit who eat no fruit and vegetables acquire their vitamin C from fresh meat (Lamb 2002). The first planned overwintering was in 1633, when 7 Dutchmen stayed the winter to guard the whaling station and equipment in Smeerenburg (theft was common after the whalers had left) (Roberts 2005). They were fully stocked with food, and had collected as much scurvy grass as they could. *Cochlearia officinalis* is common under sea birds nesting cliffs, and this plant was well known at this time, as an antiscorbutic agent and had been used by sealers and fishermen along the coast of Norway. They did much hunting and all survived without any sign of scurvy. The use of *Cochlearia* is also described in 1816 by a naval officer on duty along the coast of Finnmark (Konow 1816).

Envall, examined 7 of the 17 men who rowed south. According to his report to the Swedish Medical Society in 1874 (Envall 1874), he advised them concerning how to avoid getting scurvy and other diseases. He was very surprised and disappointed that they had died.

### Lead poisoning

Lead is a poisonous heavy metal that has both acute and chronic effects on the body. Metallic lead is little dissolved in an alkaline environment, but is readily dissolved in an acid one. After being absorbed it is deposited in the skeleton (McCord 1954).

Lead poisoning has been known since ancient times, as the Romans, for example, used lead in water pipelines, cisterns and in the glazing of ceramics, used for storing and serving food, in particular, for spirits, wine and cider, which are acidic (McCord 1954).

Preserving food in tin containers was a new invention, the first canning factory opened in 1814, and the process became an immediate success everywhere (Busch 1993). It became popular with expeditions to the polar areas. Imagine having none of your provisions subjected to the risks of rotting, attracting rats or being contaminated, or dying in case of livestock. Typically, lead poisoning leads to stomach pains and cramps, anorexia (loss of appetite), weight loss, dark gums, and a neuropathy taking away the use of the limbs, particularly of the extensor sides, and



Fig. 5. Tin boxes behind Svenskhuset.

joint pain, and also the curious condition called 'debility', total loss of incentive, interest and inertia. These are not unlike the classical symptoms of scurvy (McCord 1954).

According to the inventory list, the men at the Swedish House consumed large amounts of tinned food all with inside solder, exactly like the tins used by the Franklin expedition. The authors found more than a hundred cans on the ground, in sizes from 2–6 litres (Fig. 5). How many more were underground is difficult to say, as there was no permission to excavate. As some of the cans were 6 litre containers, it is reasonable to assume that the cans may have been heated repeatedly on the stove. This would enhance an already acidic environment, dissolving the lead, and maybe even favouring the culture of botulism (see later), as the inside soldering was often not complete, leaving room for a bacteriophilic environment. Sometimes, if the tinsmith was careless, some drops of solder fell into the tin can. This was particularly prone to happen when large quantities were made, and the manufacturers had deadlines to meet, as in the Franklin case (more than 8000 cans of meat alone, plus vegetables, fruits, soups etc) (Beattie and Geiger 2004). The canning industry that made the provisions for the Swedish House was probably no better. The solder contains a mix of tin and lead in a ratio of approximately 50/50. So when the entry in the diary states on Christmas Eve 'today we are all sick', could it be that they had canned meat for dinner, with canned milk, and maybe canned fruit for desert, to have feast on this special day? (Albrigtsen 1872–1873) In 1883, a report appeared of an outbreak of lead poisoning among 150 men of a regiment in the Tyrol, one ending fatally, 45 required treatment in hospital, and many more were disabled. The poisoning originated from a tin lined copper cooking vessel that contained lead (Magruder 1883).

### Botulism

In 2003, an article appeared in the *Journal of Toxicology* introducing the theory that botulism may have caused the demise of the Franklin crews due to an inefficient canning process (Horowitz 2003). Many of the tin cans from the Franklin expedition had a gap in the inside soldering

line near the bottom that would allow for bacterial contamination of the content. As several thousand cans had to be produced within a short time the tinsmiths would have worked under pressure, rushing things, leaving room for errors. There were more than 8000 cans of meat and 20000 cans of different kinds of soup alone, maybe cooked at a suboptimal temperature too low to sterilise the contents. These were perfect culture media for botulism to produce its neurotoxin. *Clostridium botulinum* is a bacterium normally present in soil and grows readily in an environment with little oxygen, even producing spores that can lay dormant for long periods. It may start to produce toxin, at temperatures as low as 5°C, attacking the nervous system causing paralysis and death. This typically happens in Norway when eating salted fermented trout (rakfisk), or raw marinated salmon that has been stored in basins with little oxygen, and contaminated with soil. Could this be the cause of the cluster of deaths occurring early on, killing 24 crew members of Franklin's ships early on when food was plentiful? Could this be the reason why the doctor on board performed an autopsy on one of the petty officers that was found buried in permafrost. An unexplained death? *Colstridium botulinum* was grown from the autopsy material from one of the corpses, 135 years after his death (Beattie and Geiger 2004).

### Tuberculosis

Tuberculosis was endemic in Norway in the 1870's, as it was in Britain in 1845. In Britain it was perhaps because of the industrial revolution, the migration of people to the cities to get work, and having to live close together in poor conditions. In Norway, it was because of extreme poverty. Tuberculosis is a contagious disease, the bacteria being spread by coughing or spitting. People living in poverty, with less resistance due to a poor diet or poor and crowded living conditions, were particularly susceptible. Living at close quarters on a ship or house favoured people becoming infected. In addition, tuberculosis can lie dormant in a person after becoming infected, breaking out when poor or extreme conditions occur, like poor nutrition or disease. There were several cases of tuberculosis on the Franklin expedition, and one of the sailors autopsied had evidence of Pott's disease, a condition of tuberculous infection of the spine. In fact, his death was partly attributable to tuberculosis (Beattie and Geiger 2004). Is there any reason why the sealers at the Swedish House should be spared this epidemic disease?

### The myths

Many incidents in the polar region that are recorded as facts, are, in fact, myths. Lack of evidence or documentation accounts for much of this, but also statements of opinion by peers or persons of authority have often been accepted as historical facts.

So it is in the case of the disaster at the Swedish House. Mack who explained the sealers fate as due to laziness, lack of leadership and to fondness of sweets, was extensively reported in the press and became accepted (Mack 1873). In fact, despite their young age, they were



Fig. 6. The picture shows the bones taken out at the 2 man grave, and the process of taking a hollow needle biopsy.

experienced sealers and fishermen, having been sealing and fishing since they were 14–15 years of age, and they would have known about scurvy and the use of *Cochlearia* to counter it. They were also taught by Envall how to avoid it before they started their ordeal (Envall 1874).

There was an enormous interest in the polar areas in that time in the whole of Europe. It was one of the last white spots on the map and countless expeditions were launched. So the sad story of the 'seventeen' was all over Europe in a very short time. In 1880, the disaster was described in detail in a book published in Paris (Hertz 1880), even though there is no written account of what happened except the mere facts (temperature, wind, sick or died). No symptoms are recorded, and no thoughts.

Having visited the Swedish House in August 2007, the authors made two important findings. Firstly, we found large numbers of tin cans behind the house, with inside solder like the ones found after the Franklin expedition. Secondly we discovered the grave of the first two to die. Having uncovered these facts, we applied to the Governor of Svalbard and the Directorate for Cultural Heritage for permission to open the graves to take samples of bone for lead analysis and for inspection of the spinal cord for evidence of tuberculosis. We also applied to take samples of a tin can with its solder. After a lengthy process, we were finally allowed to take out bones through the damaged corner of the 2 man grave for sampling by a hollow needle for lead analysis and inspection, and to dig a shaft 50 × 50 cm in the 15 man grave for taking similar samples (Fig. 6). The request to take a specimen from a tin can was denied until we had proved that lead poisoning was the cause of death. In August 2008, we visited the Swedish House for the second time for the exhumation.

### The excavation of the common grave

After a one minute silence out of respect to the dead the authors mapped, sketched and photographed the grave so that it could be restored to its original state upon



completion of the excavation. Then we started to excavate our small square. It took less than an hour to remove the thick and solid turf layer. Just beneath the turf we found small fragments of wood in the soil layer and further down the soil contained much moss. After a few hours of careful digging, the excavation stretched 55 cm into the ground. Then we ran into wood, presumably part of a plank, described in Larsen's account of the funeral (Larsen 1931). When removing the timber layer we encountered clear ice. Beneath the ice casting we could observe parts of two beds standing side by side, pieces of textiles and a large fragment of reindeer fur. Until this discovery there was speculation as to whether anyone was actually buried in the grave since written sources stress the shallowness of the burial in 1873 (Mack 1873). In the bottom of the square permafrost was encountered, which meant that the preservation of the buried men would probably be excellent. At this moment, however, our excavation ended, since our permission to dig was connected to taking samples from human bones, not from mummified bodies.

The result of our excavation confirmed the version given of the funeral in the written sources: '[w]e carried the corpses out in their beds and put them side by side in the grave. We covered them with planks and a tarpaulin because there was not much soil in this frozen environments' (Larsen 1931). Due to the permafrost, however, our excavation of the common grave could not give any answer to the cause of death for the fifteen persons who perished at Kapp Thordsen in 1873.

#### **Methods: The excavation of the 2 man grave**

Parts of a skeleton were retrieved through the damaged corner of the grave. Access was possible only to the upper part of one side of one body. The following bones were removed: the humerus, clavicle, scapula and 3 cervical bones (the upper arm bone, the collar bone, the shoulder bone and 3 bones from the neck part of the spine). Two hollow needle biopsies were taken from the spongy part of the humerus and one cervical bone. The biopsies were put into a plastic transport container. The bones were put back into the grave after being cleaned for inspection. There were smooth surfaces on all bones, no scaling as in subperiosteal bleeding characteristic of scurvy. Neither was there any sign of increased ridges where the tendons are fastened to the bone, also characteristic of scurvy. Bones from whalers dead 200 years, examined at the Svalbard museum, showed signs of scurvy both on the lower and upper limbs. Bacteriological swabs (Capan transport medium) for botulism were taken from inside the grave and control specimens from the ground away from the grave. The grave was then left as we found it.

The bone biopsies were examined by atomic absorption spectroscopy at The National Institute for Occupational Health in Oslo. The bacteriological specimens were cultured at the National Veterinary Institute in Oslo

#### **Results**

The dry bone sample weight was 33 mg and the lead content was 65 µg/g. We did not succeed in culturing *Colstridium botulinum* from our sample, partly because the identification of clostridium is dependant on toxin determination that could not be carried out in our case because use of experimental animals is not ethical in a project like ours.

#### **Discussion**

In the case of dry bone, the figure for lead content should be multiplied by 1.57 (Woodard 1962). That gives a lead content of 102.05 µg/g. In comparison, samples of earth taken from outside the burial grounds in 2007, showed only 16 µg/g of lead. The lead content in the bones from the Franklin expedition, ranged from 97.6–188.6 µg/g, a lead concentration accumulated over years (Keenleyside 1996). In our case, the lead accumulation must have occurred over a period of a few weeks from the arrival time at the house on 15 October to the first sickness on 2 December 1872. As the accumulation of lead in bone only occurs at a rate of 1 µg a year if the blood concentration is 20 µg/dl in cases of chronic lead poisoning (Coke 1994), our victims must have had very high levels of lead in their blood. As there are, to our knowledge, no cases in the literature that examine both blood and bone levels of lead, the estimation of lead in blood must be calculated. In the case of the Franklin expedition, if half the bone lead content had been accumulated during the expedition, the cumulative blood lead over this time (3 years) must have been 600–1500 µg/dl, giving a mean level of 200–500 µg/dl (Keenleyside 1996). That is 3–10 times higher than the recommended upper limits of lead in blood to prevent neurological damage (Nearing 1987). When our 'patient' had accumulated 102.05 µg/g in 13–14 weeks, it is obvious that he must have been severely poisoned by lead. What Mack might have described in his report (Mack 1873), without knowing it, were the typical consequences of lead poisoning.

#### **Conclusions**

There are several possible causes leading to the fate of the 17. There were no signs of scurvy on the bones we examined, even though we did not have access to the lower limbs where the signs of scurvy would have been more pronounced. Tuberculosis would not lead to an epidemic on a short time basis. Botulism is not a possible cause as it results in an acute paralysis and not a chronic illness. Several factors may have worked in concert. These were lead poisoning weakening the victims, making them prone to other afflictions and surely depression.

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