Flaws in the Ice: In Pursuit of the South Pole

Diana Noyce

Antarctic scholars have written much about Robert Falcon Scott's demise on his last expedition to the South Pole. Both Christopher Turney (2017) and Harrison Christian in his narrative *Terra Nova* attributed the inexplicable shortage of supplies at depots on the return journey from the Pole to Scott's second-in-command Edward Evans, leading to the deaths of Scott's entire party. Scientist Susan Solomon in *The Coldest March* argues in detail that it was the exceptionally and unexpected bad weather that resulted in the deaths of Scott's remaining expedition members. Although polar explorer Sir Ranulph Fiennes claims Scott was one of Britain's great explorers and has been much maligned by authors and film-makers over the years, he himself demonstrated when he followed in Scott's footsteps that unpredictable weather was possible, but more importantly, that Scott's diet and means of transport were inadequate (Stroud).

By tracing all four expeditions that involved Scott, Ernest Shackleton, and/or Roald Amundsen, it will be made clear that the British diet fell well short of the calorific and vitamin content required for polar exploration, and especially for the heart-breaking and calorie-consuming hauling of a heavy sledge. By contrast, Amundsen's diet and choice of transport was crucial to his success. Furthermore, in a life-or-death journey the ability to eat your transportation is essentially efficient. It is nutrition on four legs. Nevertheless, shocked that the Norwegian flag was first planted at the geographic South Pole, his displeased rivals regarded Amundsen's achievement as just plain good luck, as well as a little devious. Shackleton, though, received a knighthood for his attempt at the Pole, and Scott's death was regarded as 'heroic' in the eyes of the British public. However, these accolades have obscured the serious flaws that characterised their ill-fated ventures. Moreover, the explorers and the civilisations that sent them to the yet unexplored region did not discover "the ice" so much as "the ice" allowed them to discover themselves, writes the environmental historian Stephen Pyne. The ineffable whiteness of Antarctica "became a vast imperfect mirror that reflected back the character of the person and the civilization that gazed upon it" (67).

Ice featured prominently in the accounts of all early Antarctic explorers. James Cook's circumnavigation of the south polar region in 1772-75 was blockaded by a field of sea ice. James Clarke Ross in 1839-43 in search of the South Magnetic Pole described a Great Ice Barrier (now known as the Ross Ice Shelf) extending hundreds of miles across the southernmost water approach to the pole (Turney, *1912* 11, 21). The explorers who followed spoke of pack ice, fast ice, ground ice, drift ice, icebergs, ice caps, ice falls, ice floes, and glaciers. Since people had been unable to penetrate the interior of Antarctica by the late nineteenth century, it remained the last unexplored continent. A vast wilderness of ice, mountains and more ice, this southernmost continent is the coldest, driest, windiest, and most isolated place on Earth. Exploration had long been a tool of colonial expansion and of imperial prestige. However, the prestige of men and nations crystallised in the race for the last great geographical achievement, the journey to the South Pole. No longer an abstract dot on the map, it became the goal of a geographical race with strong nationalistic overtones. Scientific societies and organisations around the world planned scientific and geographic

expeditions to Antarctica. As the British boasted a long history of exploration and were the first to plant a flag on the Antarctic continent (the Southern Cross Expedition 1898-1900), the British felt it was their right to be first to plant the British flag at the South Pole.

For a generation of men who had grown to maturity under a small, plump woman ruling large slices of five continents, the *Discovery* expedition (1901-03), led by an unknown Royal Navy Lieutenant Robert Falcon Scott, gave the British navy "an opportunity to do battle with and to conquer the Antarctic ice, as our navy always conquers," said the secretary of the Royal Geographical Society, Clements Markham (Larson 249). The geographical prize though was the South Pole. Its conquest would bring prestige to both individuals and nations. For the privilege of being the first to tread this inhospitable yet so desirable spot, explorers were prepared to drag themselves 1600 miles (2575km) across a frozen wilderness and face extreme suffering and danger.

Antarctica was like no other continent. Unlike in previous continental exploration, once an exploring party passed the coast there was nothing to stand between it and the purely physical systems that comprised Antarctica, observes Pyne. Unlike in the Arctic there was no ecosystem to sustain an explorer, no indigenous culture or permanent human societies that could guide, inform, or assist. No guides to direct overland parties, or indigenous technology to rely on. No indigenous hunters who could inform them of geography and educate them in survival skills in a harsh environment. Only along the coast were there organisms that could sustain life, once crossed there was only ice and more ice (88-89).

A great deal is known today about the most basic survival in polar environments in terms of what food and clothing is required. Much of this knowledge was discovered the hard way, by men suffering from cold, starvation and nutritional deficiencies while exploring the Arctic or Antarctic regions. According to biographer David Crane, the key problems that faced Antarctic explorers heading for the South Pole, either travelling by dog sledge, or especially by man-hauling sledges which uses a great deal of energy, were calculating the balance of food and weight – and with nutritional science in its infancy, the impact of extremes of cold on the body were imperfectly understood – the unknown and variable effects of altitude, and the causes of scurvy (the great horror of expeditions on both sea and ice – as will be seen) (165).

The Pole in Their Sights

The British National Antarctic Expedition left Dundee 31 July 1901 bound for the frozen south. The *Discovery,* a purpose-built wooden ship, entered the pack ice in the Southern Ocean and after it anchored at its winter quarters at McMurdo Sound on the Antarctic continent, it remained frozen in the ice from February 1902 to February 1904. It was from here that Scott, Shackleton, and Dr Edward Wilson were to attempt to reach the South Pole supported by others who were to lay food and supply depots for the team to use particularly on the return journey. In this way the men would only need to carry enough supplies on their sledges to last them until the next depot, rather than for the whole outward and return journeys.

Although Scott had no predilection for Polar exploration, keen to learn he travelled to Norway in the lead-up to the expedition to visit the celebrated Arctic explorer and acknowledged expert on sledging, Fridtjof Nansen. He warned Scott that it was vital to take

the right supplies and equipment. He also urged him to take sledge dogs which Scott did, sending to Russia for them, and to learn to ski – which Scott did half-heartedly. Australian expedition physicist Louis Bernacchi, who was the only expedition member who had been in Antarctica before, with the Southern Cross Expedition (1898-1900), and the first to use dogs and sledges in Antarctica, was critical of Scott's "lack of system" and could see a shambles unfold before his eyes. According to Antarctic historian Michael Smith, Bernacchi reported the *Discovery*'s men could not put up a tent in a blizzard, cook or dress properly. He felt too much time was wasted playing football on the ice, rather than learning to ski and to handle the uncontrollable dogs. The spring sledging had been a failure with food and clothing incorrect and inadequate (69). Scott himself recounted that their "ignorance was deplorable" and the "lack of system was painfully evident" (*Voyage* 164). As well, scurvy, a dietary disease caused by a lack of vitamin C, was evident in all the men.

The expedition doctor Reginald Koettlitz, an experienced polar explorer, was also critical of Scott. Koettlitz spent three years in the Arctic as a member of the Jackson-Harmsworth expedition (1894-97) and had noted that scurvy was not a serious problem for them. This he credited to regularly eating fresh meat (seal) and the necessity to have good quality canned food.[1] Physician and explorer Frederick Cook's (1865-1940) account of the *Belgica* expedition (1897-1899), the first to overwinter in Antarctica, had shown after an outbreak of scurvy that fresh raw seal and penguin meat was the cure, and this became the accepted prophylaxis and treatment for subsequent Antarctic expeditions. However, according to Aubrey Jones, Koettlitz tried to persuade Scott that everyone should eat fresh seal meat frequently, but Scott disagreed because he thought the slaughter of so many seals was cruel and would not be well-received by the British public. He allowed a few meals of seal, but not enough to make a significant difference to health. In any event, the cook made no attempt to make the seal meat palatable and it was unpopular. Soon mild scurvy was rife. According to Scott, Koettlitz took advantage of the improved light and warmth to grow a crop of mustard and cress using Antarctic soil as well as flannel. Unfortunately, it was not enough to act as a cure for scurvy, but it was enough to provide one good feed of mustard and cress sandwiches "for all hands." It was not until the junior doctor Edward Wilson and four other men ventured out to slaughter over a "thousand pounds" of seal meat and the cook found better ways of preparing it that scurvy was abated. The seal flesh was curried, stewed, roasted, fried, and hashed. The use of tinned meat of any description was ceased (Scott, *Voyage* 368-69). Nutritional analysis confirms that seal meat is a reasonable source of ascorbic acid (vitamin C), providing two milligrams per one hundred grams of meat; seal liver provides nearly ten times that amount. Men aged nineteen + need a minimum of 90mg daily (Rubin 38). The livers of two full grown seals were sufficient for a meal for all the men.

The scurvy outbreak delayed Scott, Wilson, and Shackleton's departure for the assault on the pole, but they managed to get underway by 2 November 1902. They set out on skis with 19 dogs, and five sledges (Nansen's design). Unable to attain the Pole, they reached a new furthest south record on the last day of 1902 at latitude 82º 17′S. The team returned to base 3 February 1903, had been gone for 93 days, and had covered 920 statute miles (1481km). Scott was unable to reach the pole due to a cascade of calamities. The British were inexperienced in handling dogs as Bernacchi had observed and the lack of skill with dogs was soon evident, so that progress was slow. Moreover, the dog's food, Norwegian stockfish, (dried unsalted cod which Nansen had recommended) had been brought through the tropics on the journey south and unknown to Scott had spoiled. The dogs sickened and grew weak,

[1] It was thought at the time that scurvy was caused by ptomaine poisoning from tainted canned meat.

making them fractious and even more difficult to handle. Some dogs died on the trail and Wilson and Shackleton were forced to kill the weakest dogs as food for the others. The men, too, were struggling, afflicted by snow blindness, frostbite and extreme hunger, and scurvy was again evident in all three men. After all the dogs had died or been killed, the men man-hauled their sledges using more calories than their meagre and dwindling rations could satiate. Shackleton's scurvy symptoms were such that he struggled to walk let alone pull a sledge. He also suffered from fainting spells, a severe cough, difficulty in breathing, and blood-spitting (Scott, *Voyage* 455). On return to the *Discovery*, all three men were very tired, and Scott and Wilson in particular had very swollen gums, legs and ankles. According to Aubrey Jones, Wilson and Scott occupied their beds for days at a time and took a long time to recover from their exertions, but Shackleton was up and about before the other two and it was fifteen days after his return from the south that Scott made his first visit to the supply ship Mornington (159-160).[2] Nevertheless, with nine other men Shackleton was invalided back to England on the *Mornington* due to a broken blood vessel in his lung while the remainder of the expedition members stayed behind for another year.[3]

Figure 1: L-R Shackleton, Scott and Wilson embarking on the Southern journey. Image source: Cool Antarctica

After the *Discovery* Expedition Wilson wrote an article published in the *British Medical Journal* entitled "Medical Aspects of the 'Discovery's Voyage." He recounted that after the spring sledge journeys scurvy presented itself after only three weeks of sledging which meant

[2] Wilson had only just recovered from tuberculosis (TB) prior to the *Discovery* Expedition and had been declared unfit on medical examination, but Scott insisted he join the expedition.

[3] Shackleton died at the age of 47 from a heart attack. Considering the symptoms that presented throughout Shackleton's adult life, he has posthumously been diagnosed with atrial septal defect (ASD) which would account for the times when he collapsed with breathlessness and fatigue. Despite his heart condition, Shackleton went on to make some epic journeys.

their diet many weeks or months before was totally inadequate.[4] He blamed tinned food as the cause of scurvy, and advocated fresh meat, especially seal meat, as the cure. He stressed scurvy in polar regions could be cured with fresh seal meat and without lime juice and vegetables; besides, their fresh vegetables had not kept well (80). Wilson reported that no tinned meat was issued after the outbreak and with recipes from Mrs Beeton's Cookery Book, seal meat was made palatable and eaten every day as well as penguins and skuas and bottled fruits (77). However, the seal meat would have been overcooked destroying most of the vitamin C.

Although the British navy had issued lemon juice since the 1740s when Scottish surgeon James Lind had demonstrated its curative powers, once the navy introduced the less effective processed bottled lime juice, scurvy presented itself again, leaving Lind's remedy discredited. Now scurvy was said to be caused by ptomaine poisoning from tainted tinned meat, a theory championed by British bacteriologist and immunologist Sir Almroth Wright, who had the nickname Sir Almost Right. He threw his considerable medical reputation behind the ptomaine theory and so delayed the proper re-understanding of scurvy for many years. Consequently, many doctors in Britain including Wilson and the subsequent *Terra Nova* expedition's surgeon Dr Edward Atkinson, as well as the highly regarded Fridtjof Nansen, accepted the ptomaine theory. In 1907 the experiments by Norwegian scientists Axel Holst and Theodor Frølich were published in the *Journal of Hygiene*. They demonstrated that scurvy was a dietary problem with a dietary solution, but their results were largely overlooked, and the accepted view that scurvy was caused by ptomaine poisoning continued (Norum and Grav). Wright refused to change his view on scurvy until 1937.

Shackleton returned to Antarctica five years later, leading a privately funded expedition aboard the 40-year-old converted sealer *Nimrod.* He wintered at Cape Royds on Ross Island before heading south with Frank Wild, Eric Marshall, and Jameson Adams, with four sledges, four ponies, and provisions for 91 days across the Ice Barrier, up a glacial pass known as the Beardmore glacier, and then onto the vast Polar Plateau. The men, however, departed for the south in better condition than the *Discovery* party. Marshall, the expedition's surgeon, insisted that over winter the party should build up their resistance to scurvy by eating regular amounts of freshly slaughtered and undercooked seal or penguin meat. Although fresh seal meat contains only small amounts of vitamin C, it was enough to make a difference.
After the disastrous experience with dogs on the *Discovery* expedition, Shackleton chose Manchurian ponies which he regarded as hardy, sure-footed and accustomed to hauling heavy loads in very low temperatures (Shackleton 11). The ponies proved to be successful to a certain extent but suffered badly in sub-zero conditions. Three were shot and their meat cached but the remaining pony disappeared down a deep crevasse. The team then resorted to man-hauling, without skis, drawing their heavy loads. They were within 97.5 geographical miles (156 km) of the South Pole and set a new furthest south record reaching 88º 23´ S on 9 January 1909 before being forced to turn back. They turned back because they were starving. Again, the amount of food required to make such a journey, this time on foot, was underestimated. Although Shackleton was aware from the outset of the "need for fatty and farinaceous foods in fairly large quantities," Shackleton's narrative of the return journey reveals a different story (5). The men were "appallingly hungry," became obsessed with food and first Wild, then the remainder of the men, were ill with dysentery from eating tainted pony meat. Hunger propelled them: "Our food lies ahead, and death stalks us from behind,"

[4] Humans must consume vitamin C ready made in our food. And the body can only store enough vitamin C for about three months.

wrote Shackleton (214). Both Scott and Shackleton showed that it is not strength of body but rather strength of will which carries a man farthest where mind and body are taxed at the same time to their utmost limit.

Figure 2: L-R, Frank Wild, Ernest Shackleton, Eric Marshall, Jameson Adams. They had walked 1700 miles (2735km). Image source: Cool Antarctica.

On his return from the expedition, Shackleton at the end of October 1909 set out on an ambitious series of lecture tours to help pay off the debts of the expedition. He delivered a lecture in Norway and in attendance was Tryggve Gran who, on Nansen's advice, was to accompany Scott in his next expedition as a ski instructor. Gran recounted how Shackleton made it clear that, "if he had had skis on the journey south and known how to use them like the Norwegians, he should probably have reached the Pole." He told his Norwegian audience, "… they will feel quite at home when ashore in Antarctica" (Gran 10). Roald Amundsen was in the audience. Britain hailed Shackleton as a national hero and bestowed the title of 'Sir'.

The Final Assault on the Pole

Scott returned to Antarctica in 1910. Sailing from Cardiff, Wales on 15 June aboard *Terra Nova*, with his sights locked on the South Pole, he had his second Antarctic expedition under way before Amundsen's ship, *Fram*, departed Oslo on 9 August 1910, with the same ultimate destination. The two teams spent the Antarctic winter in the Ross Sea basin 400 miles apart (644 km), with the British base at Cape Evans and the Norwegian base at the Bay of Whales which was more than sixty miles (90 km) closer to the Pole and offered a more direct route. However, the British regarded the entire Ross Sea basin as another slice of a continent that they ruled by right of discovery and prior exploration – Amundsen was therefore seen as an intruder. The attainment of the Pole, however, came down to good food and reliable transport which are fundamental and essential components to the success of polar exploration. As will be seen, Amundsen had both plus more. Just as important to the attainment of the Pole was the character of the leader and the men who accompanied him. Before his departure for the Pole, Amundsen stressed:

> I may say that this is the greatest factor – the way in which the expedition is equipped – the way in which every difficulty is foreseen, and precautions taken for meeting or avoiding it. Victory awaits him who has everything in order – luck, people call it. Defeat is certain for him who has neglected to take the necessary precautions in time; this is called bad luck (Amundsen, *South Pole* 180).

Amundsen's initial intention was to go to the North Pole but when this was claimed by both Frederick Cook in 1908 and Robert Peary in 1909, unbeknown to the British, he secretly turned his attention southward. Amundsen was a 38-year-old powerfully built man over six feet in height and an experienced professional explorer. As a boy, reading the Arctic Expeditions of Englishman John Franklin, both prior to and including his fateful Northwest Passage attempt, ignited and fuelled Amundsen's fascination for the Arctic and a desire for exploration. In his youth he insisted on sleeping with the windows open even during the frigid Norwegian winters to help condition himself for a life of polar exploration, and as an adult Amundsen had salt water pumped from the sea up to his bathtub. Ironically, it was Amundsen who first pipped Britain at the post in 1903-06 when he successfully navigated the elusive Northwest Passage from the Atlantic to the Pacific, something the British had long expected to achieve.

Amundsen had spent much time in both the Arctic and Antarctic, and as such had considerable empirical knowledge of surviving in polar regions. As a member of the *Belgica* expedition, along with Frederick Cook, he witnessed first-hand the horrors of scurvy. It was Cook who taught Amundsen the curative powers of fresh seal and penguin meat. Moreover, when Amundsen navigated the Northwest Passage, he spent two winters living on King William Island, where he learnt the skills of survival in the Arctic environment from the local Netsilik Inuit people. He learnt to drive a sled using dogs, to eat raw fish and meat thus preserving the vitamin C and swapped heavy woollen clothing for furs.

When Amundsen departed from Oslo, he had a crew of 18 aboard the *Fram.* as well as 97 Greenland dogs, along with a prefabricated wooden hut and provisions for two years. The provisions included live pigs, fowls, and sheep which were killed within the Antarctic Circle and then frozen in the ice. After Amundsen established his base camp Framheim, it was time to make ready for the trek to the South Pole. He laid three depots of food to 82ºS (the South Pole is 90ºS) before winter set in. During winter he prepared equipment as well as preparing himself and his men physically for the journey. During the long dark winter, Amundsen's men maintained an exercise regime and built up their body reserves of nutrients to sustain them for their upcoming trek. The cook was the most important person to these would-be conquerors. Amundsen's expedition cook was an experienced 'polar' cook named Adolf Lindström and, according to Amundsen, a "technical wizard" (*Diaries* 264). He rose each morning at six to prepare hot buckwheat cakes spread with whortleberry and cloudberry preserve, traditional Norwegian antiscorbutics. Amundsen recounted Lindström's cakes "slipped down with fabulous rapidity" (*South Pole* 147). Wholemeal bread enriched with wheat germ and leavened by fresh yeast which Lindström brewed was also served with butter and cheese. This provided vitamin B-complex, the importance of which, according to historian Roland Huntford, has been overshadowed by the focus on vitamin C (*Scott,* 389). Seal meat was served twice a day, lightly cooked, preserving most of the vitamin C. A thick, black seal soup made with potatoes, carrots, cabbage, turnips, peas, celery, prunes, and apples was one of Lindström's signature dishes. Before the winter set in Amundsen had 60 tons (60,000kg) of seal meat as well as penguin meat in their winter quarters, which he thought was enough for the men and dogs (Amundsen, *South Pole* vii).

For dessert, the Norwegians ate green plums, tinned California fruits, and cloudberries, all rich in vitamin C, as well as tarts, pudding, pies, and pastries. Seal meat, brown bread, hot cakes, and berries were the main food of the Norwegians, a simple natural and nutritious diet. All through the winter the Nordic team built up their stock of vitamin C and vitamin B-complex. Their defences against scurvy and beriberi, according to Huntford, were as high as they could make them. (*Scott* 388).

After an aborted early start, Amundsen set out again on 20 October, with four men, four lightweight sledges with 13 dogs each, and provisions in addition to those stockpiled the previous summer in three well-marked depots. Amundsen arrived at the South Pole at 3 p.m. on 14 December 1911 with 17 dogs and three sledges remaining. Then "five weather-beaten, frost-bitten fists" planted the Norwegian flag, the first at the geographical South Pole (Amundsen, *South Pole* 249). The weather was mild with a temperature of -2.2º F (-19C) and the "going was splendid and all were in good spirits, so we went along at a great pace," said Amundsen as they began their return journey to Framheim. And rations steadily increased for both men and dogs (*South Pole* 256-57). Amundsen's healthy team returned from their 1500-mile (2414km) trek on 26 January, ten days earlier than anticipated, with two sledges and 11 dogs. They had been gone for 99 days and the men and remaining dogs had gained weight. Although the men and dogs were "ravenous" at times, Amundsen recorded they had "no cravings for fat or sugar," indicating that the rations' calorie content was sufficient (*South Pole* 209).

Figure 3: L-R Sverre Hassel, Oscar Wisting, Roald Amundsen, Olaf Bjaalund and Helmer Hansen on board the *Fram.* Image Source: Antarctica21.

Amundsen believed the sledging rations he chose made a significant contribution to their success (*South Pole* 43). The standard sledging ration in Antarctica during the Heroic Age of exploration (1898-1922) consisted of pemmican, biscuits, butter, cocoa, sugar, tea, and powdered milk, with various additions such as oatmeal, chocolate, cheese, and raisins. These dried and preserved foods were essential for travelling light, but fresh food was crucial for long-term health, especially in preventing scurvy. For the trek South, Amundsen's sledging

rations were only four in number: 400gm biscuits, 75gm dried milk, 125gm chocolate, and 375gm pemmican per man per day equal to 4560 calories (19078kj) (Huntford, *Scott* 581). However, the individual foodstuffs were very nutritious.

Pemmican, the time-honoured polar sledging ration, originated from North America's Cree Indians. It was a mixture of tallow, dried meat, and berries. The pemmican that Antarctic explorers knew was finely ground dried beef with 60% added beef fats and a little seasoning, packaged in cans or rectangular cakes—it had a high calorie to weight ratio (6 kcal per g). Amundsen mistrusted the commercial product. He had pemmican made to his requirements which included dried vegetables and oatmeal. Amundsen's biscuits made by the Norwegian company Sætre were prepared with oatmeal, sugar, and dried milk, and were based on wholemeal flour and crude rolled oats with yeast as the leavening agent (Griffiths 348). The oatmeal in both the pemmican and biscuits contained necessary B-Complex vitamins. The Norwegians made lobscouse with their pemmican and biscuits; a thick stew made with added meat (either dog or seal meat) and cooked on a primus stove.

Amundsen's choice of transport was crucial also to his success. Moreover, in a life-or-death journey the ability to eat your transportation is essentially efficient. He chose Greenland dogs for their powerful bodies and heavy coats, but also unlike some other animals, they will eat one another. Moreover, if they fall down a crevasse, unlike a pony, they are easy to pull up. He intended to use the dogs as transport, then kill some along the way to provide fresh meat for the men and remaining dogs. Dogs synthesize their own vitamin C, which would help to maintain vitamin C levels in both the dogs and the men. To avoid snow blindness, Amundsen travelled in the night hours [24-hour daylight in summer] when the sun was behind them.

Amundsen's five-man team was also an essential component to his success. These latter-day Vikings included Olav Bjaaland, Helmer Hanssen, Sverre Hassel, Oscar Wisting – all accustomed to snow and ice in their backyard, and proficient on skis from an early age. Olav Bjaaland was recruited to the expedition on his strength as a champion skier. The men were very skilled and experienced in dog handling and the speed of the dogs and skiers meant they covered on average 23 miles (37km) per day and longer periods of rest were possible for both man and dog.

Figure 4: Amundsen's South Pole mark constructed with part sledge runner and a black flag. Image source: Sketch by Edward (Bill) Wilson in *Diary of the "Terra Nova*."

After fierce storms and a long delay in the pack ice, the British Antarctic Expedition sailed into the Ross Sea on the *Terra Nova* on New Year's Eve 1910. The ship had a crew of 65 on board as well as four Wolseley motor sledges, 19 Manchurian ponies, 33 Siberian dogs, materials to build a hut, a pianola, a gramophone, and provisions to last two years. A well-insulated icehouse on the upper deck held 162 carcasses of frozen New Zealand mutton, three beef carcasses, and sweetbreads and kidneys. In transplanting civilisation to the ice Scott constructed the hut at Cape Evans, then it was time to lay depots of food along the intended route to the Pole. The aim of the first season's depot-laying for Scott's party was to place a series of depots on the Barrier from its edge (Safety Camp) to 80°S, for use on the polar journey beginning the following spring. The final depot would be the largest, One Ton Depot, so the expedition team would not have to carry all its supplies. However, the weak, unacclimatised ponies used to pull the sledges were struggling, so Scott decided to lay One Ton Depot at 79°29'S, 35 miles (56 km) north of its intended location (Scott, *Last* 130), something that was to prove critical during the return journey from the Pole the following year. Although the ponies struggled in the ice and sub-zero temperatures, and were emaciated when they returned to base, Scott nonetheless took the ponies the following summer for the assault on the Pole.

Like Amundsen, over winter Scott prepared for the journey south by preparing sledges and formulating and packing sledging rations. As Scott intended his team to man-haul the sledges for the last 150 miles (242 kilometres) as well as the return journey, he made careful calculations to minimize weight. However, unlike Amundsen, Scott was not building up his nutritional reserves. Scott's cook, Thomas Clissold, a young mechanic who trained as a Royal Navy cook to join the *Terra Nova* expedition, baked white bread, not brown, and used much tinned food. Soup, usually tinned tomato soup followed by seal or penguin either baked,

stewed, or curried (overcooked) and mutton twice a week, served with tinned vegetables, formed the basis of their meals, followed by pudding. Seal liver was a breakfast specialty and popular amongst the men, but it was overcooked. Beef was served on special occasions. Processed lime juice or water was served with the meal, and alcohol on special occasions.

On 24 October Scott's supporting parties of 16 men transporting supplies – with two driving the dog teams, a team of ten travelling with horses, and four with the motor sledges – left for the trek to the South Pole. Scott joined the cavalcade on 1 November. Scott's previous experience with dogs greatly disturbed him; he therefore favoured walking with the ponies and then man-hauling their sledges once on the polar plateau. An Englishman, Francis Leopold McClintock, earned the title of "Father of Arctic Sledging" for his feats of man-hauling travel during one of the many expeditions despatched to search for the missing Franklin Expedition (1845). Thereafter man-hauling began to be seen by the British as a natural, even a "nobler" alternative to the use of dogs (Berton 187). As they progressed, the various teams gradually turned back. The British expedition, however, was plagued with problems from the start. Only 51 miles (82km) from base camp, the motorized sledges failed and were abandoned. Travel was difficult as the ponies that had been described by their handler Lawrence Oates as "broken down old crocks" (Preston 113), sank in the snow (the snowshoes had been left behind) and as before suffered from the cold. The first pony was shot for food on day 24, and the last one was eaten on day 39. Some of the meat was fed to the dogs, adding to their diet of Spratt's dog cakes, as well as cached for the men on the return journey.

By the middle of December, Scott's sledging parties, averaging ten miles (16 km) a day, were all beginning to suffer from frostbite and hunger. Hunger was so great that the men engaged in food fantasies, dreaming of sumptuous banquets, and they were becoming noticeably thin. Moreover, as their bodies were losing body fat the men were beginning to feel the cold as never before. Man-hauling sledges requires 6500 to 8000 calories per day, far more than when driving dogs. Scott's daily polar ration from the Beardmore glacier was for each man: 20gm. (0.7oz.) tea, 454gm. (1lb.) biscuits, 24gm.(0.86oz.) cocoa, 340gm.(12oz.) pemmican, 56.75gm. (2oz.) butter, and 85.13gm. (3oz.) sugar, a total of 980gm (2lb.3oz.). This ration contains about 4430 calories (18535kj); Scott's 1902 South Pole ration contained 3750 calories (15690kj) (Huntford, *Scott* 581). Moreover, the rations contained the same nutrients as the 1902 rations. The men were only receiving, 210 g of fat (24% of the ration), 257 g of protein (29%), and 417 g of carbohydrate (47%) per day with negligible vitamins (Feeney 159). Scott and his men were effectively on a 'starvation diet' from 10 December. To consume their ration, the pemmican was melted down in a Nansen cooker and mixed with melted snow and crumbled biscuits with added cached meat (either pony or seal meat). This made a meal which the British called hoosh.

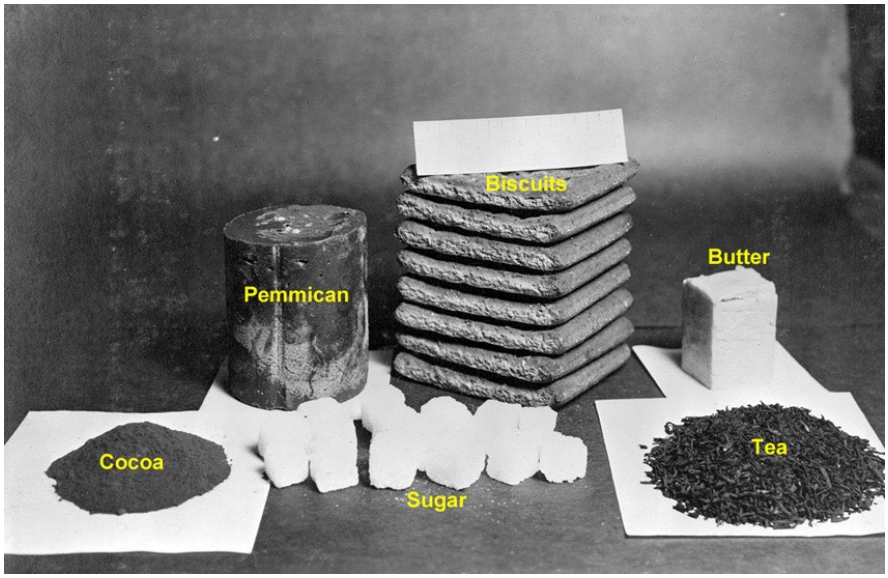

Figure 5: Scott's rations for one man for one day while man-hauling. Image source: Cool Antarctica

The British also had rations made to their own requirements. Scott's biscuits made by the British company Huntley & Palmer were according to Apsley Cherry-Garrard cooked to a secret recipe devised by Dr Wilson and the firm's chemist (200). Looking at Scott's daily sledging rations, the lard-laden biscuits constituted a significant proportion of Scott's sledging diet. Wilson argued "increase your fats (carbohydrates)," "is what science seems to say," recounted Scott (*Last* 213). Historians have analysed the Huntley & Palmer biscuits, but they appear to be no different to the commercial biscuits you can buy today. The biscuits contained, apart from lard, soluble milk protein, white flour which made them low in vitamin B, and sodium bicarbonate. The presence of sodium bicarbonate would have lowered the contents of some of the vitamins on baking, possibly destroying all the thiamine. This lack of thiamine may have been a critical deficiency. A deficiency of thiamine can lead to beriberi, a disease which presents not unlike scurvy (Griffiths 348). It appears not much science went into the making of the biscuit. The pemmican, however, was a commercial product made by J. D. Beauvais of Copenhagen and contained pulverised meat, dried berries, and rendered animal fat.

On 3 January when the final support party left to return to base, Scott made another fatal decision – to increase his polar team from four to five men. Scott had not planned to include Henry Bowers who was part of the support party in his polar party but changed his mind just 150 miles (242 km) from the Pole. Only a few days earlier, Scott ordered the support team to depot their skis, so Bowers had to travel on foot while the others were on skis. Scott estimated they had enough food: "5½ units of food—practically over a month's allowance for five people which ought to see them through" [a unit of food was a week's supply for four men]. Their four-man tent now had to accommodate five. Moreover, since the Nansen cooker contained only four mugs and spoons, cooking for five took seriously longer, which Scott noted he "had not considered when reorganising" (*Last* 384-86).

The sledging party for the final assault on the South Pole comprised Scott, Dr Edward Wilson, Captain Lawrence Oates, Lieutenant Henry Bowers, and Seaman Edgar Evans. At this point they began the heart-breaking work of man-hauling sledges, four on skis and one walking. The party arrived at the Pole 17 January 1912, only to discover Amundsen's tent and the Norwegian flag he planted more than a month earlier. Reaching the Pole after

Amundsen understandably was a dispiriting experience; they turned wearily for home the following day. They now had to man-haul from the pole back to Hut Point, 800 miles (1287 km).

The party was already ravaged by starvation and malnutrition, dehydration, snow blindness, exhaustion, frost bite and injury. It was getting late in the season, and the return journey became one of sheer survival. According to Joseph Coulson, Mike Stroud, nutritionist, and polar explorer, estimates that Scott's men had a deficit of 3000 calories a day. That would have meant each man lost 25kg of body weight by the time they reached the Pole. "You don't just lose fat; you lose muscle as well. You can't keep warm," said Stroud. "On the return journey the men would have been emaciated. … vitamin levels – low at the start – would have dropped further. Furthermore, the last-minute decision to add a fifth man to a journey originally planned for four put extra pressure on food rations." Scott should have followed Robert Peary's recommendation, written in 1890, that, "every increase in the party, beyond the number absolutely essential increases an element of danger and failure" (Feeney 152).

The first to die was Evans. In less than halfway on the return journey he had fallen and never recovered. Seaman Edgar Evans was a former Royal Navy gymnastics instructor, well-built, and weighing over 180lbs (81.6kg). He may have been the first affected by privations because of his size, suggests biochemist Robert Feeney (150, 158). Big men require more calories, and he did complain to Scott he required more food because of his size. As well, a bad cut on his hand refused to heal. The likely cause severe cold and lack of vitamin C. Evans became disorientated (another sign of scurvy) and finally lagged behind the group, collapsed off the trail, and died 17 February – probably from a brain haemorrhage caused by scurvy. Both Scott and Wilson would have easily recognised the symptoms of scurvy but chose not to record them in their diaries. There was a certain stigma with scurvy, especially in their case, having thought they had taken such pains to forestall the disease after the outbreak of scurvy on the *Discovery* expedition, yet Scott's sledging rations contained the same nutritional value as the 1902 rations when scurvy clearly presented. Moreover, the longer the men were in the hostile Antarctic climate, experiencing the hard work of man-hauling would greatly accelerate the ailment.

Then Oates began to fail, particularly with frost-bitten feet and hands, and a wound on his thigh may have suffered dehiscence caused by a lack of vitamin C. On 16 March, Oates marched out of the tent and allegedly declared, "I am just going outside and may be some time." All knew he was walking to his death (Scott, *Last* 430). By this time, the remaining three, Scott, Wilson, and Bowers, were also suffering in various ways, but particularly from lack of food and fuel, even with two men down. Moreover, they continued to pull thirty-five pounds (16 kg) of rocks Wilson had collected, a further drain on their resources. On 20 March, an extreme blizzard stopped all progress. It was late in the season and contrary to Solomon's argument that the weather was exceptionally and unexpectedly ferocious, Shackleton recounted it was "the time of the year when bad weather is expected" (215). The men were within 11 miles (18 km) of One Ton Depot, which had been laid the previous summer further north than planned. If the depot had been laid correctly, the men would have had access to badly needed supplies. However, it was found later that the food was almost inedible owing to the quantity of paraffin used as fuel had leaked out into the food. In other depots the fuel was in short supply as it had vapourised. Scott used screw caps with leather washers which had perished. This phenomenon had been noticed by previous expeditions, but Scott took no measures to prevent it. Amundsen, by contrast, sealed his cans with cork bungs, topped with metal caps which were soldered and cut open as needed. (Cherry-Garrard 436).

A fuel depot found 100 years later was still full. Scott often complained of being thirsty, and the fuel shortage meant he was unable to melt as much drinking water as Amundsen.

Figure 6: The South Pole party from L-R, Oates, Bowers, Scott, Wilson, Evans. Image source: Cool Antarctica.

On 29 March, 150 days out with supplies of food and fuel exhausted, Scott made his last diary entry and in a weakened state gave a reason for the expedition's failure. For Scott they had "Shot our Bolt," that is, they had done everything possible to achieve their goal but failed, and now can do nothing else to achieve their aims. He explained how the expedition's disaster was not due "to faulty organisation, but by bad weather and bad luck. It was no one's fault", wrote Scott. "Every detail of our food supplies, clothing, and depots […] worked out to perfection […]. We have missed getting through by a narrow margin which was justifiably within the risk of such a journey" (*Last*, 441). However, things did not work out to perfection: "it was a miserable jumble," according to Scott's uncensored journal entry dated 10 March 1912 (Huntford, *Race* 385–87); and indeed, it was. [5] Sometime after 29 March, Scott, Bowers, and Wilson died.

On the *Terra Nova* journey south, and before departing from a stopover in Australia, Scott had frankly talked to the press about the expedition's chances: "We may get through, we may not. We may have accidents to some of our transports, to the sledges or to the animals. We may lose our lives. We may be wiped out. It is all a question that lies with providence and luck." This fatalism was both part of Scott's nature and born of his experiences on the *Discovery,* suggests historian Diana Preston (129). Or was it a self-fulfilling prophecy? Scott,

[5] Huntford, Turney and others reveal that Scott's and particularly Wilson's diary were substantially censored before publication. Expedition diaries yield clues but not hard evidence as to what occurred on polar expeditions.

unlike Amundsen, was relying more on providence and good luck rather than good food and reliable transport. In the end British zeal could not compensate for poor nutrition, lack of food, and inappropriate transport. If an army marches on its stomach, a polar expedition lives or dies on its supply lines.

Scott complained that there were unexplained food and fuel shortages at key depots. According to Turney (2017) and Christian, Scott's second in command Lieutenant Edward 'Teddy' Evans played a part in the deaths of Scott and his men. Evans led the last return party to see Scott and his men alive. Evans, however, came down with scurvy on the return journey and Turney reveals that newly discovered documents imply that Evans and his two companions therefore entered the depots and consumed more than their fair share of food supplies. Christian recounts that on the outward journey to the Pole, Evans hoarded food and regularly asked the dog sledging team for some of their rations of cocoa and biscuits (172). Evans verifies that he did so because the dog drivers were not as "ravenous" as the man-hauling party (184). Indeed, Teddy Evans had spent more time away from base camp man-hauling sledges than all the other expedition members (four months) and would have lived longer on sledging rations, which have been shown to be lacking in nutrition as well as calories. Was he justified in taking more than his share of food if that was the case?

In conclusion, the flaws in the British teams were inadequate and unwholesome food, and inappropriate and inefficient transport for such a lengthy and arduous journey. Scurvy quickly gives rise to fatigue, and this would have seriously lengthened the journey time back from the Pole. Combine this with a serious underestimate of the energy expended in sledge-hauling and the exceptionally bad weather that Scott and his companions experienced (a topic discussed in detail by Solomon), it is clear why Scott's carefully calculated rations were inadequate and severe malnutrition resulted. Moreover, vigorous physical activity is a powerful antidote to the effect of cold, so the fatigue caused by scurvy exacerbated the hypothermia that the intense cold caused. Scott and his men were effectively on a 'starvation diet' from 10 December 1911 until their deaths in March 1912. For both Shackleton and Scott, it was the reliance on pure grit and courage of their companions that really characterised their expeditions, and not good food and reliable transport.

Figure 7: Comparison of Amundsen and Scott's South Pole Expedition. Image Source: Wikipedia Commons.

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