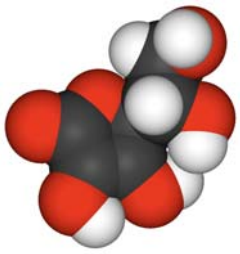
SPQ Module 19 – Vitamins and Bacteria



"Last entry. For God's sake, look after our people."
-Robert Falcon Scott

These were the last words penned by Robert Scott before he perished on the Ross Ice Shelf with two of his five men at his side. Having run out of food and fuel to melt ice and snow for water, they doubtless succumbed to dehydration, starvation and hypothermia. Yet were their deaths simply a byproduct of a shortage of food and water, or were there other factors that came into play?

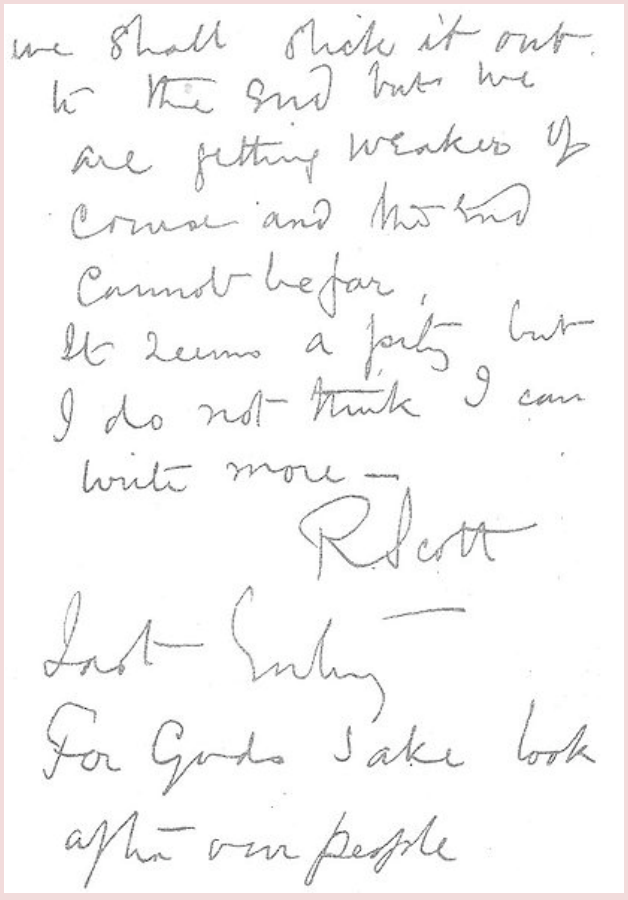

we shall stick it out
to the end but we
are getting weaker of
course and the end
cannot be far
It seems a pity but
I do not think I can
write more —
R Scott
Last Entry
For God's Sake look
after our people

Figure 1: The last page of Robert Scott's diary, which was found by his side (source: Project Gutenberg, online book catalog).

There has long been speculation about what led to the spectacular failure of the British expedition and the demise of the five men. Although the ultimate shortages of food and water, and the severe cold of the approaching Antarctic winter were central to this failure, they do not tell the whole story. A study of the deaths of Scott and his men reveals very important lessons about human physiology and disease processes that have informed future generations of explorers.

Before embarking on an analysis of the circumstances of the British expedition it is important to understand that the five men on the

expedition, Evans, Oates, Wilson, Bowers and Scott did not all perish at the same time, and may well have succumbed to different ailments. Evans passed away on February 17 1912, followed by Oates on March 16th and finally Scott, Wilson and Bowers on, or about March 29th. Let us reconstruct the series of events and factors that contributed to their death.

In his diary Robert Scott makes frequent reference to the increasing hunger and weight loss of the polar party, this despite the fact that they had full rations for the better part of their journey. We have discussed in previous modules the important function that food serves as a fuel to generate heat to warm the human body. More fuel is required in cold environments to keep the body warm. Add to that the huge workload that Scott and his men were performing on a daily basis in hauling heavily laden sledges, and the energy needs of their bodies were very high. It is now well understood that the amount of food energy the British team was supplied with on a daily basis, about 4,500 calories, was clearly insufficient to sustain them.

When you do not have enough caloric intake to sustain the work and temperature regulation, then energy stored in the body begins to be consumed – first fat reserves – followed by protein in the form of muscle. Both of these processes pose a problem to an explorer. Fat serves as insulation against the cold. Loss of fat stores will lead to increased caloric requirements to stay warm. In turn, when muscle is burned for energy this decreases strength – which slows an explorer down preventing their timely arrival. Both of these processes were doubtless occurring with Scott and his men as they struggled across the Antarctic Ice Cap.

Delving deeper into the British diet reveals a further major problem. The human body requires essential vitamins to function normally. Unfortunately knowledge of vitamins and their role in human metabolism was virtually non-existent in 1911. The first vitamin described, Vitamin A was discovered in 1909 the year before the expedition embarked for Antarctica.

Figure 2: The daily vitamin supplements taken by the South Pole Quest team members (Photo: Ewan Affleck)

It is now understood that the diet of the British expedition was seriously deficient in most vitamins, including vitamin C. Robert Scott was a captain in the British Navy whose sailors were popularly known as Limeys, a nickname believed to derive from the British practice of supplying sailors with limejuice in order to prevent scurvy. Although it was not understood in 1910 how certain foods prevented scurvy, certainly Scott shared the knowledge of navy compatriots that lime, and other citrus fruit could prevented the illness. Curiously, despite this knowledge Scott did not provide for this necessity in the expedition diet.

Amundsen's diet proved far more balanced largely because he followed the Inuit practice

of consuming raw, or only very lightly cooked meat in the fresh seal, penguin and dog he ate. Amundsen correctly guessed that all essential vitamins are represented in the traditional Inuit diet.

The British not only lacked vitamin C but also vitamin B groups. In addition they wintered over in Antarctica and consequently were deprived of sunlight, a major source of vitamin D for human beings. Recent studies of scientists overwintering in Antarctica found that a significant percentage of those not taking vitamin D supplementation become vitamin D deficient after only one winter.

Most historians agree that the British team was severely vitamin deficient and malnourished, which doubtless caused a variety of ailments contributing to decreased strength, capacity and an impaired immune system. The decreased immunity would have made them more subject to infections. The popular belief during the British expedition was that there was no risk of infection in Antarctica as there were no naturally occurring sources of viruses or bacteria. As Apsley Cherry-Garrard writes in The Worst Journey in the World, " There are no germs in the Antarctic, save for a few isolated specimens which almost certainly come down from civilization in the upper air currents."

Yet comments made by Wilson, a physician in his Polar journal would suggest the opposite.

> **"Evans, who cut his knuckle some days ago at the last depot has a lot of pus in it tonight" – Wilson, January 19th 1911**
>
> **"Evans' fingers suppurating. Nose very bad and rotten-looking" – Wilson, February 5th 1911**

Twelve days later Evans collapsed while man-hauling and fell unconscious. He died hours later without regaining consciousness. Wilson surmises that he died of a brain contusion, suggesting that he might have hit his head in a fall. Given the course of Evan's illness this seems unlikely. More probably Evans died of an overwhelming bacterial infection of his blood, known as sepsis. For indeed the British were at significant risk of infection.

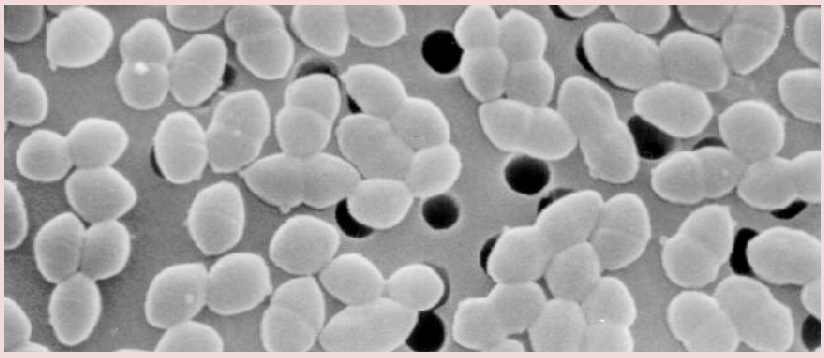


Figure 3:Scanning electron micrograph Enterococcus sp. Bacteria that normally colonize the human digestive tract, and can become pathogenic when their host becomes immunosuppressed (Source: the Centers for Disease Control and Prevention's Public Health Image Library).

For what the British did not understand was that although there are no native repositories of bacteria or virus in the interior of Antarctica, they themselves were a source of infection. The human gastrointestinal tract is home to a broad array of bacteria. A man suffering from malnutrition, vitamin depletion, sleep

deprivation and hypothermia will have less capacity to fight off infections. Evans had suppurating wounds on his hands and a "rotten" nose indicating that his wounds and frostbite had become infected. In his debilitated state and with no antibiotics to treat these infections (they had not yet been invented) it would only be a matter of time before the bacteria entered his blood and caused overwhelming sepsis. Add to this the fact that the men were unable to bathe themselves or properly wash their cooking and eating implements, and a fertile environment is created for the spread of infection.

According to the great British explorer Ranulph Fiennes diarrhea is common on expeditions. He explains that as it is impossible to wash pans out properly this causes bacteria build up. Indeed about half way through the South Pole Quest Expedition Ray developed a mercifully short gastroenteritis, the source of the infection doubtless being a team member.

Fortunately Ray, Richard and Kevin have benefitted from the knowledge accrued in the 98 years since the Scott and Amundsen expeditions of 1910 -11. They have a daily caloric intake of 7000 calories, take a daily regimen of vitamins, have equipment and clothing carefully designed to ensure warmth, and carry antibiotics to take in case of infection.

Figure 4: Cairn built over the bodies of Scott, Wilson and Bowers after their discovery in Nov 1911 (Source: Herbert Ponting).

Did You Know?

The bodies of Scott, Bowers & Wilson lay on the Ross Ice Shelf which moves north toward the Southern Ocean at a rate of about 500 meters a year, so they ultimately were committed to the sea.