

A century of learning about the physiological demands of Antarctica

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In late 1911, British Naval Captain Robert F. Scott led a team of five Englishmen on their quest to be the first to reach the South Pole. Upon arrival they learned they had been preceded by a Norwegian team, led by Roald Amundsen (which had arrived more than a month before). Scott and his companions died during their journey home as a result of natural causes induced by the extreme physiological stresses they experienced. A century later, our understanding of the effects stresses have on the body, and how it reacts to severe exercise, malnutrition, hypothermia, high altitude, and sleep deprivation has greatly increased. A century after Scott's expedition to the bottom of the Earth, a paper published in the current edition of *Physiological Reviews* recaps present-day knowledge and contrasts it with the relative ignorance about these issues around the turn of the 20th century.

The article is entitled, "100 Years Since Scott Reached the Pole: A Century of Learning About the Physiological Demands of Antarctica". Written by [physiologist](#) Lewis G. Halsey of the University of Roehampton and physician Mike A. Stroud of Southampton University Hospitals Trust, who has undertaken record breaking treks in Antarctica, the article examines whether Scott's party would have survived if they knew then what physiologists know now. They conclude that even with the advance of knowledge, Scott's party may have increased their chances of survival only slightly with small tweaks to the composition of their diets. Land journeys to the South Pole remain a tremendous risk that should only be attempted by the hardest of explorers. "Even with today's knowledge," the review authors say, "a repeat attempt at his

expedition would by no means be bound to succeed."

Extraordinary Physical Demands

The authors note that few places around the world are as physiologically demanding as Antarctica. Temperatures regularly dip to below 70 degrees Celsius, accompanied by fierce winds. Few [vertebrate species](#) live in this desolate environment, and those that do rarely venture away from the coast.

Halsey and Stroud explain that Antarctic explorers, including Scott's party, are extraordinarily ambitious when attempting a sustained journey through this physiologically challenging place. Because of humans' African ancestry, our species is far better suited to extreme heat than cold. Additionally, man-hauling—pulling sledges only with human power—is very physically arduous. Combined with the extreme cold, they say, it can be nearly impossible to carry the appropriate amount of food rations necessary to make it all the way to the South Pole and back. Thirdly, the polar plateau is at an elevation of about 2800 meters, combining explorers' other challenges with those of high elevation.

The Explorers' Mistakes

Studies in the past several decades have shown that hauling a sledge in the extreme cold uses an enormous number of calories—an average of 7,000 calories per day, with an extreme of 11,000 calories on days ascending the polar plateau. Such hard physical labor can lead to a phenomenon called exercise starvation, Halsey and Stroud say, caused by an inability to consume enough calories to replace the daily loss. This deficit depletes fat stores, increasing the chances of hypothermia, and makes it harder to efficiently pull a sledge, which increases the time explorers are exposed to extreme conditions.

Scott's party's rations probably peaked at 6,500 calories per day, the reviewers note, with diets heavy on carbohydrates and protein. However, modern knowledge suggests that rations heavy in fat would have been a better choice, since many more calories can be carried in the same weight of food.

Additionally, these early explorers had diets extraordinarily light on vitamin C. The reviewers note that only pony meat, obtained when the crew had to shoot their pack animals, had any significant measure of this important vitamin. Though the crew's doctor never diagnosed any member with scurvy, a disease caused by marked vitamin C deficiency, member Edgar Evans quite possibly had early signs of this condition. His poor wound healing was likely exacerbated by "fussy eating," Halsey and Stroud say, which included not eating raw pony meat, probably encouraging his early demise.

In addition to these two dietary problems, Scott's party probably also suffered from dehydration, chronic lack of sleep, and decreased oxygen availability due to elevation.

What Could They Have Done Differently?

However, beyond incorporating more fat and vitamin C-rich foods into their rations, and perhaps starting their journeys at higher body weights, little can be changed about how Scott's party would attempt such a journey today, according to Halsey and Stroud. The reviewers note that the return journey, upon which Scott's party succumbed, is the most physiologically challenging part of the land crossing to the [South Pole](#) and is just within reach for only the most capable of people. Even today, such a journey remains an enormous, potentially life-threatening trial.

According to the authors "technological advancements can now compensate certain limitations of the human condition; however, other

weaknesses remain as restricting factors whose capacities must be dangerously stretched if these feats are to be achieved."

More information: The article is available online at bit.ly/LmV69T

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