During the 1898-99 *Belgica* Expedition to the Antarctic, the famous polar explorer and expedition's physician, Frederick Cook, attempted to ward off the sadness and melancholy that plagued the crew by having them eat fresh seal and penguin meat; spend long hours walking on a path, known as the “madhouse promenade”, that encircled the ice-bound ship; and sit in front of a blazing fire. The fresh meat was intended to provide energy and reduce the risk of scurvy; the walking was intended to keep the crew physically active; and the fire both warmed the crew and perhaps exposed them to one of the earliest known forms of light therapy during the polar winter (1).

In many ways, the treatments prescribed by Cook for his crew anticipated the research described in the papers by Simpson and Pääkkönen found in this issue of the journal. Simpson's review of the research on energy dynamics and aerobic fitness in Antarctica underscores the importance of both physical activity and diet under conditions of prolonged exposure to cold temperatures (2). This research has consistently documented an increase in caloric intake and energy expenditure among polar expeditioners in the Antarctic. Although these changes in energy dynamics may be the result of increases in metabolic rate and thermogenesis, Simpson notes that cold-induced changes are less likely to occur when cold exposure is minimized by heated buildings and insulated clothing. Energy expenditure may thus be greatest during the austral summer when expeditioners spend more time outdoors in bulky clothing, whereas restricted outdoor activity and more time spent indoors in heated buildings during the austral winter may lead to reduced energy expenditure and the frequently observed increase in body weight and body fat.

Simpson concludes his review by noting that the majority of research conducted in the Antarctic is several decades old and that further research could help to elucidate the patterns of energy dynamics of modern Antarctic workers. Pääkkönen appears to have anticipated this call through a series of laboratory and field studies comprising...
her dissertation research at the University of Oulu (3). Her review of the literature on cold exposure and hormonal secretion found that while there were several studies of the effects of cold on thyroid hormones, there were no studies of cold and melatonin secretion, which occurs mainly at night when the body experiences a drop in core temperature. In a laboratory study, levels of serum thyrotropin were found to be inversely associated with core body temperature and directly associated with skin temperature. These findings are consistent with the thermogenesis associated with the Polar T3 Syndrome (4). However, a similar pattern was observed between core and skin temperature and melatonin, suggesting that this hormone is also cold sensitive in addition to being light sensitive.

Pääkkönen’s research also extends the work on energy dynamics by examining the behavioral correlates of these physiological changes (3). In one laboratory study, her team found that independent of season, exposure to cold and darkness combined was significantly associated with improvement in cognitive performance, which was attributed to increased arousal. In both the laboratory and in a field study of polar expediters at two Antarctic research stations, significant associations were found between levels of thyroid hormones and mood and cognitive performance consistent with the Polar T3 Syndrome. In addition, the laboratory study reported significant associations between serum melatonin and increased vigor but decreased accuracy on simple cognitive tasks.

Together, these two studies raise the following questions: 1) how much cold exposure is sufficient to induce an increase in metabolic rate and thermogenesis, 2) are the hormonal changes associated with these increases sufficient to produce decrements in mood and cognitive performance; 3) does the physiological adaptation that is initiated during the austral summer continue during the winter despite the restricted physical activity; and 4) is the physiological adaptation induced by cold, by darkness, or by the combination of the two? It is possible that the answer to these questions may be found within the Polar T3 Syndrome. Contrary to Simpson’s assertion that this constellation of physiological conditions is only relevant to Antarctic expeditioners, seasonal variations in thyroid function consistent with this syndrome have also been observed in residents of the Arctic (5). Among polar expeditioners, changes in thyroid function have been observed to occur shortly upon arrival to the Antarctic during the austral summer when temperatures are less cold and outdoor activity is greatest in frequency, intensity and duration (2). However, these changes in thyroid function persist during the austral winter, despite more time spent indoors and reduced physical activity (6). Pääkkönen’s research suggests that the reason this occurs may have more to do with the darkness of winter than to its cold temperatures. A recently published study by Palinkas and colleagues (6) has shown that thyroid hormones, like melatonin, are also light sensitive and can be influenced by even limited exposure to light therapy during the
winter. Future research in the Antarctic might therefore benefit by examining the role played by darkness, either independently or in combination with, the cold in energy dynamics and its behavioral correlates in the Antarctic. If coming out of the cold represents an important first step in improving the quality of life for humans in circumpolar regions, research on the relationship between energy dynamics and exposure to light may represent the next important step.

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