

Book review: *Psychrophiles – living below zero*

Coming in from the Cold

Permanently frozen environments host a wide diversity of life. A new text book shows how the inhabitants' strategies enable them to thrive successfully in their cold habitats and their important roles in the terrestrial biosphere.

In September 1991, German tourists made a spectacular discovery in South Tyrol. On a glacier they discovered a mummy. Since the glacier is located in the Ötztal Alps, the iceman was named "Ötzi". The corpse is about 5,000 years old and thus the oldest mummy ever found. Frozen all this time, it remained well-preserved for millennia.

"Ötzi" is the flash-frozen biography of a typical Neolithic man, a time traveller who has granted us a comprehensive insight into human life of the past for the first time in history. In many other places throughout the world the cryosphere holds new surprises ready. This portion of the Earth, where water is held in solid form as snow or ice, including vast areas of sea ice, freshwater ice, glaciers, ice sheets, snow cover and permafrost, is characterised by extremely harsh climatic conditions. However, an increasing number of recent studies of microbial ecology and the diversity of natural ice samples have shown that permanently frozen environments host a wide diversity of bacteria, araea, yeast, filamentous fungi, and algae. These psychrophiles have evolved a number of strategies to thrive successfully in cold

habitats, where they play important roles in nutrient cycling, such as nitrogen fixation, nitrification and denitrification, photosynthesis, sulphur oxidation and reduction, methanogenesis, and the transformation of organic compounds.

The new book *Psychrophiles – from Biodiversity to Biotechnology* from the editors Rosa Margesin, Franz Schinner, Jean-Claude Marx and Charles Gerday focusses on psychrophiles and describes, with cutting-edge knowledge, representative groups of cold-adapted micro-organisms as well as the habitats in which they live and the strategies they employ to cope with the cold. Its 462 pages are subdivided into four main sections. Section one covers the boundary conditions for microbial life at low temperatures. The reader gets an overview of the functional limits of biomolecules and active metabolism and is confronted with the problem that identifying the limits of life is often hampered by an inability to define its essential nature, rather than describing its properties (such as energy use, growth, response to stimuli and reproduction). The second chapter presents current knowledge about the detection, diversity, survival and activity of bacteria in snow and glacier ice. The extensive collection of different aspects of microbial diversity in cold ecosystems as well as the presented examples are very impressive, since the cryosphere is an in-

tegral part of the global climate system. The total number of bacterial cells in the Antarctic and Greenland ice sheets is estimated at 9.61×10^{25} , which corresponds to a significant carbon pool and represents a considerable reservoir of microbial diversity.

Over past years, scientific publications of cold-adapted micro-organisms have multiplied tenfold. In the genomic and proteomic field especially, studies of psychrophilic micro-organisms have strongly increased. How these genomic data from individual micro-organisms can provide an improved understanding of biological adaptations relevant to particular low temperature ecosystems and how these data operate as a powerful resource is described in the third chapter.

What's going on in your freezer?

The last chapter provides 100 pages of contribution to biotechnology. In addition, various possibilities for practical application are discussed in detail. Of particular interest are cold-adapted enzymes for their enhanced selectivity and high catalytic activity at low and moderate temperatures, as well as the inherent conformational plasticity of their enzymes, which may be particularly suited to organic synthesis applications used during the production of fine chemicals and pharmaceutical intermediates.

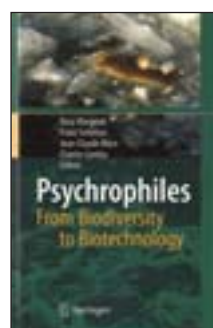
This excellent book, which covers almost all fields of "cold" microbiological research, matches current demands and trends in applied biotechnology. Furthermore, it is a valuable source of information to all those scientists interested in knowing what's going on in the lab's -80°C freezer.

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Rosa Margesin, Franz Schinner, Jean-Claude Marx & Charles Gerday (eds): *Psychrophiles: From Biodiversity to Biotechnology*. Springer, 2008, 462 pages, €213,95.



Photos (2): Ralph Schill



A mixture of bacteria and algae embedded in ice, found by the reviewer at a glacier's edge in the Ötztal alps.