Ancient Microbes in the Antarctic Ice

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Four kilometers under the vast sheet of ice that covers Antarctica lies a large freshwater lake, sealed under the ice and sequestered for the last 420,000 years. Vostok Lake, which lies below Russia's Vostok research station, is about the size of Lake Ontario, with a very deep rift that has sediment thought to be millions of years old. The life in this lake could represent organisms that have survived, virtually unchanged, over the eons. This is probably the most isolated lake on earth and may contain microorganisms never yet seen on this planet.

However, the lake itself has not yet been tapped. Over the last 25 years a vertical core of ice 3,623 meters long has been removed from beneath the research station. That core has revealed layers of ice that contain important information about the earth's past, including the composition of the atmosphere, the temperature at the time the ice formed, and microorganisms that represent time periods up to 200,000 years ago. Last year scientists stopped drilling as they approached the lake for fear of penetrating the water and contaminating the lake forever. This is an interesting dilemma: how can scientists study a lake that is important, in part, because it has not been touched for half a million years, without ruining it? One plan that was discussed last year at a meeting in St. Petersburg, Russia involves a thermal probe that can sterilize itself as it moves through the ice. As the probe descends, the ice freezes behind it forming a seal. As the probe enters the water it will release a "hydroblot" that will sample the lake. It may be several years before the sampling of the lake actually begins, since all the scientists involved want to be sure that the lake will not be harmed.

So far the research on the ice core has revealed many interesting facts about the past. There have been at least three ice ages followed by periods of slow warming. During all the periods in which the Antarctic temperatures were warm the atmosphere had relatively high concentrations of the greenhouse gases, carbon dioxide and methane. Of great concern is the fact the concentrations of greenhouse gases today appear to be higher than they were at any time during the formation of the ice core. The periods of relative warmth in Antarctica produced layers of ice that have the highest numbers of microbes, although different microbes have been found in different layers suggesting that differences in climate affected the types of microbes that thrived at different times.

Among the microbes in the ice core are representatives of bacteria, fungi, algae and diatoms. Most of these organisms have been studied by scanning electron microscopy, a technique that produces high-resolution pictures of microbial colonies and even cells. A number of microbes from the ice core have actually grown in the laboratory, proving that they are still alive. Most of the microbes that have been identified in the ice are actually part of small colonies. Many of these colonies have unusual shapes and have been given names such as "Mickey Mouse" and "Klingon." Some of the microbes look like fluffy cotton balls about 1 micron in diameter. The fact that they appear strange in the electron microscope does not mean that they are actually new organisms; it may be that their age and their habitat have resulted in an unusual form. Other microbes are readily identified as cyanobacteria, bacteria, fungi, spores, or diatoms. One unusual aspect of some of these microbes is that those recovered from certain layers of the ice core contain high concentrations of the metal antimony, which is not seen in modern microorganisms. Scientists are now attempting to extract DNA from microbes in the core to learn more about their genetic make-up.

The characterization of microbes from the Antarctic ice and eventually from Vostok Lake will take many years, but will surely provide important new information on a microbial world held dormant for the last million years.