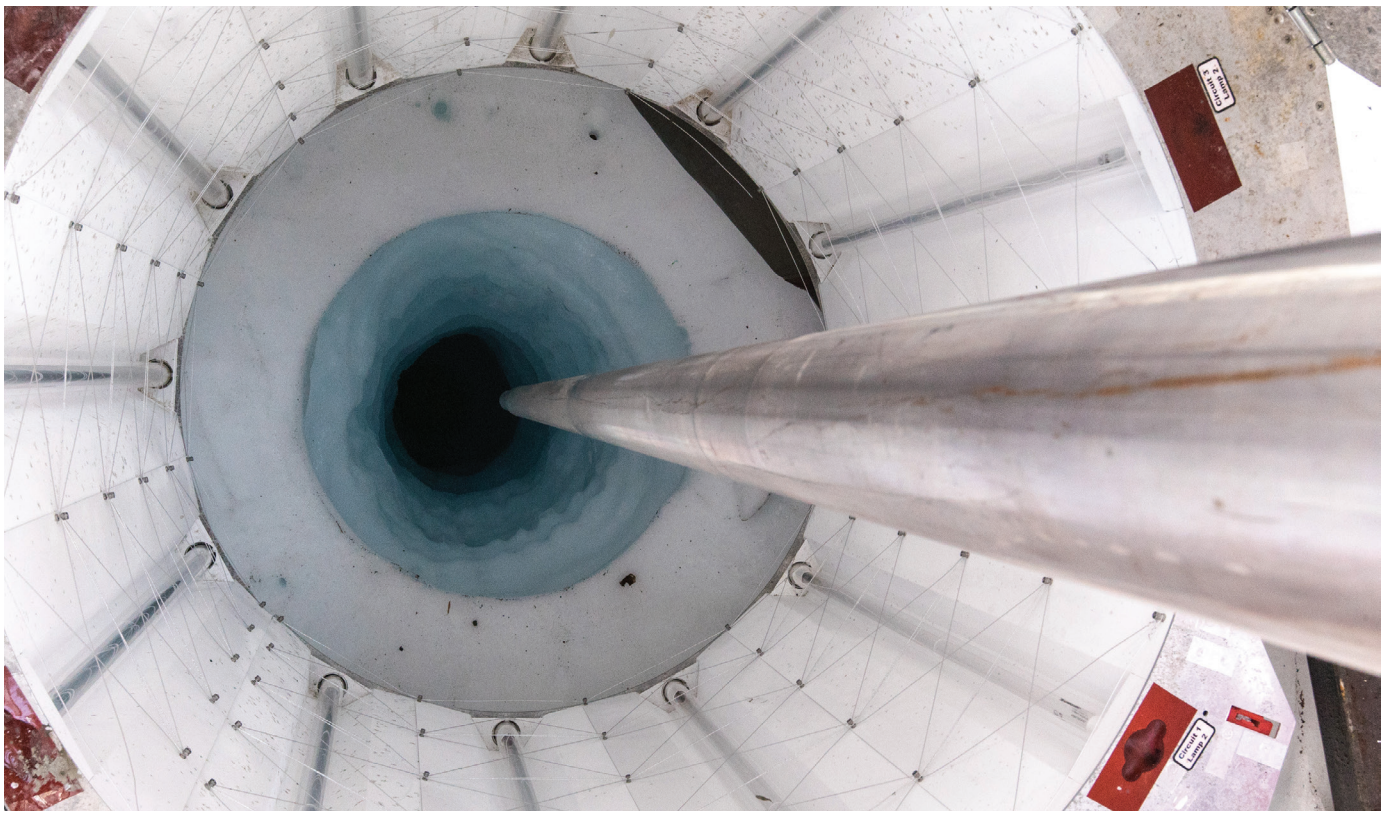
NEWS IN FOCUS

BILLY COLLINS/SALSA SCIENCE TEAM



Researchers used a hot-water drill to bore through a kilometre of ice, creating a portal with a diameter of just 60 centimetres.

EXCLUSIVE

Tiny animal carcasses found in buried Antarctic lake

Surprise discovery emerged from rare mission to drill into a lake buried by a kilometre of ice.

BY DOUGLAS FOX

Scientists drilling into a buried Antarctic lake 600 kilometres from the South Pole have found surprising signs of ancient life: the carcasses of tiny animals preserved under a kilometre of ice.

The crustaceans and tardigrades, or 'water bears' — all smaller than poppy seeds — were found in Subglacial Lake Mercer, a body of water that had lain undisturbed for thousands of years. Until now, humans had seen the lake only indirectly, through ice-penetrating radar and other remote-sensing techniques. But that changed on 26 December when researchers funded by the US National Science Foundation (NSF) succeeded in melting a narrow portal through the ice to the water below.

The discovery of the animals was "fully unexpected", says David Harwood, a palaeontologist at the University of Nebraska–Lincoln who is part of the expedition — known as SALSA (Subglacial Antarctic Lakes Scientific Access).

The intrigue deepened when biologists realized that at least some of the beasts from Lake Mercer were landlubbers. The eight-legged tardigrade resembles species known to inhabit damp soils. What looked like worms were actually the tendrils of a land-dwelling plant or fungus. And although the scientists couldn't rule out the possibility that the crustaceans had been ocean denizens, they might just as easily have come from small, ice-covered lakes.

The researchers now think that the creatures inhabited ponds and streams in the Transantarctic Mountains, roughly 50 kilometres ▶

from Lake Mercer, during brief warm periods in which the glaciers receded — either in the past 10,000 years, or 120,000 years ago. Later, as the climate cooled, ice smothered these oases of animal life. How the crustaceans and tardigrades reached Lake Mercer is still a matter of debate. Answers could come as the SALSA team tries to determine the age of the material using carbon dating, and attempts to sequence the creatures' DNA. Piecing together that history could reveal more about when, and how far, Antarctica's glaciers retreated millennia ago.

"This is really cool," says Slawek Tulaczyk, a glaciologist at the University of California, Santa Cruz, who is not part of the SALSA team. "It's definitely surprising." Tulaczyk, who has studied sediments retrieved from beneath glacial ice since the 1990s, says that nothing like that has ever been found before under the ice sheet. He was a co-leader of the only previous expedition to drill into a subglacial Antarctic lake, in 2013. Scientists found Lake Whillans, 50 kilometres from Lake Mercer, brimming with microbes, but saw no signs of higher life.

In the case of Lake Mercer, Tulaczyk says, rivers under the ice could have washed the animal carcasses and fungi from the mountains down to the lake. Or the creatures might have frozen onto the bottom of a glacier that dragged them out of the mountains as it advanced. In other words, the key to understanding a long-ago period of the Transantarctic Mountains' history could be buried at the bottom of a lake 50 kilometres away.

The saga began on 30 December, as SALSA scientists hoisted up an instrument that had measured the water temperature, and scraped grey-brown lake mud off it.

When Harwood slid the mud under a microscope, he found what he was hoping for: the shells of photosynthetic algae called diatoms that lived and died millions of years ago, when Antarctica was warmer and an ice-free ocean covered the area that is now Lake Mercer (see 'What lies beneath'). But he spotted something out of place among the glassy diatom shards: the shell of a shrimp-like crustacean with legs still attached. Its carapace was speckled and discoloured "like an old leaf that's been sitting on the ground for a season", Harwood says.

The palaeontologist soon found another fragment of a crustacean's carapace, this one a healthy amber hue, and still bristling with delicate hairs. "It looked really fresh," he says.

The idea that live animals might be flitting around in this dark water, sealed off from the outside world, seemed at once reasonable and outlandish. Samples of the lake's water contained at least 10,000 bacterial cells per millilitre, and enough oxygen to support aquatic animals. Harwood wondered whether small animals, originally from the ocean, might survive there by grazing on the bacteria.

"This is really cool. It's definitely surprising."

There were other reasons to suspect that sea animals could have got into Lake Mercer. Five thousand to ten thousand years ago, the ice sheet thinned briefly, allowing seawater to intrude under floating ice and reach what is now Lake Mercer. Any animals that came in with the ocean could have been trapped in pockets of water when the ice sheet thickened and once again came to rest like a lid on the sea floor.

Scientists know that something similar, although less extreme, has happened in other parts of Antarctica. The gradual uplift of the continent transformed shallow ocean bays into isolated lakes. And tiny marine crustaceans seem to have survived for thousands of years in some of those lakes, probably spending periods trapped under several metres of permanent ice.

Those ice-covered lakes still receive dim sunlight — giving crustaceans algae to eat. But subglacial lakes such as Mercer are tougher environments. No sunlight penetrates their frozen caps, so bacteria survive by gnawing on minerals and organic matter from plankton and diatoms that lived millions of years before, when the lake bed was part of an ocean. Most biologists do not believe that bacteria in these lakes can grow quickly enough to supply food for even the smallest aquatic animals.

John Priscu, a lake ecologist at Montana State University in Bozeman and the SALSA project's leader, was cautious but excited when *Nature* spoke to him by satellite phone on 3 January, several days after the animal carcasses were found. He worried that the critter remains his team had found in the lake might simply be contamination carried in by dirty equipment.

To rule that out, his team re-cleaned its gear and retrieved more mud. Harwood continued to find crustacean shells and organisms that vaguely resembled worms in the new mud. But neither he nor anyone else at the SALSA camp specialized in studying animals. A more reliable interpretation would have to wait.

POSTCARDS FROM THE PAST

On 8 January, Byron Adams — an animal ecologist at Brigham Young University in Provo, Utah, who is not part of the SALSA team — got his hands on a sample of the Lake Mercer mud. Adams was at McMurdo Station, an NSF base 900 kilometres northwest of the lake.

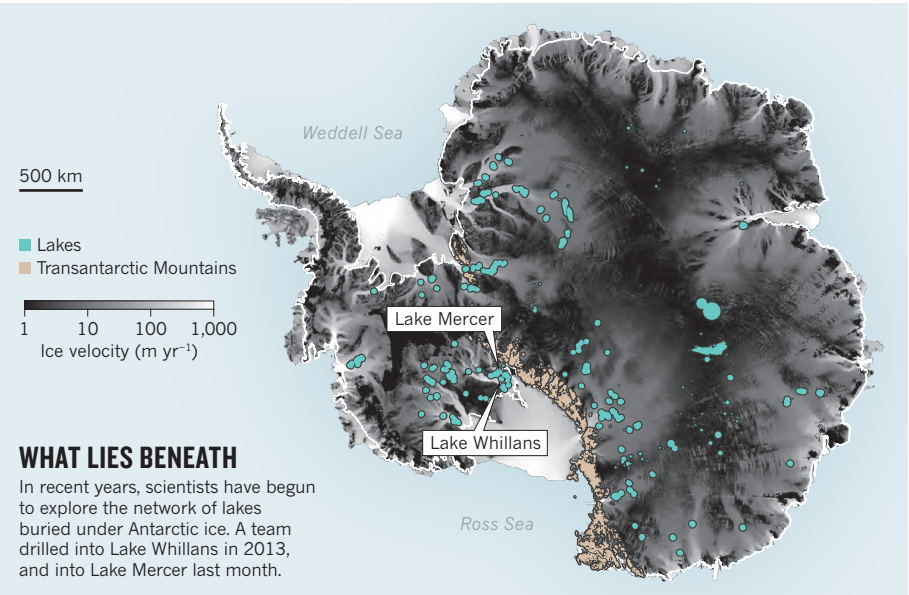
When he peered at the mud through his microscope, Adams recognized the worm-like objects as thread-like plants or fungi. He had seen those, and the crustaceans and tardigrades, both alive and dead, in a region of Antarctica called the Dry Valleys. He had also seen some of these creatures in the Transantarctic Mountains.

Adams was all but certain that the organisms had been dead for millennia by the time the scientists scooped them out of the lake. He thought that they had once lived in the Transantarctic Mountains and were transported down to Lake Mercer sometime after they died, anywhere from thousands to tens of thousands of years ago.

The remains are young compared to those of other ancient organisms found in the lake, such as the diatoms, which are thought to have lived millions of years ago. By determining when the organisms in Lake Mercer lived, and what kind of environment they required, biologists can learn something about Antarctica's past succession of warm and cold spells.

The SALSA scientists finished their work at Lake Mercer and sealed off the borehole on 5 January. Now the team will attempt to establish the age of the animal remains using radiocarbon dating, and try to sequence scraps of DNA from the carcasses, mud and lake water.

Adams hasn't completely let go of the possibility that some animal used to live under the ice, or still does. As he looked through the mud from Lake Mercer, he was hoping to see something alive. But it was a tiny sample, barely a teaspoon's worth. If it were possible to examine more of the muck, he says, "it's possible that you could still find things that are alive". ■



WHAT LIES BENEATH

In recent years, scientists have begun to explore the network of lakes buried under Antarctic ice. A team drilled into Lake Whillans in 2013, and into Lake Mercer last month.

SOURCES: SALSA; M. R. SIEGFRIED & H. A. FRICKER *ANN. GLACIOL.* **59**, 42–55 (2017)