

**THE YEAR IN SCIENCE**

# Discover

SCIENCE FOR THE CURIOUS

January/February 2014

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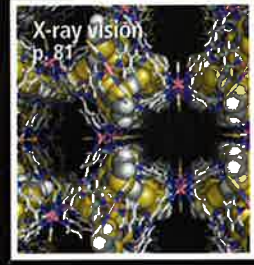
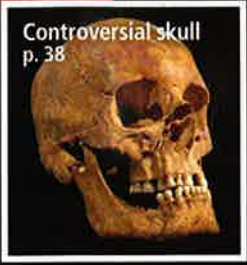
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## Seriously, Science?

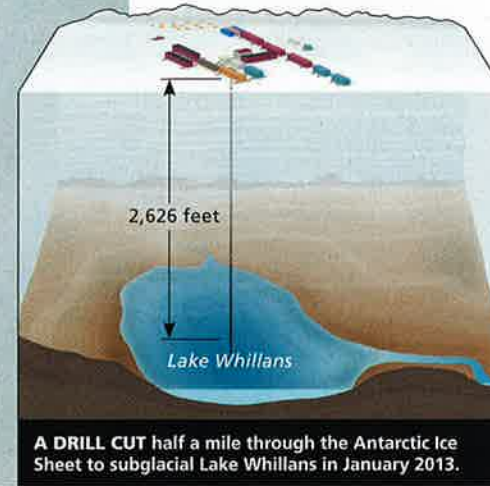
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**AN AERIAL VIEW** captures the drill site at subglacial Lake Whillans, Antarctica.



**A DRILL CUT** half a mile through the Antarctic Ice Sheet to subglacial Lake Whillans in January 2013.

# 13

## Mind Melds Made Real

➔ The Vulcan characters in *Star Trek* were able to perform "mind melds," wordlessly passing their thoughts into the brains of other people. This year saw three demonstrations of mind melding, although the information transmitted was simple motor commands.

In February, Duke University researchers reported they had linked the brains of two pairs of lab rats. When the first rat pressed one of two levers, either right or left, an electrode in its cortex picked up a signal. The researchers converted that signal to a set of pulses, which were transmitted over the Internet to an electrode implanted in the cortex of the second rat. That animal, already trained to differentiate between the two types of pulses, pressed one lever or another depending upon the signal it received. The receiving rat chose the correct lever 64 percent of the time — not perfect, but better than if the rat had flipped a coin.

Then Harvard University neuroscientists reported in April that people wired up to electroencephalography (EEG) devices had interfaced with rats. A person's brain waves were converted to an ultrasound pulse, which was transmitted to a specific section of the rat's motor cortex, causing its tail to swish.

And in August, University of Washington scientists announced the first successful brain-to-brain interface achieved in humans. Project leader Rajesh Rao wore an EEG cap while playing a video game. His associate, Andrea Stocco, connected by Internet across campus, positioned himself so that an electromagnetic pulsar touched the skull region above his left motor cortex. When Rao gave the command to "fire" through thought alone, his brain waves were picked up by a computer that then transmitted a pulse to Stocco. Upon receiving the signal, Stocco's hand flicked down on the keyboard.

One day such mind melds might help stroke patients recover through physical therapy. "If you could transmit motor commands" from a recovered patient to one still on the mend, "the rehab process could be speeded up," says Stocco. "It's futuristic. We don't know if it's possible." —JEFF WHEELWRIGHT



**MEETING OF MINDS:** Researcher Rajesh Rao (left) imagines firing a weapon in a video game. His neural signals are picked up by cap electrodes and transmitted via Internet to Andrea Stocco (right) across campus. Stocco's cap turns the signal into a magnetic pulse, causing him to press the "fire" button.

# The Search for Life Trapped Under Ice

➔ In January, climatologist Vladimir Lipenkov laid a disk of ice onto a light box in an Antarctic lab. The ice sparkled in a kaleidoscope of reds, blues and yellows as light scattered through trapped gas bubbles. His Russian scientific team had finally accomplished its elusive goal: retrieving the purest sample yet from Lake Vostok, an Antarctic body of water that has likely been locked beneath thousands of feet of ice for up to 15 million years. They are now testing that frozen water — which comes from a place Lipenkov says is unlike "any other environ-

ment on our planet" — for signs of life.

For years, teams of scientists in the Antarctic have plotted to drill into the continent's vast subglacial lakes, hoping to find life that has been isolated for eons. They have faced many challenges, including weather delays and equipment breakdowns. A drill finally penetrated through the ice to Vostok's waters in February 2012, and samples were obtained from water that froze on the drill. In March 2013, biologist Sergey Bulat of the Petersburg Nuclear Physics Institute announced that this ice hosted a new form of bacterial DNA, but his claim was disputed because the sample was contaminated with kerosene drilling fluid.

Lipenkov, on the same team but from the Arctic and Antarctic Research Institute in St. Petersburg, hopes the cleaner water obtained this year will settle the controversy. And ongoing analysis of the new sample's air bubbles could confirm a tantalizing theory: According to Lipenkov, Vostok may hold 50 times as much oxygen per gallon as seawater — a level toxic to most life. "If there is microbial life in the lake, it should be something unusual," says Lipenkov. High levels of oxygen likely accumulated in the lake over millions of years as glacial ice melted, injecting trapped gases from air bubbles into its waters.

### REAL LIFE

January 2013 also brought another milestone: An American team penetrated 2,600 feet of ice

to reach Lake Whillans, another subglacial lake in Antarctica. Scientists there were able to begin analyzing the lake water as soon as a sample was lifted out of the borehole. Within hours, they found bacterial cells, more than 450,000 per teaspoon. Deprived of sunlight, some of these bacteria may instead eat iron and sulfur minerals generated as glaciers grind up the bedrock, says Jill Mikucki, a microbiologist at the University of Tennessee in Knoxville who helped sample the lake.

Life forms in Whillans and Vostok could help researchers understand what kind of life might survive on other worlds. Subglacial lakes provide earthly analogs of ice-covered oceans deep beneath the surface of moons orbiting Jupiter and Saturn. By discovering what kind of life inhabits Antarctic lakes, John Priscu — a microbial ecologist at Montana State University in Bozeman who is analyzing samples from Lake Whillans — hopes to understand what sort of technology will be needed when probes are eventually sent to those frozen moons. In Lake Whillans, says Priscu, "we have an excellent model to draw a fairly strong hypothesis of what [life] we might find in another icy world." —DOUGLAS FOX

➔ Watch video of life under the ice and see more pictures of the Lake Whillans expedition at [DiscoverMagazine.com/Antarctica](http://DiscoverMagazine.com/Antarctica)



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