



SMITH BARNEY
citigroup

FOCUS.

It can see you through the peaks and valleys
on the road to your financial goals.

CLICK HERE TO LEARN MORE

Search news.nationalgeographic.com

[Sign up for our free e-mail newsletter](#)

Also see: [Today's Top Stories](#)

This Story
Science &
Technology

- [Related Sites &
Stories](#) ▼

- [E-mail this story](#)

Sponsored in part by



Supported by the
National Science
Foundation

Rust-Breathing Bacteria: Miracle Microbes?

John Roach

for National Geographic News

April 12, 2004

They breathe rust, clean up polluted groundwater, generate electricity, and may harbor clues to the origins of life. That's a lot for one family of microscopic bugs, but don't be surprised when Derek Lovley wows the world with another wonder from the *Geobacter* genus of bacteria.

"When we think we have hit the last of the big discoveries, something else comes along," said Lovley, a microbiologist at the University of Massachusetts, Amherst.

Read the full [story >>](#)



Magnetite (attracted to the magnet), the byproduct of Strain 121's respiration of iron oxide, offers a tell-tale sign of life in the left tube, compared to the uninoculated tube on the right.

Photograph courtesy of Derek Lovley, University of Massachusetts, Amherst/NSF

Funding for this Earth-systems science story was provided by the [National Science Foundation](#).

This special series of news stories is produced as a complement to *Pulse of the Planet*, a daily sound portrait of the Earth broadcast on radio.

Listen to this and other *Pulse of*



The microbes' metabolism is unique: They use metals to get energy from food in the same way humans use oxygen. In 1987 Lovley discovered *Geobacter metallireducens* in some iron-rich mud he scooped up from the Potomac River.

In the 17 years since that discovery, Lovley and his colleagues have found more than 30 species in the bug family, sequenced the genomes of several, and filled scientific journals with the details of new insights.

Lovley collaborates with scientists around the world, and his lab buzzes with more than 50 researchers. Most recently, Lovley and his colleagues sequenced the genome of a *Geobacter* species that can generate electricity and cleanup groundwater contaminated with uranium.

"Never underestimate the abilities of the microbial world," said Tim Magnuson, a microbiologist who worked in Lovley's lab before moving to Idaho State University in Pocatello.

[More News](#)

[Adventure & Exploration](#)

[Archaeology & Paleontology](#)

[Kids News](#)

[Animals & Nature](#)

[Science & Technology](#)

[People & Culture](#)

[The Environment](#)

[Travel](#)

[National Geographic Channel](#)

[Special Series](#)

[Emerging Explorers](#)

[TravelWatch](#)

[National Geographic Out There](#)

[Oceans](#)

[Mount Everest Expedition](#)

Magnuson believes that the *Geobacter* species and a number of other metal-reducing bacteria discovered since Lovley's seminal 1987 find are the just the beginning of what promises to be an exciting scientific journey into the world or microbes with unique metabolisms.

"The more we look, the more we discover. We have and will discover organisms that are not at all related to *Geobacter* but can carry out that kind of metabolism. It is a huge frontier."

Lovley Bugs

When Lovley embarked on his academic journey into the sciences, all he wanted to find was a good job in the outdoors. But as he pondered what made the world go around as an undergraduate biology major at the University of Connecticut in the 1970s, things began to change.

"It started to be apparent that these microorganisms account for a lot of biomass [living matter] on Earth and are big drivers for the environmental and ecological processes," Lovley said. "So I went to grad school and tried to learn microbiology."

After receiving his Ph.D. from Michigan State University in 1982, Lovley took a job with the United States Geological Survey studying how microorganisms affected groundwater in the Chesapeake Bay.

He knew that microorganisms could live in oxygen-deprived environments by processing things such as sulfate and methane. If they could do that, Lovely reasoned, they might also be able to make a living from iron. Which is why, in 1987, Lovely scooped up the iron-rich mud from the Potomac River just

SMITH BARNEY
citigroup

PATHWAYS TO
ACHIEVEMENT

WIN
a National
Geographic
Safari
in Southern
Africa
CLICK TO ENTER!

Sponsored by
SMITH BARNEY
citigroup

NATIONALGEOGRAPHIC.COM

downstream from Washington, D.C. Unbeknownst to him, the microbes therein would change his life.

Back in his lab, Lovley put the mud in a test tube, added some acetate—essentially vinegar, a favorite microbe food—and watched. Eventually, he noticed little black minerals collecting on the bottom of the tube amidst a sea of fluffy orange iron oxide, or rust.

"I put a magnet up to the side of the tube, and all the little pieces flew over to the side of the glass," Lovley said. "That was a 'Eureka!' moment."

The mud-dwelling microbes, which Lovley later named *Geobacter metallireducens*, obtained their energy by transferring electrons onto the rust. In the process, they turned the rust into magnetite.

Magnetite is the source of most of the magnetic material deposited on Earth some two billion years ago. Lovley and his colleagues concluded in a 1987 paper published in *Nature* that the microbes may have been responsible for most of these early magnetite deposits.

Microbes in Action

Since *Geobacter metallireducens* was discovered, Lovley and his colleagues have tried to figure out how to take advantage of this unique microbial metabolism, from cleaning up contaminated groundwater to generating electricity.

Magnuson, the Idaho State University microbiologist, believes that the ability of microorganisms like *Geobacter* to clean up groundwater may be of

More Information

Our Top News

Get the latest news of exploration, discovery, science, animals, nature, travel, adventure, and more—updated every weekday by the National Geographic online newsroom:

National Geographic News: Our front page, for the latest news.
[Go to News >>](#)

National Geographic Television Stories:
National Geographic Ultimate Explorer: Weekly news show presented by Lisa Ling, airing in the U.S. on MSNBC and the National Geographic Channel.
[Go to Ultimate Explorer News >>](#)

BirdWatcher: National Geographic's online news service about birds and birding.
[Go to BirdWatcher >>](#)

Dinosaurs: Latest finds reported by *National Geographic News*
[Go to Dinosaurs >>](#)

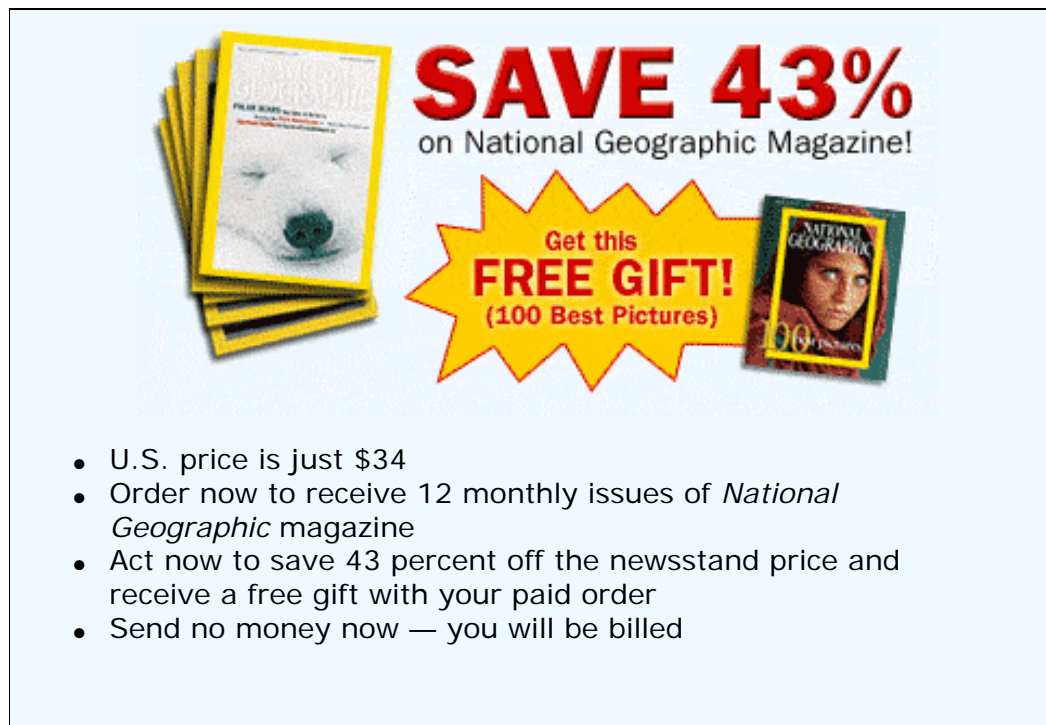
particular use to humans in the coming decades, as world populations are predicted to experience a water crisis.

He envisions using microbes not only to decontaminate water supplies but to protect them until human consumption.

"Using *Geobacter* to protect and maintain the quality of these aquifers might be a viable solution, seeing as we are going to run into water-quality issues," he said.

Lovley and his colleagues are not yet developing Magnuson's proposed superefficient water filters, but they are actively developing a method to remove uranium from billions of gallons of contaminated groundwater.

[\(Related story: "Microorganism Cleans Up Toxic Groundwater".\)](#)



The advertisement features a stack of National Geographic magazines on the left, with the top cover showing a close-up of a polar bear's face. In the center, the text reads "SAVE 43% on National Geographic Magazine!". To the right of this text is a yellow starburst graphic that says "Get this FREE GIFT! (100 Best Pictures)". Further right is a smaller image of a National Geographic magazine cover featuring a woman's face.

- U.S. price is just \$34
- Order now to receive 12 monthly issues of *National Geographic* magazine
- Act now to save 43 percent off the newsstand price and receive a free gift with your paid order
- Send no money now — you will be billed

Everest: Adventures, drama, science, and geography about the world's highest mountain.

[Go to Everest >>](#)

Human Origins: Who are we, where did we come from? Read the latest theories.

[Go to Human Origins >>](#)

Iraq: News and features about the geography, nature, and people impacted by the war.

[Go to Iraq >>](#)

Oceans: Science, geography, and creatures of the sea.

[Go to Oceans >>](#)

Research, Conservation, and Exploration: News from National Geographic in the field.

[Go to Research >>](#)

Sharks: Science and stories

[Go to Sharks >>](#)

Snakes: Science and stories

[Go to Snakes >>](#)

TravelWatch: *National Geographic Traveler* magazine's regular column

Canadian price \$38 (C\$59), and includes GST. Sales tax will be added where applicable. Savings based on annual U.S. newsstand price of \$59.40. While all dues support National Geographic's mission of expanding geographic knowledge, 90 percent is designated for the magazine subscription, and no portion should be considered a charitable contribution.

Related Stories

- [Microorganism Cleans Up Toxic Groundwater](#)
- [Group of Microbes Change Dissolved Gold to Solid](#)
- [Microbial Colony in U.S. Suggests Life Could Live on Mars](#)
- [Bacteria May Be Star Player in Toxic Cleanup](#)
- [Deciphering the "Bugs" in Human Intestines](#)

Related Websites

- [Geobacter Project](#)
- [Pulse of the Planet](#)

Comments? Contact the [news desk](#).

about sustainable tourism and destination stewardship, produced by geotourism editor Jonathan B. Tourtellot.

[Go to TravelWatch >>](#)

National Geographic News Alerts

Register to receive e-mail headlines from National Geographic News. [Click here](#) to sign up. (We will not share your personal information, and there is no charge for this service. View our [privacy policy](#).)

More to Explore in the World of National Geographic

National Geographic Channel

[Streaming Video News Stories >>](#)

[Online News Stories >>](#)

National Geographic Magazine Online:

[This Month's Features and Photos >>](#)

National Geographic Traveler Magazine:

[Latest Best Travel Deals and More >>](#)

National Geographic Adventure Magazine:

[Excerpts and More from the Latest Issue >>](#)

National Geographic Kids
Magazine:

[Online News, Games, Polls,
and More from the Current
Issue >>](#)

National Geographic
Explorer Classroom
Magazine:

[Articles, Games, and More
from the Current Issue >>](#)

**Shop National
Geographic**

[Check Out Our Books,
DVDs, Toys, and More >>](#)

[News Home](#)

[Write the Editor](#) | [Masthead](#) | [nationalgeographic.com E-mail Updates](#) | [Press Room](#) | [Privacy Policy](#)

More to see at [nationalgeographic.com](#)

© 2004 National Geographic Society. All rights reserved.