

**In Brief**, continued from page 24

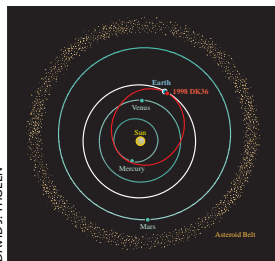
### Asteroids on the Inside

Scientists have long looked far afield for asteroids. Now they have found one circling the sun inside the earth's orbit.

David J. Tholen and graduate student Robert Whiteley of the University of Hawaii spotted the object, named 1998 DK36, using a specialized cam-

era on the 2.24-meter telescope atop Mauna Kea in February. Preliminary calculations show that nearly 1.3 million kilometers always separate the earth from the asteroid as it passes through the daytime sky—good news, given that DK36 appears to be 40 meters in diameter. The asteroid that devastated the Tunguska region of Siberia in 1908 was about the same size.

DAVID J. THOLEN



### Phone Home

Still no sign of extraterrestrial life, according to SERENDIP III, the most sensitive sky survey to date. The search, led by Stuart C. Bowyer of the University of California at Berkeley, used a detector mounted on the world's largest radio telescope in Arecibo, Puerto Rico. Starting in 1992, the instrument analyzed 500 trillion signals, looking in a radio band centered on a wavelength of 70 centimeters—a region typically reserved for communications. No luck. But the team hasn't given up hope. SERENDIP IV, now in the works, should be 40 times more sensitive than its predecessor; it will simultaneously examine 168 million frequency channels every 1.7 seconds.

### Just Add Water

The wonders of modern science never cease. Ryuzo Yanagimachi and colleagues at the University of Hawaii have produced live mice from dead sperm. The workers added water back to freeze-dried sperm and injected it into mouse eggs using a procedure called intracytoplasmic sperm injection (ICSI). They found that freeze-drying had preserved the genetic information in the sperm well enough to regenerate healthy mice. The tactic is expected to be an improvement on previous methods of storing genetic information from mice used in research. —Kristin Leutwyler

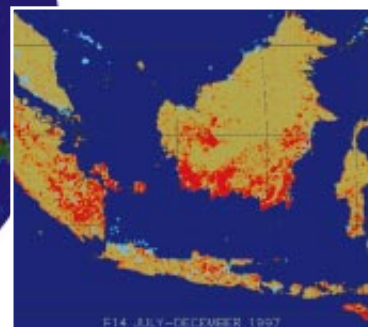
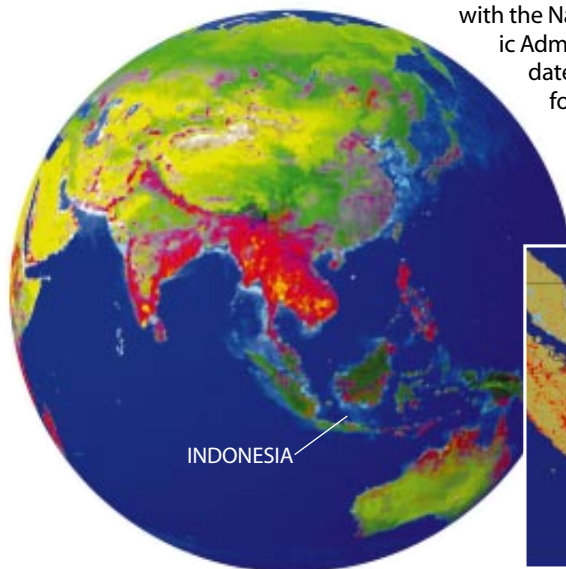
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## ECOLOGY

### A World Aflame

Every year fire scorches some 71 million hectares (175 million acres) of forest and grassland. In 1997 drought brought on by El Niño exacerbated fires, many of which were deliberately set, the world over. In Indonesia, for instance, the devastation was particularly extreme because of the worst drought the country had seen in 50 years. According to the World Wildlife Fund's 1997 report *The Year the World Caught Fire*, Indonesia lost two million hectares to flame. A satellite image from last year shows the extent of the damage (red in image at right). A composite of data from 1992 to 1995 (at left) shows fires in the region in red and purple. Fires this year in the Amazon, Mexico, Florida and elsewhere promise to make 1998 another record year. The National Aeronautics and Space Administration has teamed up

with the National Oceanic and Atmospheric Administration to provide weekly updates on fires around the world. Information can be found at [http://modarch.gsfc.nasa.gov/fire\\_atlas/fires.html](http://modarch.gsfc.nasa.gov/fire_atlas/fires.html) on the World Wide Web. —Sasha Nemecek



SIMMONS/STOCKLI NASA/Goddard EOS AM-1 Visualization Team (global); DEFENSE METEOROLOGICAL SATELLITE PROGRAM (map)

## BIOLOGY

### RIVER OF VITRIOL

*The Rio Tinto in Spain abounds in acid—and unexpected organisms*

Against the dark stand of pine trees, the waters of the Rio Tinto appear even more vividly red than usual. Here, near its headwaters in southwest Spain, the strong smell of sulfur overwhelms even the fragrance of the dense forest. The crimson river—in-famous for its pH of two, about that of sulfuric acid, and for its high concentration of heavy metals—seems dead, a polluted wasteland and a reminder of the ecological devastation mining can entail.

Yet the remarkable Rio Tinto is hardly lifeless, as scientists have discovered in the past several years. Even in parts of the river where the pH falls below two—and the water is painful to touch—green

patches of algae and masses of filamentous fungi abound. "Each time we go there we find something new," says Ricardo Amils, director of the laboratory of applied microbiology at the Center for Molecular Biology at the Autonomous University in Madrid, who discovered the river's wild ecosystem in 1990. "We have now collected about 1,300 forms of life living here, including bacteria, yeast, fungi, algae and protists. But the real number is surely much higher."

Before Amils and his colleagues studied the 93-kilometer (58-mile) river, it was assumed that the acidic waters were purely the result of the Rio Tinto copper mine, one of the world's largest and oldest. The microbiologist now believes that industry—in particular, the sulfuric acid associated with copper mining and the discarded metal tailings—is not entirely responsible for the condition of the water. He has found that historical records refer to the river's long-standing acidity. Amils postulates that the river's strange chemistry led its first miners—the Tar-

tessians in 3000 B.C.—to investigate the banks for deposits. Soon after, the Romans, who extracted great quantities of gold and silver, called the river *Urbero*, Phoenician for “river of fire.” And the Arab name for it was “river of sulfuric acid.”

Amils’s argument is bolstered by other observations. The low pH and high concentration of metals—including iron, arsenic, copper, cadmium and nickel—is consistent throughout the entire river, becoming less acidic where the Rio Tinto meets the Atlantic Ocean. Typically, waterways that receive mining waste have acidic concentrations only near the source of pollution. Strong rains also cannot seem to reduce the acidity of the river.

To explain how this amazing condition came about—and is perpetuated—the researchers point to what they have learned about the species found there. They are convinced that the extreme conditions are produced by bacteria. *Thiobacillus ferrooxidans*, for example, is abundant in the river. This microorganism is capable of oxidizing sulfur and iron—thereby giving the Rio Tinto its red hue and name. Amils and his colleagues recently documented the presence of another bacterium, *Leptospirillum ferrooxidans*, which feeds exclusively on iron and is even more abundant than *T. ferroxi-*

*dans*. Evidence of its corrosive capability sits on the banks, where abandoned railroad cars were flooded with river water. In service just 15 years ago, these cars now appear as skeletons, devoured by the Rio Tinto microbes. “These bacteria are a kind of metallic piranha,” Amils says.

Other bacteria—not as well under-

stood for the time being—appear to feed on the immense deposits of metal sulfides, creating the sulfuric acid that, together with oxidized iron, produces the very conditions that lead to heavy metals in solution.

The most abundant organisms in the river appear to be algae, which produce oxygen in champagnelike bubbles that the researchers watch float to the surface. How algae work in this acid inferno, however, has the scientists mystified. “We need more research to explain how algae can collect light and produce organic matter and oxygen in such conditions,” Amils notes.

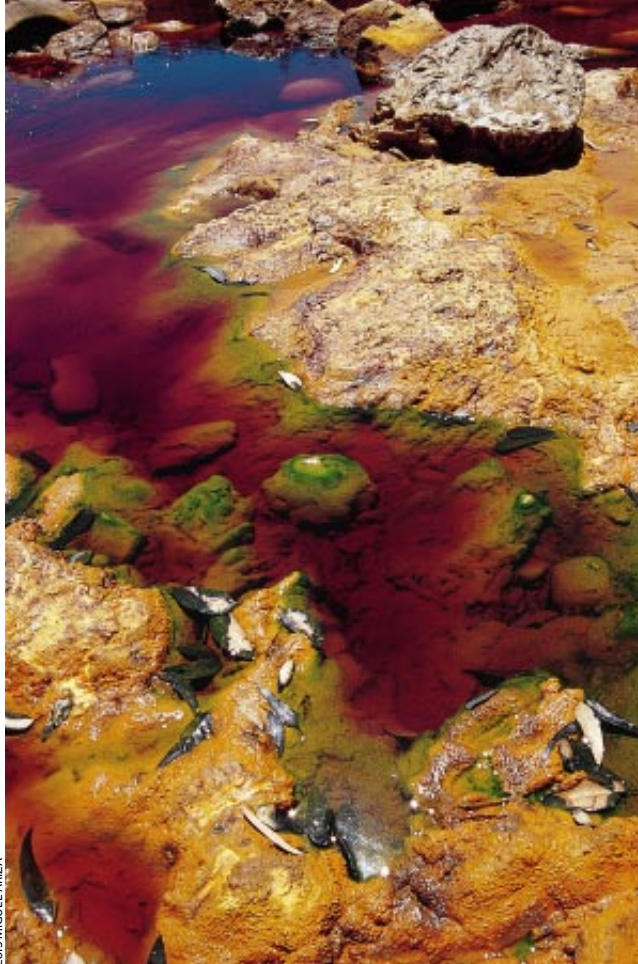
One possibility is that some of the Rio Tinto algae and fungi have established certain symbiotic associations. “Through evolution we can see that symbionts can thrive successfully in a habitat that otherwise would be inhospitable,” explains Lynn Margulis, a biologist at the University of Massachusetts at Amherst. “Long-term associ-

ation can create new species through symbiogenesis.”

Understanding this symbiosis—if it is present in the Rio Tinto—could help Margulis, Amils and others understand the development of early life on the earth. “In my view, the river is a better model for the life that flourished in the Proterozoic, with an abundance of oxygen and algae, than it is for the anoxic Archean eon,” Margulis says. During the Proterozoic—between 2.5 billion and 600 million years ago—anaerobic and aerobic organisms survived in extreme conditions, perhaps assisting one another.

The Rio Tinto could also offer further insights. Perhaps Amils and his crew are seeing the kind of life that thrived on Mars millions of years ago. The versatility of these bacteria—particularly those that work in anoxic conditions on mineral substrates such as iron sulfides—make them good candidates for a model of extraterrestrial life. “I cannot say that Martians were like this, but Mars would be a perfect bite for many bacteria living here, that is for sure,” Amils says.

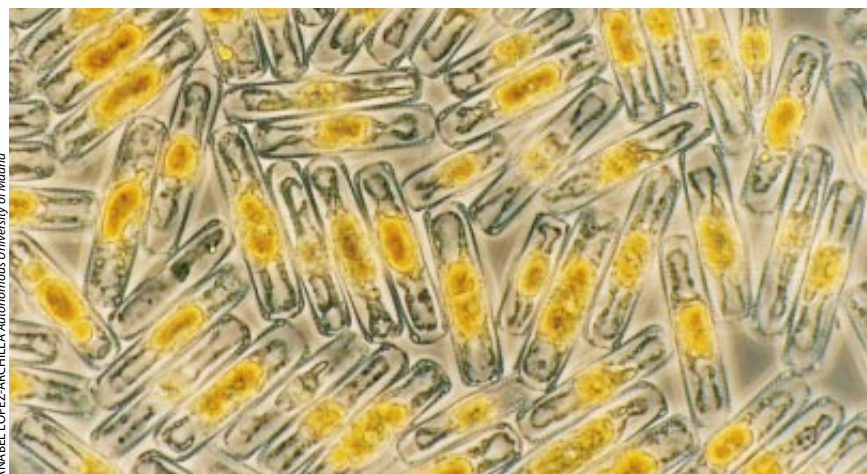
—Luis Miguel Ariza in Madrid



LUIS MIGUEL ARIZA

#### RED WATERS

*and high acidity of the Rio Tinto do not deter a wealth of microscopic life, including blooms of algae.*



ANABEL LÓPEZ-ARCHILLA Autonomous University of Madrid

#### DIATOMS

*from the Rio Tinto are among the 1,300 species found to live there.*