BIOTECHNOLOGY

Yellowstone Managers Stake a Claim on Hot-Springs Microbes

YELLOWSTONE NATIONAL PARK, WYOMING—National parks like Yellowstone may themselves be national treasures, but the government now wants to convert some of their natural riches into working capital and knowledge that will benefit the park, the public, and science. In a meeting here last month that drew representatives of such big biotechnology and pharmaceutical names as Promega, New England Biolabs, Novo Nordisk, Eli Lilly, and DuPont, Yellowstone National Park managers said they intend to seek a share of commercial profits generated by hot-water microbes, or thermophiles, incubated by the park's bubbling hot springs.

The meeting, to discuss the latest research on thermophiles (see box), marked the latest step in the National Park Service's efforts to see that taxpayers reap dividends on their investment in maintaining the park. Without such a payback, said John Varley, Yellowstone's resource management chief, microbe prospecting might assume the image of public lands mining, logging, and grazing as "yet another giant rip-off of the people who have been paying their tax money to support this park" since it was established in 1872.

Large sums could be at stake. Take Taq polymerase, the driving ingredient of the polymerase chain reaction (PCR). Taq gets its name from its parent bacterium *Thermus aquaticus*, identified in 1965 in a 73-degree Celsius Yellowstone pool. Two decades later, its enzyme proved useful in high-heat PCR cycles that multiply a few DNA strands into millions—and earns millions of dollars for Swiss drug giant Hoffmann-La Roche, which owns patents on PCR and Taq polymerase. Other companies are now searching out newer, better thermophiles in springs where 99.9% of the microscopic inhabitants may remain unknown. The talents of those few found so far run from churning out sturdy enzymes that strip old paint off airplane wings to erasing byproducts from gold ore in a high-heat reaction that would weaken other bacteria.

Park managers made their first move earlier this year, when federal attorneys interpreted the laws governing research in national parks to mean that park microorganisms remain government property even after they are carted around the globe and cultured in the lab. Park collecting permits now sanction commercial development of Yellowstone microbial strains, but only with an agreement that cuts the government in on any revenue. (Purely academic researchers won't have to pay anything.) While no rate structure has been set, Varley said, options run from fees or royalties to a request that companies donate 1% of profits from Yellowstone discoveries back to the park.

Varley's suggestions drew a mixed response. David H. Gelfand, a Roche scientist who first applied the Yellowstone enzyme to PCR when he worked for Cetus Corp., said that Taq polymerase was a one-time windfall the government is now unfairly using as a "whipping boy." Biotech companies already hand over plenty of cash to Uncle Sam through income taxes, he said, and the greatest public benefit comes through knowledge of the microbial world.

Taq polymerase is a whipping boy, Varley responded, because it's a prime example of the value of preserving national parks. If a profit-sharing mandate puts collectors off, he said: "Go somewhere else. You're not going to find what you find here." Indeed, Yellowstone's 10,000 or more hot-water features may be the most diverse collection of springs anywhere. Micro-organism prospectors argue, however, that they do not harm the resource. "I don't come with a backhoe," said Jeff Braman of Stratagene, a California biotech company. "I'm not prospecting in the same way the strip miners are prospecting for ore."

Many at the meeting were eager to back the park, financially or otherwise, although they did not agree how. Jay Short, chief technology officer of Recombinant BioCatalysis Inc., said the environment and its prized microbes will be protected only if industry shows they have value. Roche has, in fact, offered donations to Yellowstone, but officials, previously unsure of their legal standing, turned them down. Now the park is on the brink of closing facilities due to short budgets, and Yellowstone Superintendent Michael Finley said: "We'll take money from anyone who wants to give it to us."

–Michael Milstein

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A Glimpse of Early Life Forms

M. MILSTEIN

Microbe hunters. Susan Barns and Siegfried Burggraf prospecting in Obsidian Pool.

Fizzling and bubbling furiously, spitting bursts of steam and black sand, Obsidian Pool looks a bit primordial. That's fitting: The oblong hot spring, in a backcountry nook of Yellowstone National Park, contains living relics of Earth's early life, if Indiana University microbiologist Norman R. Pace is right. Pace announced at a meeting in Yellowstone last month (see main text) that he and his colleagues have found two microbes from Obsidian Pool and one from another Yellowstone spring that appeared early in the evolution of life on Earth and have undergone relatively little change since then.

Discovered by Susan M. Barns of Pace's lab and Anna-Louise Reysenbach, a colleague of Pace's now at Rutgers University, the microbes belong to the domain Archaea, which includes microscopic organisms distinctly different from true bacteria, or eubacteria. But their gene sequences are so different from those of familiar archaeal species that Pace proposed they be classified in a new, third kingdom within the Archaea. He and his colleagues have named the proposed new kingdom Korarchaeota, using the Greek word for youth.

A computer-generated evolutionary tree based on their genetic variations suggests "they are the most primitive organisms so far discovered," said Pace. "They have the shortest [branch] from the common ancestor of all life." Montana State University microbiologist David M. Ward, who also works in Yellowstone and is familiar with the data, says, "The idea that these may be close relatives of the primordial archaea seems like a good one."

To learn more about these primitive organisms, microbiologist Siegfried Burggraf has replicated Obsidian Pool's chemistry in Karl O. Stetter's lab at the University of Regensburg in Germany, in hopes of growing enough of them to study. If the microbes cooperate, Barns says, "we may get some idea of what the common ancestor was like."

–M.M.