NASA Astrobiologist Identifies New 'Extreme' Life Form

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The end of a scientific journey -- started five years ago in a frozen tunnel deep below the Alaska tundra -- came in January for NASA astrobiologist Dr. Richard Hoover.
It proved a long, arduous journey for Hoover and his colleagues to complete the process of identifying a unique new life form. For the life form itself, a new bacterium dubbed Carnobacterium pleistocenium, the journey to discovery took much longer -- some 32,000 years.

The bacterium -- the first fully described, validated species ever found alive in ancient ice -- is NASA's latest discovery of an "extremophile." Extremophiles are hardy life forms that exist and flourish in conditions hostile to most known organisms, from the potentially toxic chemical levels of salt-choked lakes and alkaline deserts to the extreme heat of deep-sea volcanoes. NASA and its partner organizations study the potential for life in such extreme zones to help prepare robotic probes and, eventually, human explorers to search other worlds for signs of life.

This search is a key element of the Vision for Space Exploration, the ambitious effort to return Americans to the Moon and to conduct robotic and human exploration of Mars and other worlds in our Solar System, which might conceal life forms unimaginable to us -- thriving in conditions few Earth species could tolerate.

In 1999 and 2000, Hoover, a researcher at NASA's Marshall Space Flight Center in Huntsville, Ala., time-traveled back to the Pleistocene via the U.S. Army's Cold Regions Research and Engineering Laboratory,

or "CRREL tunnel." The research site near Fox, Alaska, just north of Fairbanks, was carved by the Army Corps of Engineers in the mid-1960s to enable geologists and other scientists to study permafrost -- the mix of permanently frozen ice, soil and rock -- in preparation for construction in the early 1970s of the Trans-Alaska Oil Pipeline.

Hoover initially went to the CRREL tunnel in search of "psychrophiles" -- organisms that live only at extremely low temperatures. Hoover initially suspected the samples he collected there, from ice more than 30 millennia old, were diatoms, or microscopic, golden-brown algae. But closer study at the nearby University of Alaska revealed not diatoms but something much more interesting -- an assortment of bacterial cells, many of which came to life as soon as the ice thawed.

Hoover and his collaborator, microbiologist Dr. Elena Pikuta of the University of Alabama in Huntsville, studied the samples at the National Space Science and Technology Center, the research consortium operated by NASA and Alabama universities. They found the samples contained anaerobic bacteria that grew on sugars and proteins in total absence of oxygen. The bacteria had frozen near the end of the Pleistocene Age, which extended from about 1.8 million years ago to just 11,000 years ago -- and earned the new organism its name.

Further testing revealed the organism was not a psychrophile at all, but a "psychrotolerant" -- not an organism that thrives only at very cold temperatures, but one capable of enduring deep cold that resumes normal activity when temperatures rise.

Hoover, Pikuta and their collaborators -- Damien Marsic of the University of Alabama in Huntsville, Professor Asim Bej of the University of Alabama at Birmingham and Dr. Jane Tang and Dr. Paul Krader of the American Type Culture Collection in Manassas, Va. -- published their discovery in the January issue of the International Journal

of Systematic and Evolutionary Microbiology. The bimonthly periodical, the official journal of record for new bacterial species, is produced by the Society for General Microbiology.

"Astrobiologists ask, 'Is life strictly terrestrial in origin, or is it a cosmic imperative, an undeniable, universal biological truth?' That possibility is central to our desire to explore the universe," Hoover said. "The existence of microorganisms in these harsh environments suggests -- but does not promise -- that we might one day discover similar life forms in the glaciers or permafrost of Mars or in the ice crust and oceans of Jupiter's moon Europa."

Although many people think of bacteria merely as a cause of illness or decay, Hoover and Pikuta are quick to defend the organisms, which they call highly advanced marvels of natural engineering. There are approximately 7,000 validly described species of bacteria, though far more are surmised to exist. The vast majority are harmless to humans. Only a very few -- less than 1 percent of all known species -- are dangerous. And many, Hoover noted, are valuable to human life, aiding us in numerous ways: culturing wine, dairy products and other foods; assisting in the biological extraction of gold and other precious metals from ore wastes; and aiding production of valuable proteins and life-saving drugs.

Carnobacterium pleistocenium could even offer new medical breakthroughs. "The enzymes and proteins it possesses, which give it the ability to spring to life after such long periods of dormancy, might hold the key to long-term, cryogenic -- or very low temperature -- storage of living cells, tissues and perhaps even complex life forms," Hoover said.

"Life is far more diverse, and far more resistant to conditions we consider hostile, than was thought possible only a decade or two ago," he adds. "Studying these organisms helps us understand that life may be far

more widespread in the cosmos than we previously imagined."

Living cultures of the new bacterium have been deposited in the American Type Culture Collection, in the Microbial Collection at the Pasteur Institute in Paris, and in the Japan Collection of Microorganisms in Saitama, Japan.

Source: NASA