From Outer Space to Inner Earth

Microbe Hunter Digs for Clues to Exotic Life in Mono Lake

David Perlman, San Francisco Chronicle Science Editor

Brine shrimp dart in the shallows along this weirdly tower-studded lakeshore, and clouds of alkali flies darken patches of the lake's salty surface. But Richard Hoover, a onetime solar physicist, collects only a few of those mundane creatures.

He is on the hunt for stranger prey.

Glass tubes cram his pockets as he gathers samples of muck from the lake's rough and rubbled bottom. Some of the samples, he hopes, will reveal the presence of "extremophiles," microbes that inhabit some of the most bizarre environments on Earth.

An infinite variety of life forms has been found in environments that more familiar organisms can't tolerate. Hoover hopes that some of these places just might resemble the extreme environments where life may once have thrived on other worlds in our solar system.

Perhaps, Hoover muses, extremophiles might thrive beyond Earth even now.

The space probes that examine red-hued Mars, or giant Jupiter's icy moons Europa and Callisto, or ringed Saturn's smog-shrouded satellite Titan, are spurred by the possibility that life may well be far more widespread in the solar system—or at least may once have existed in extreme environments other than on Earth alone.

But what might life be like in such alien places? Some of their environments are much too hot or cold to support the normal life of Earth's surface and its waters. Some are much too acid or alkaline, and the atmosphere on some may be much too dense or sparse for normal Earthly organisms.

Yet on Earth, such extreme environmental niches exist, and life inhabits them: in the boiling hot springs and geysers of Yellowstone; in ice layers thousands of feet beneath the surface of Antarctica; in the deepest metal mines of Asia; and in the muck of Mono Lake, where not a single fish can withstand the water's heavy burden of salt and alkalinity.

Hauling "Beautiful Creatures"

At Pyramid Lake, northeast of Reno, Hoover found "deep red and orange bacterial mats" in areas of the lake bottom where no oxygen exists, and he hauled up quantities of diatoms and unusual algae with their varied silica exoskeletons.

But it was at Mono Lake that Hoover found his richest haul.

"What beautiful creatures they are," he exclaims as he describes with more than a hint of rapture the three new species of bacteria he had already found during an earlier visit to the lake.

"It may take months in the lab before we can be sure of what I'm collecting today, but you never know, and in this kind of wonderful mud, with absolutely no oxygen and so heavily alkaline, we're bound to find more new ones—the very kinds of microbes that could well be living—or at least might once have lived—somewhere else in the solar system."

Hoover and his research colleague at Huntsville, microbiologist Elena Pikuta, have already identified three new species of bacteria they have found in Hoover's avid quest at Mono Lake. They bear formidable names: *Spirochaeta americana*, *Tindallia californiensis*, and *Desulfonatronum thiodismutans*.

The last one, *D. thiodismutans*, is particularly notable, Hoover says, because it apparently lives and obtains its energy by metabolizing sulfur—the very element that sustains bacterial life at the base of the food chain in deep-sea hydrothermal vents, miles beneath the sea where there is neither light nor oxygen and where fiery volcanic heat dominates the environment.

Hoover has sought his microbial trophies in some of the most remote places on Earth, including the Russian Antarctic research station called Vostok, where temperatures often reach 130 degrees below zero.

That outpost sits atop more than two miles of ice, and far below it lies a mysterious lake almost 125 miles long and 3,200 feet deep—twice the depth of Tahoe—which American and Russian scientists would dearly love to explore.

Finding Common Ground in Ice

The Russians, with American help, drilled a hole through the Vostok ice toward the lake and stopped when their drill reached a depth of 11,900 feet for fear of breaking through the ice and contaminating the pristine lake.

Teams of Russian and American scientists are seeking a way of probing the lake itself with some kind of meticulously sterile robot minisubmarine, but no one has yet figured out just how to do it.

Hoover and his Russian colleague, Sabit Abyzov, have been examining ice core samples from the Vostok drilling project that are as much as 400,000 years old. And living in the ancient ice are fungi, algae, bacteria, protozoa and diatoms.

"That ice must be very much like the icy crust of Jupiter's moon Europa," Hoover says, "so is it too much to wonder whether all kinds of similar forms of life have existed up there, too?"

Hoover notes that the geologic basin in which Mono Lake lies resembles a prominent feature on Mars called Gusev Crater, where NASA's Mars robot rover named Spirit will land early next year. Gusev Crater surely holds no water today, but it may contain fossil evidence of past life. Hoover hopes the extremophiles he picks up in Mono's alkaline waters may help scientists understand the ancient life of such fossils—if ever they are found on Mars. ❖

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