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CROSSCURRENTS

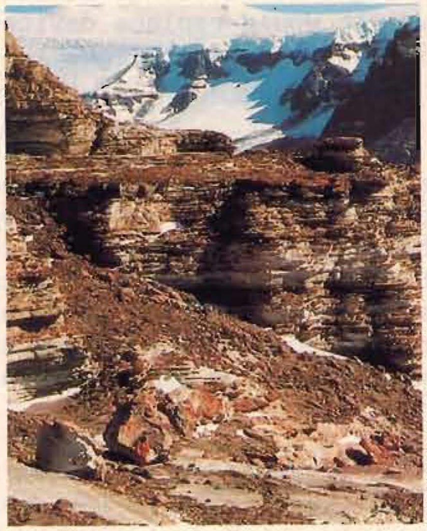
Living in rock and lichen it

In the south of Antarctica's Victoria Land lies a polar desert—2,000 square miles of sandstone and dolomite mountains and deep, glacier-cut valleys. Blasts of wind, dry and powerful, sweep down from the continent's ice plateau to scour away ice or snow cover. The rock in the dry valleys is warmed by the sun and frozen by the wind in cycles of less than an hour. Temperatures in the summer can reach 30 degrees Fahrenheit but plunge to −158 degrees during the dark winter.

Biologists consider this inhospitable environment Earth's closest approximation to the arid frigidity of Mars. Yet a mere tenth of an inch beneath the barren rock surface, there is life. Within the porous sandstone, lichens have taken refuge from the air's erratic temperature swings. Filaments of fungi and clusters of algae, the symbiotic association that makes up a lichen, grow between and around the rock crystals in rich, sun-warmed microbial zones invisible to outside observers. Several species of colorless bacteria have moved in as well.

E. Imre Friedmann, a specialist in Antarctic microbiology at Florida State University, and his wife, biologist Roseli Ocampo, first noticed these pioneering life-forms in 1974 when they cut open an Antarctic rock. After six austral summers of study, Friedmann has concluded that a square foot of rock may harbor about three-fifths of an ounce of the tenacious lichens.

The plants have settled in to the point that they have formed thin specialized bands. At the top is a black zone, mostly fungi, that "provides some shading from the high light intensity of the Antarctic summer," Friedmann explains. What's left of the sunlight then passes through a white lichen layer composed mainly of colorless fungal filaments. Finally, less than half an inch from the surface, the light reaches a green band of algae. "It's like a rain forest," says Friedmann. "The green zone organisms are at the bottom living in deep shadow and have to be satisfied with the light they can get."


E. Imre Friedmann

Antarctica's "dry valley" region, above, seems lifeless. But just beneath the exposed surface of the sandstone, cryptoendolithic (hidden in the rock) lichens thrive, below; each colored band is a distinct biological zone. Could Mars harbor such survivors?

The slow-growing lichens live on mineral salts from the rock, carbon dioxide from the air, and water from snow blown in from the Antarctic plateau. Even the brilliant aurora australis plays a role: The fluorescent discharges in the upper polar atmosphere produce nitrogen compounds that are carried down to the rocks by snow.

It constitutes a beautifully compact ecosystem, says Friedmann. What the algae produce, through photosynthesis, the fungi consume; the bacteria clean up by feeding on dead algae and fungi. Winter's freeze simply puts the lichens into suspended animation until the summer thaw.

Friedmann and his wife had seen blue-green algae adapt to unfriendly conditions in hot, dry deserts. "But what got people excited about the Antarctic find," he says, "was its implications for extraterrestrial life." If microorganisms could stave off Antarctic extremes, could a similar survival mechanism also operate on Mars?

During the last Viking mission, in 1976, the Martian soil was found to be devoid of organic matter. But this may not be true near the poles, and many planetologists still suspect that unexplored areas may hide small pockets of water that could support life. Friedmann offers this scenario:

"Let's assume that when Mars had its water, microscopic life arose on the planet. Then, when Mars dried out, the organisms could have withdrawn into the state that now exists in the dry valleys of Antarctica. Our terrestrial findings do not prove this. But it keeps the possibility for life on Mars alive."

—Marcia Bartusiak


E. Imre Friedmann