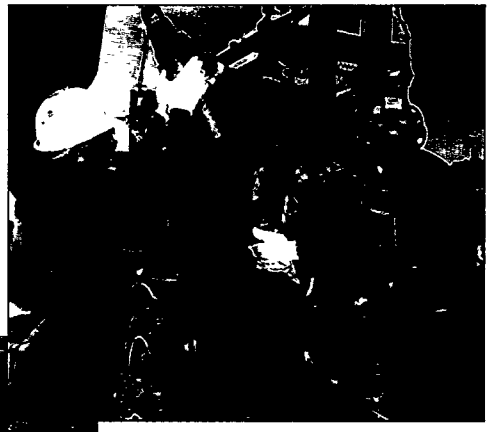
environmental contaminants, and they were early leaders in the study of large ecosystems. The spirit of these efforts continues today in studying global climate change and its environmental effects.

RECLAIMING THE PAST

A half-century ago, environmental research emerged in response to concerns about fallout and the effects of atmospheric weapons tests. Following the 1963 ban on aboveground tests, and in concert with a growing environmental movement, attention shifted to a much broader set of issues—ecosystem modification, acid rain, even the possibility of global climate change. Over the past decade, OHER and OBER have widened the scope of their environmental research still further, impelled by a commitment to clean up the contamination left by past generations.

From the dawn of the Atomic Age, workers were well aware of the potential for harm harbored by the radioactive waste they produced; much of the research described in the preceding pages testifies to their concern. But treatment and storage technologies were relatively primitive, and the needs for weapons research and nuclear power production were compelling. The result was a legacy of contamination. In the same era, nonnuclear wastes were also handled carelessly: Organic solvents were discarded with little thought to the consequences, and toxic materials were often simply buried and forgotten. Today, we are less tolerant of environmental insults and more confident of our ability to avoid them—even to remedy those of the past. Among the means available to us are the tools of modern molecular biology.

The first forays into bioremediation, the use of biological processes to address the problems of waste management, came in the late sixties, when Oak Ridge sought to harness microbes to clean up wastes from coal conversion reactions and nuclear materials processing. More recently, Brookhaven patented a process that relies on naturally occurring citric acid to treat



NOTES FROM UNDERGROUND Once considered a lifeless place, the earth's deep subsurface has now been shown to be home for a host of microorganisms. Using innovative aseptic techniques, scientists supported by OHER's subsurface science program isolated microbes such as the red bacterial cells shown in this confocal microscope image. Associated with basaltic rock several kilometers beneath the surface in the state of Washington, these organisms obtain their energy and nutrition exclusively from the rock. Such microbial systems as this may be models for early life on earth and perhaps on other planets.

1992 Pacific Northwest developed techniques for aseptic drilling and microbiological sample-handling to collect and preserve microbial populations from the subsurface for potential application to bioremediation and pharmaceuticals.

1993 OHER Global Change Research (conducted by scientists at the National Oceanic and Atmospheric Administration, Columbia University, and East Anglia University) produced a historical climate database revealing a global trend of increasing nighttime temperatures over the past fifty years, a finding consistent with the greenhouse gas warming theory.

1994 OHER launched the Microbial Genome Initiative to understand the workings of the simplest life forms. Within three years, Craig Venter at The Institute for Genomic Research would sequence the complete genomes of four microorganisms.