by injecting air and methane to enhance the activity of bacteria already present in the subsurface. This remediation technology is now in use around the world. Meanwhile, at Hanford, researchers developed a process that exploits natural chemistry in the subsurface to form a barrier permeable to ground water that efficiently removes contaminants as the water passes through.

A second BER research thrust, focusing the technologies of the Human Genome Project on remediation needs, is even more fundamental. If the genetic details of key microbes could be obtained, they would afford profound insights into the workings of these "minimal" forms of life, some of which inhabit environments notable for extremes of temperature, pressure, acidity, and salinity, as well as high concentrations of toxic chemicals and even high fluxes of radiation. In addition to enhancing our understanding of evolution and the origin of life, the benefits would extend to medicine, agriculture, industrial processes, and, not least, environmental bioremediation. Such were the incentives for the Microbial Genome Program, launched by OHER in 1994. Among the program's early successes were the complete genomic sequences of *Mycoplasma genitalium,* the smallest-known free-living organism—and a key to understanding the minimum requirements for life—and *Methanococcus jannaschii,* an evolutionary throwback that survives entirely on inorganic nutrients near hot vents on the ocean floor. Of particular current interest is the microorganism *Deinococcus radiodurans,* which prospers even when exposed to doses of radiation that would kill the typical microbe many times over. The secret is not avoidance of damage, but rather a remarkably efficient DNA repair mechanism—one that might be engineered to allow bioremediation of dangerously radioactive wastes.

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Environmental remediation thus completes a research picture that encompasses a lasting emphasis on public health and safety, a noble record of medical breakthroughs, and a deep concern for the environment. But in fact, this canvas of achievement is no more complete than any other description of scientific advance. It is more like a mural in progress than a completed portrait. The only proper conclusion must be a glimpse of the future, a look to the promise of the genome project, to the latest advances in medical imaging, and toward an era of swift environmental cleanup. In closing, then, a brief forecast for the coming years.

1996 Pacific Northwest scientists provided the first scientific evidence of active, anaerobic microbial ecosystems in the deep subsurface that derive metabolic energy from geochemically produced hydrogen. Their discovery would offer opportunities for low-cost bioremediation of ground water and for improved methods of microbially enhanced oil recovery.

1996 After receiving EPA approval, Oak Ridge conducted the first field trial of a genetically engineered microorganism in the U.S., a first step toward developing a process to degrade polycyclic aromatic hydrocarbons in contaminated soils.

1997 The William R. Wiley Environmental Molecular Sciences Laboratory at Pacific Northwest began full operation as a state-of-the-art research facility. Using advanced analytic and computational capabilities, scientists there focus on forefront research in environmental chemistry and on environmental cleanup.