

Radiation effects and bioterrorism response have more in common than might at first be apparent. The link is DNA, the genetic code of all living things. Technologies developed during Livermore's studies of how radiation affects DNA contributed to the founding of the Human Genome Project, the largest biological research project ever undertaken. Since the working draft of the human genome was completed in 2000, the genomes of many other animals and microbes have been sequenced. Sequencing the DNA of bioagent microbes supplies the basis for DNA signatures that are being put to work in new detectors.

Livermore's early analysis of DNA damage has evolved into long-term research in several areas important to human health. Research on radiation exposure resulted in new assays that were first used to evaluate genetic changes in atom bomb survivors in Japan and later applied to understanding the exposures incurred by workers who cleaned up the Chernobyl nuclear power plant after the 1986 accident. Several of these tools have broad application in bioscience. Another research area focuses on how DNA repairs itself. One project analyzes the ways that damaged DNA affects sperm during critical stages of reproduction. Another examines how cooking certain foods produces chemicals that damage DNA. Along the way, Livermore bioresearchers have pioneered many new tools and methods for bioscience research, often collaborating with physicists, chemists, engineers, and computer scientists.

In 1972, Roger Batzel, then Laboratory Director, said, "I personally view Bio-Med as an area which could well grow. It's

been a relatively small program, but I think it could develop into one of the strengths of the Laboratory."

Batzel could hardly imagine how dramatically Livermore's nascent biomedical program would grow and change. The recent proposal to establish a homeland security center of excellence at Livermore owes much to the distinguished efforts over the years of many Livermore biological research scientists.

Of Chromosomes and DNA

Biological studies at Livermore have two major origins. One was the advent of thermonuclear testing in the Pacific Ocean during the mid-1950s. The other was Project Plowshare, which was devoted to the peaceful uses of nuclear weapons for stimulating underground natural gas production, mining, blasting out harbors, and perhaps even creating a new Panama Canal. Testing in the Pacific and in the Soviet Union had made radioactive fallout a major public issue. With Plowshare's

vision of nuclear explosions near populated areas for routine engineering tasks, nuclear contamination became a more direct concern.

John Gofman, a professor of medical physics at the Donner Laboratory of the University of California at Berkeley, was recruited to set up the new program. As it happened, Project Plowshare was largely shelved by the time Gofman started working. "But he studied the dose to humans anyway, with an emphasis on radiation safety," says Mort Mendelsohn, who followed Gofman as leader of the biomedical research program.

By 1963, the scientific community suspected that DNA was the cellular part most sensitive to radiation damage. Gofman had already become involved in cytogenetics, the study of chromosomes, a field that was making major advances at the time. According to Mendelsohn, "Gofman wanted to measure chromosomes for a reason that was way ahead of its time." Many researchers were growing



During the 1983 celebration of the 20th anniversary of biomedical research at Livermore, then Laboratory Director Roger Batzel, Associate Director Mort Mendelsohn, and former Program Director John Gofman viewed the work of bioscientist Laurie Gordon.