The First Underground Nuclear Test

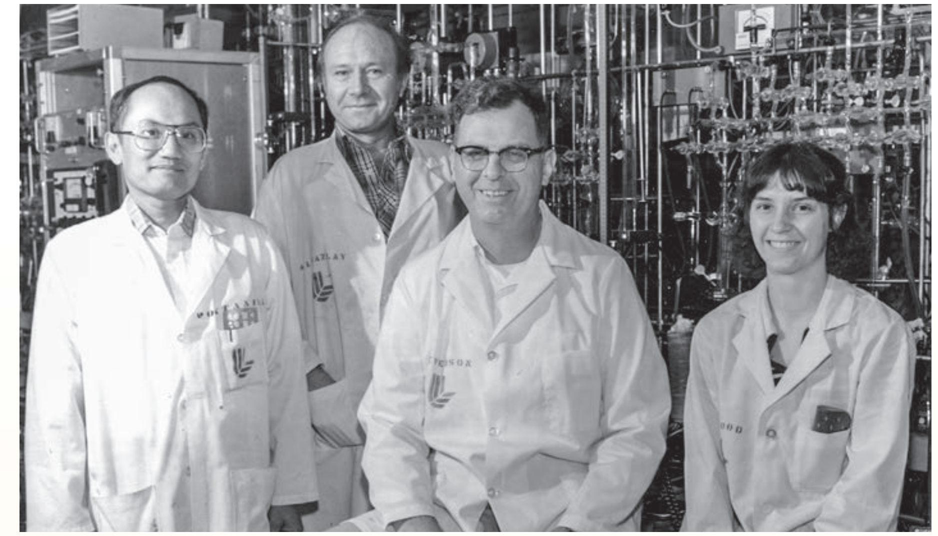
On September 19, 1957, the Laboratory detonated the first contained underground nuclear explosion. Rainier was fired beneath a high mesa at the northwest corner of the Nevada Test Site, which later became known as Rainier Mesa.

Carrying out such an explosion had been proposed early in 1956 by Edward Teller and Dave Griggs, a geophysicist who greatly contributed to Teller's effort to establish a second nuclear laboratory while serving as Chief Scientist of the U.S. Air Force in the early 1950s. Their interest was in the coupling of the explosion energy to the surrounding geology and in the resulting seismic effects. They also noted the environmental advantages of such a test at a time when there was growing concern about atmospheric nuclear testing. Rainier would prove to be a pivotal event by giving a boost to the nascent Plowshare Program and affecting the future of nuclear arms control and the conduct of nuclear tests.

The idea of using nuclear explosions for nonmilitary purposes—beating swords into plowshares—preceded the Rainier event. In the summer of 1956, Harold Brown (Laboratory Director 1960–1961) proposed a symposium on the subject to the Atomic Energy Commission (AEC), and it was eventually held at Livermore in February 1957. Some 24 papers were presented covering a broad array of ideas. Although the discussions were hampered by the lack of data on the effects of underground explosions, interest was high. In June, the AEC established the Plowshare Program to explore peaceful nuclear uses, such as the building of canals and dams, and the stimulation of natural gas reservoirs. Subsequently, the Rainier test and its data gave a tremendous boost in confidence that a variety of applications were possible and could be implemented safely.

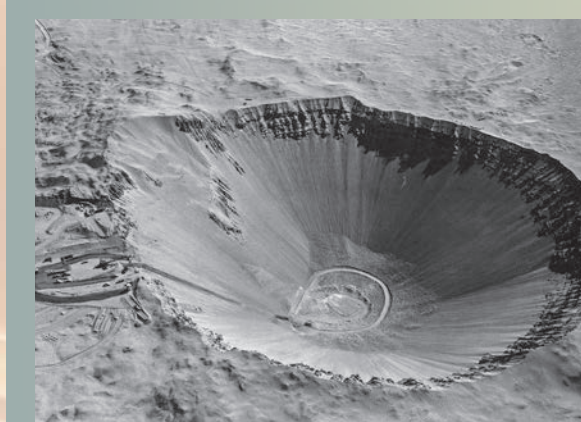
The Rainier event was announced in advance so that seismic stations throughout the U.S. and Canada could attempt to record a signal. In addition, samples were collected for radiochemistry analysis by drilling a series of holes through the mesa above and in the original tunnel. More data were collected by mining a tunnel into the bottom of the explosion cavity about 15 months later, when radioactivity had decayed to manageable levels. From these post-shot investigations, scientists developed the understanding of underground explosion phenomenology that persists essentially unaltered today. That information provided a basis for subsequent decisions in 1963 to agree to the Limited Test Ban Treaty, which banned atmospheric nuclear weapons tests and led to systems being established for monitoring nuclear test activities worldwide, including an international array of seismic detectors.

Radiation detection equipment in the foreground monitors the environment for a worker in a tunnel at the Nevada Test Site that was dug for the Rainier event in 1957.



Radiochemical analysis of the isotopes created by a nuclear explosion was an important diagnostic tool for determining the yield and studying the performance of tested devices. Major advances in radiochemistry were made by Peter Stevenson (second from the right), who was killed in a plane crash returning from the Nevada Test Site in 1979.

The Legacies of Plowshare



The first Plowshare test, Gnome, created a nearly 70-foot-high, 165-foot-diameter underground cavity in a dry salt bed near Carlsbad, New Mexico. Many potential applications were explored until the program ended in 1977, and they drove nuclear design to the two extremes—minimum fission or minimum fusion depending on the application. The most dramatic relic of Plowshare is a 350-foot-deep, 1,200-foot-diameter crater (left) at the Nevada Test Site created by the Sedan event in 1962. Important legacies of the effort include Livermore's biomedical research program to study the effects of fallout and other radioactive hazards on biological systems (see Year 1963) and the Laboratory's Atmospheric Release and Advisory Capability (ARAC) program, which grew out of the need to predict the potential for atmospheric release from cratering shots (see Year 1979).