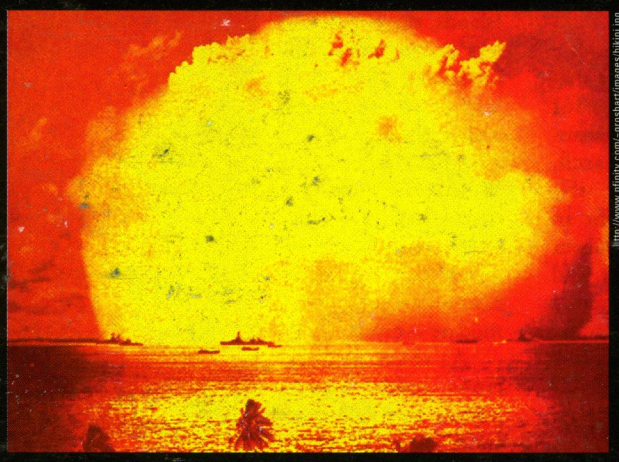
Atomic Legacy in the

Soon after the end of World War II, the United States began a rigorous program to develop its newfound nuclear arms capacity. Much of the testing associated with this program took place in the Marshall Islands, a group of 29 small atolls sprinkled across 600,000 square kilometers of the tropical Pacific Ocean. During 1946–1958, the United States detonated 67 nuclear devices on the atolls of Bikini and Enewetak in the northwest corner of the Marshall Islands territory. These tests resulted in the displacement of hundreds of the islands' inhabitants, nuclear contamination or obliteration of some islands, and increased incidences of cancer in nearby populations. However, the extent of the health problems caused by the testing and the prevalence of those effects in the Marshallese people today continue to be subjects of debate.



http://www.nfinity.com/~groshar/images/bikini.jpg

Poisonous mushroom. The atomic devices detonated in the Marshall Islands often produced huge clouds of irradiated material extending up to 47,000 feet in the air and 70 miles in diameter.

Most recently, the journal *Health Physics* entered this dispute by dedicating its July 1997 issue, one of its largest ever, to recent studies and testimonies related to the nuclear testing program in the Marshall Islands. The conclusions of these studies, which largely show that the islands and their inhabitants have recovered from the nuclear onslaught, are being hotly contested by officials in the Marshallese government. These officials claim that the research in this issue of *Health Physics* cannot be trusted because nearly all of it was conducted by scientists from the U.S. Department of Energy (DOE), the federal agency that oversees the U.S. nuclear weapons program.

Nuclear *Naissance*

The nuclear testing program in the Marshall Islands began in February 1946, when the U.S.-appointed military governor of the territory asked the people of Bikini Atoll to leave their islands temporarily so that the United States could begin testing atomic bombs "for the benefit of all mankind." The 166 islanders living on the atoll were relocated to the smaller Rongerik Atoll in preparation for Operation Crossroads, which involved the world's third and fourth atomic explosions.

Other tests and more relocations followed. Operations Sandstone (1948), Greenhouse (1951), and Ivy (1952) involved eleven atomic detonations on nearby Enewetak Atoll, which previously had been home to 145 Marshallese villagers. These people were relocated to Ujelang Atoll in 1947. That same year it was reported that due to insufficient resources on Rongerik Atoll, much of the former Bikini population that had been moved there was suffering from malnutrition and near-starvation. In 1948 they were moved to temporary shelters near a U.S. airfield on Kwajalein Atoll. Six months later they were moved again to Kili Island.

During most atomic tests, the populations of nearby islands were moved further away from the test site to prevent any accidental exposure to radiation. However, during Operation Castle (1954), it was determined that such precautions would not be necessary because wind directions would be monitored prior to the tests to ensure that radioactive fallout would not travel toward inhabited islands.

On the morning of 1 March 1954, the first test of Operation Castle, "Bravo shot," was detonated on Bikini Atoll. The test was undertaken despite weather data that showed the winds above 17,000 feet were blowing roughly toward the nearby Rongelap, Rongerik, and Ailinginae atolls. The yield of the Bravo explosion was 15 megatons, 1,000 times the power of the atomic bomb dropped on Hiroshima and "three times the most probable predicted value" for the test, according to a 1954 Defense Nuclear Agency report. The unexpectedly high yield of the bomb, the largest ever detonated, and the wind direction resulted in heavy radioactive fallout on the inhabited Rongelap Atoll and on Rongerik Atoll, where 28 U.S. military personnel were stationed as observers. In addition, the inhabitants of several other atolls received significant doses of radiation.

According to papers in the July issue of *Health Physics*, the inhabitants of Rongelap reported seeing the flash of the Bravo detonation that morning followed minutes later by the blast wave. A snowlike material fell for several hours, covering the ground and adhering to the peoples' skin. The water in the village cisterns was said to turn yellowish. Many people became nauseated and vomited; after two weeks some developed cutaneous lesions and lost hair. Two days after the detonation, the 64 inhabitants exposed on Rongelap—including three pregnant women—were evacuated from the island after having been exposed to radiation in excess of 200 roentgens.

The Operation Castle tests continued after Bravo with four more detonations on Bikini and one on Enewetak. Another 50 detonations followed. The combined yield of all the tests done on the Marshall Islands was over 108 megatons; in comparison, all the bombs detonated at the United States' other major atomic testing site in Nevada had a cumulative yield of slightly over one megaton.

In 1963, nine years after Bravo, the first thyroid nodule (a lump in the thyroid gland that may be indicative of cancer) in the exposed Rongelap population was detected in a 12-year-old girl. In 1966, the National Academy of Sciences reported that 79% of children under 12 years of age at the time of the exposure had developed thyroid abnormalities. However, the death of a 19-year-old male in 1972 from radiation-induced leukemia was the only documented death that U.S. scientists directly linked to the Bravo test.

Aftershocks

The new studies published in *Health Physics* suggest that little chance exists for further health complications to develop in the Marshall Islands' population as a result of U.S. atomic testing. Radiological surveys indicate that radiation levels on all of the atolls of the Marshall Islands except Bikini and Enewetak have faded to near-background levels and that with aggressive remediation, even these islands soon can be safely inhabited again. Other papers show that the Marshallese populations exposed to the highest levels of radiation during the tests are no longer exhibiting elevated levels of radiation-related illnesses. In particular, scientists from Brookhaven National Laboratory in Upton, New York, reported that no significant differences were found in the incidence of thyroid nodules among populations located downwind of nuclear tests on the Marshall Islands and a comparison group that was not

Marshall Islands

acutely exposed. Another study showed only a slightly elevated incidence of thyroid cancer in women born during the years testing was conducted.

However, the conclusions presented in *Health Physics* are being disputed by many Marshallese, who claim that those studies represent only the official view of the U.S. government and not good science. "The Marshall Islands government protested loudly against that issue of the journal," says Holly Barker, the senior advisor to the ambassador of the Marshall Islands to the United States. "It was heavily financed by the Department of Energy, and as a result, what is ordinarily a very good journal presented only one biased view of the issue. Most of the contributing authors are either from Brookhaven or Lawrence Livermore [National Laboratories], which are laboratories that were both involved in the nuclear testing, so they have an interest in making the health problems seem minimal. . . . The people of the Marshall Islands were not given the opportunity to present their side [in the journal]."

Though Kenneth Miller, editor-in-chief of *Health Physics*, concedes that the July issue was partially funded by the DOE, he says that the funding came after the fact and did not affect the journal's content. "I know the [Marshall Islands] embassy in Washington was upset about this issue . . . but I never understood what they were objecting to. Also, by the time they contacted us, it was too late to change anything, not that we would have anyway. What we tried to do was put out a collection of good science, and I'm confident that the papers in the journal represent some of the best research done on the subject." Miller and others also point out that since various U.S. government agencies have been monitoring health in the Marshall Islands since the testing ceased, these groups can provide the most in-depth and comprehensive research. Comparatively little research has been conducted by other groups.

However, Barker says, good scientific evidence does exist showing that health effects from U.S. nuclear testing are far more prevalent in the Marshall Islands than any government sources have indicated. In 1995, for example, Glenn Alcalay, an assistant professor of anthropology at the City College of the City University of New York who researched reproductive problems on the islands in 1990–1991, testified before the Presidential Advisory Committee on Human Radiation Experiments that a significant association exists after 1951 between the incidence of miscarriages and stillbirths in the Marshallese population and distance from the testing grounds at Bikini and Enewetak. The prevalence of radiation-induced reproductive problems is an issue that was not addressed in *Health Physics*.

But the lack of attention paid to birth defects and reproductive problems on the islands by government scientists is warranted because fallout levels were simply not high enough to produce such effects, says Bill Robison, the scientific director of the Marshall Islands dose assessment and radioecology program at Lawrence Livermore National Laboratory in Livermore, California. "There was a higher incidence of thyroid cancer on Rongelap Atoll—there's no question about that. But elsewhere in the Marshalls, doses were no different than average worldwide fallout levels [from all atomic testing]," says Robison, who is lead author of three papers and a coauthor of six additional papers in the July *Health Physics*.

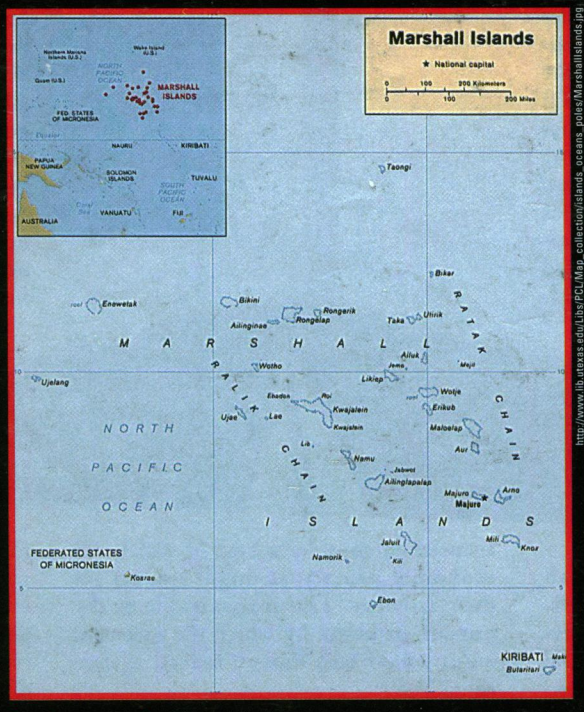
"Obviously, the U.S. government has come up with its own perspective on the environmental and health effects of the tests," counters Barker. "But the fact is that radiogenic effects are showing up on every single atoll." According to Barker, cancer continues to be much more prevalent today in the island nation than it ever was before the tests and birth defects have become commonplace. In fact, she says, the Marshallese now use words like "octopus" and "jellyfish" to describe some of the more common birth defects seen in the population because these were so rare before the testing that no proper Marshallese medical terms exist to describe them.

"It's all part of the game they're playing," Alcalay says of studies conducted by scientists from Brookhaven National Laboratory and other DOE institutions. "They're willing to admit that there was excess thyroid cancer because that's undeniable—there's literally a thyroid disease epidemic there. But they don't want to study reproductive problems or other effects. Instead they just say they're not there."

In addition, the nuclear testing in the Marshall Islands has left many of their residents distrustful of the U.S. scientists who regularly monitor the health of the population. Though these scientists maintain that providing health care to the islanders is their primary goal, Barker and many other Marshallese remain skeptical. "The [U.S.] government had a desire to study the effects of radiation on human beings," she says. "After the people had been exposed, the [Atomic Energy Commission] took some people off of their islands and left some behind that had the same exposure. Then, the two populations were studied. . . . Brookhaven still monitors these groups, but they don't provide care to them. They just study them."

Thus far, some $300 million has been awarded to various Marshallese groups to offset the social and physical damages resulting from the U.S. testing program, and many say that this, combined with the ongoing efforts by U.S. scientists to assess and treat exposed populations, is adequate compensation. However, Barker says that the Marshallese will not be satisfied until the United States builds a hospital in the island nation for treating cancer and radiation-related health problems, and provides medical training to Marshallese that will allow them to care for their own people without further intervention from U.S. medical teams.

In 1994, the first public hearing on the Bravo incident was conducted, but no formal investigation into the circumstances surrounding the radiation exposures has ever been conducted. A comprehensive study on health in the Marshall Islands that will reassess many of the DOE's conclusions is being planned by the CDC.



http://www.lib.utexas.edu/Libs/PCL/Map_collection/islands_oceans_poles/MarshallIslands.jpg

So close yet so far. Though half-way around the world, the Marshall Islands have had tremendous significance for the United States.

Christopher Reuther