

They Never Knew:
The Victims of Atomic Testing
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Introduction

One hundred and forty-nine atomic bombs have exploded over American soil. No one knows how many people, if any, these bombs have killed. The initial heat and shock of the explosions probably killed no one. Open-air atomic explosions, however, have more lasting and distant effects. They create and release tremendous amounts of highly dangerous radioactive materials. Radiation causes cancer, leukemia, cardiovascular problems, cataracts, immunological weakness, genetic defects, pre-natal problems, mental retardation, and many other problems. Any deaths caused by radiation normally occur only years or decades later. Estimates of deaths worldwide from American, Soviet, British, French and Chinese nuclear tests range from something near zero to several million.

In the name of democracy and self-defense, the United States tested bomb after bomb at a test site in Nevada. Each "shot" sent tons of radioactive particles boiling into the sky and drifting across the United States. The isotopes of plutonium, cesium, strontium, iodine-131 and other deadly elements gradually came to earth as "fallout." A lot of it settled in Nevada and Utah, killing cattle, burning ranchers, sickening residents, causing leukemia in children, cancer in adults, deformities in the unborn. It contaminated milk in North Dakota. It ruined

photographic film in New York. It settled into the soil of every state except Alaska and Hawaii.

Another 66 test bombs - many of them far more powerful than those in Nevada - were detonated over the Marshall Islands, a U.S. "Trusteeship" territory in the South Pacific. An estimated 5,000 local people had to abandon their homes and live for four decades on distant islands where life just wasn't the same. Forty-two thousand U.S. military personnel trying to clean up the atomic mess worked under conditions so radioactive that they would be illegal in any industry today.

How many have these bombs killed? After years of lies and denial, the United States government reluctantly admitted to a toll of perhaps a dozen civilians. Thousands of American citizens, however, have sued the government claiming damages that range from illness to death. Almost none, however, have received any compensation. Some scientists, among them a several Nobel laureates, have warned that the radiation may eventually cause as many as ten million deaths worldwide. Other scientists claim the fallout was dispersed and diluted by air and water to the point where it could not be harmful. Congressional hearings have found negligence in the testing program and horrifying consequences. The courts, however, have very rarely awarded compensation to those who claim to have been injured by radiation from the tests.

Among the victims are an unknown number of the 250,000 military personnel who witnessed nearby atomic explosions or their aftermath to train them for nuclear warfare. They were used as human guinea pigs as the military sought to see the effects of radiation on their physical and mental health. They were used as human robots to gather information near ground zero or in radioactive clouds. They were ordered into positions as close as 1.2 miles from atomic explosions to see if they would survive. Some of the soldiers were protected by nothing more than a trench dug six feet deep. Some had the advantage of sunglasses or a cotton face mask.

For much the same reason, a government research program had hospital patients injected with plutonium, the deadliest substance in the world. Again, the government simply wanted to know how radiation affected health. Again, the program and its results were hidden from the public. At least 4,000 people were subjected to experiments involving radiation. Many of them were unaware of the nature of the experiment or the real degree of danger.

No one will ever know the whole truth. Much of it was hidden by the Atomic Energy Commission and other government agencies. Much of it depends on statistics which depend on scanty, inaccurate, or falsified information. Much of it depends on the work of attorneys and the decisions of judges. Much of it has been distorted by hysteria, rumor, grief and wild fears. Much of it depends on an imperceptible link between a case of cancer and an explosion that happened hundreds of miles away and ten or twenty or forty years in the past.

The tests may have been dangerous, but they took place during dangerous times. The Soviet Union, an avowed enemy of the United States, was developing a nuclear arsenal that very quickly became powerful enough to destroy every city in North America. In the infancy and adolescence of nuclear science, bombs, designs, fuels, and triggers had to be tested. If the United States let the Soviet Union get ahead in the design or production of atomic weapons, the weakness of the U.S. arsenal might very well have tempted its enemy to launch a nuclear war. Atomic testing, therefore, in one form or another, in one place or another, had to happen to maintain a balance of power. Ironically, the only place American bombs exploded was in American territory, and, if we include the people of the Marshall Islands, the only people killed were Americans.

Twenty years after the tests in the atmosphere stopped, Americans started asking questions. Did the tests have to happen in such secrecy? Did the AEC have to deny the dangers of fallout? Could it not announce upcoming tests? Could it not warn the public about approaching clouds of radiation? Could it not carefully monitor levels of radiation and the

doses that people received? Could it not keep track of the health of local residents? Could it not care?

The important issue here is not the tests themselves as much as the behavior of the U.S. government. It is now generally acknowledged that government agents and agencies denied the known danger of radiation, lied to the public about the safety of the tests, perjured themselves in court, withheld information that would have indicated guilt, falsified records that indicated problems, and discouraged research that might have revealed the danger of testing.

Though we've learned our lesson about the dangers of exploding nuclear weapons in earth's atmosphere, we still have more to learn. We need to know more about the effects of radiation, not just from bombs but from nuclear power, nuclear waste, nuclear medicine, and equipment that uses nuclear materials. At the same time, we need to understand how well the government regulates its own activities and judges its own negligence. We need to understand the long-term repercussions of working with new technologies. In short, we need to learn how to live in the nuclear age. A look at our nuclear past, therefore, may be glimpse of our future.

Chapter Three

Just Testing

By the end of the summer of 1945, President Truman had called for the creation of a federal agency to oversee the civilian and military uses of nuclear power. The Atomic Energy Commission would take control on January 1, 1947. It would report to the Joint [Congressional] Committee on Atomic Energy. Its board of directors would consist of five civilian commissioners and a general manager, all to be appointed by the President and approved by the Senate. The intent was to have civilians control the use of atomic weapons. The first five general managers, it turned out, were military men, and one of the first commissioners, Lewis Strauss, was an admiral in the Naval Reserve. Seventy percent of the budget over the next fifteen years would be dedicated to weapons development.

The AEC was given the power to regulate everything atomic, from nuclear power to atomic tests to bomb production to waste disposal. It would also have the power to regulate itself, to determine which of its activities would remain secret from the public, which projects and tests it would pursue, and whether any of its activities were dangerous. Certainly much of this secrecy was necessary in the tense times of the early nuclear arms race. Over the next two decades, however, when the AEC faced criticism, it often used secrecy to hide information that had little to do with national security and much to do with public safety.

The AEC controlled nuclear activities until 1974, when the AEC was abolished, its functions split between the Nuclear Regulatory Agency (NRA) and the Energy Research and Development Commission (ERDC). The NRA oversaw regulation and licensing of nuclear power plants. The ERDC handled development of all kinds of energy. The

functions of the ERDA were given to the U.S. Department of Energy (DoE) then it was created in 1977. Any controversy over testing done under the AEC is how under the umbrella of the DoE.

Until the AEC took control, General Leslie Groves and the Manhattan District continued to decide all nuclear matters. Because of the tense, U.S.-Soviet post-war struggle for international power, General Groves wanted to immediately test three more bombs. He also recognized that future wars might well include nuclear weapons. The military needed to know not only how effectively such weapons could attack an enemy but how effectively friendly forces could defend against them. The Navy was especially interested in research on how well atomic bombs would work as weapons against naval fleets. Someone suggested using captured Japanese and German warships in an experiment. Later, old U.S. ships were added to this target fleet.

The target fleet was unmanned, of course, but the ships were loaded with such typical military equipment as trucks, weapons, ammunition, fuel and general gear. The ships would also carry a crew of 200 goats, 200 pigs, and 5,000 mice and guinea pigs.

The initial test series, code-named Crossroads, was to detonate three atomic "devices," as the bombs were often called. The shots would be called Able, Baker and Charlie, detonated in alphabetical order. Able would explode at 900 feet above the fleet. Once results were gathered and tallied, Baker would be detonated 180 feet below the surface of the water. Charlie was to explode deep under the sea.

A joint task force of Army and Navy personnel was formed to conduct the tests. The Manhattan District was responsible for safety. The task force found an ideal test site: the Bikini Atoll in the Marshall Islands, a U.S. Trust Territory. This "Trusteeship" was granted by the United Nations. While it didn't make the Marshall Islands a U.S. Territory, it

gave the United States the right to serve as the government and to pretty much do as it pleased there, including bombard it with atomic bombs.

As a test site, Bikini Atoll was perfect: ring of islands offering a calm harbor for the anchoring of 173 target ships and 200 operations ships. The weather tended to be calm and predictable. The only problem was that people lived there. The only disadvantage was its distance from the United States: 4,500 miles from San Francisco, 2,000 from Honolulu. It would be hard to move personnel and equipment to the site, and valuable time would be lost when transporting radioactive specimens to laboratories on the continent. Due to their short half-lives, some radioisotopes would disappear by the time they arrived at a laboratory that could have analyzed them.

People can be moved, however, and the U.S. government proceeded to move them. They explained to the 162 people who lived in the Bikini Atoll that the tests were necessary to ensure that atomic weapons could be used for the good of all mankind and to end war on earth. They described in detail the power of the bombs. The Bikinians, a religious people willing to do what they could for mankind (and not willing to argue with anyone armed with the weapons so clearly described) accepted temporary resettlement on the island of Rongerik, some 130 miles away. They understood that they could move back as soon as the tests were over. All members of the task force would stay away, too, at least 15 miles from ground zero, the point on earth directly below the detonation.

The dangers of the shock wave, light and heat were thus resolved. Of more important and difficult concern was the spread and effect of radiation. The effect of the Able air burst was relatively predictable. It would be the fourth air burst since the Trinity test. Radiologists already knew approximately how much radiation would be produced and how far it would go under certain weather conditions.

The Baker test was harder to predict. An explosion underwater - the world's first - would irradiate the water, making it radioactive, and that

water would be vaporized and heaved high into the air. On top of that, the fission products produced by the chain reaction, and the fuel not consumed by the chain reaction, would remain concentrated in the water. A pre-test report predicted that "the water near a recent surface explosion will be a witch's brew...probably enough to plutonium near the surface to poison the entire combined armed forces of the United States at their highest wartime strength. The fission products will be worse." Another task force document predicted that "it will undoubtedly be some weeks before the lagoon and largest ships will be habitable" after the underwater shot.

Much of the radiation in the air fell as rain, called "rainout," as had happened at Hiroshima and Nagasaki. Rainout is extremely radioactive. It brings down airborne radionuclides - the radioactive atoms - before they thin out in the wind.

Shot Able, detonated on July 1, 1946, went well. Ships that survived the blast picked up little radiation. Shot Baker, detonated on July 25, proved much more difficult and dangerous. The explosion near the bottom of the lagoon heaved up a half-mile-wide column of water, all of it instantly radioactive from the sudden burst of sub-atomic particles and gamma waves. Much of it came down as rain, soaking the target ships and surrounding area for about an hour. A dense mist that wafted across the lagoon, "the most poisonous cloud that ever existed in the history of the world." It contaminated the ships inside and out. The resulting contamination was far more serious than expected. Radiologists had hoped to at least board the target ships to measure the effects before much radiation "burned off" by breaking down into nonradioactive isotopes. They had to hold off, however. Only the ships upwind were safe to board, and only for a while. The Crossroads technical director, Ralph Sawyer, said the radiation created by the explosion "was roughly equivalent to that from several thousand tons of radium." (A few millionths of a gram of radium lodged in the human body has proven to be deadly.) An hour after the explosion, some target ships were emitting radiation at a rate of 1,200 roentgens per day, three times the lethal dose. The daily allowable dose would have been reached in three seconds.

Twenty experimental pigs and 200 rats in inner rooms, therefore, were doomed. All the pigs and a third of the rats died within a month, and the rest died within the next two months. They had received doses of 310 to 2700 roentgens, enough to kill humans either by radiation poisoning or, eventually, by cancer.

Contamination spread to the task force operations fleet. Men returning from target ships also brought radiation onboard. It came in through water ducts that used seawater. It attached itself to hulls in the form of radioactive algae and barnacles. Later tests would show that some marine organisms can concentrate enough radionuclides to emit radioactivity 100,000 times the background level. The hull radiation was detectable and even dangerous inside the ship. Several sleeping quarters against the hull or salt water pipes had to be abandoned. Scraping algae off the hulls helped, but not much. Water filters were ineffective. Eventually a separate ship had to be reserved just for laundry operations where clean-up crews could leave their radioactive clothes, and eventually that boat had to be abandoned, too.

The efforts to decontaminate the target ships, which were more for experimental purposes than actual attempts to save them, were dangerous and largely ineffective. Washing the ships with water, soap, alkaline compound and lye removed much of the fission products created by the explosion but did not remove the plutonium and other elements from the bomb fuel, of which only a small percentage had actually reacted. The only effective treatment was to sand-blast all surfaces on the ships. Sand-blasting, however, threw radioactive particles into the air and from there into workers' lungs, and still the ships emitted radioactivity.

George Seabron helped decontaminate target ships after both Able and Baker tests. On the trip back to the United States, he recalls, many sailors were very sick. They were told it was sea sickness, which seemed odd for professional sailors. Seabron suffered dizziness, rashes and headaches, and until today suffers back, bone and muscle problems, constant pain, and he is sterile.

Burney Durkin was one of the sailors who stayed on deck during the tests of Operation Greenhouse in the South Pacific in 1951. When the bombs went off 9 to 13 miles away, he could see the bones of his hands and arms. His job was to help scrub down the deck of his ship with sand, stone and water while most of the crew stayed below deck. He worked in bare feet, with no protective clothing at all. He received beta burns on exposed skin. Fifteen years later he had lymphoma cancer. His son would die of leukemia in 1983.

Ben Fudge, with the army on Eniwetok Island in 1955, was ordered to stand on the beach during the Castle series. After one shot, the island was evacuated. He later swam in the lagoon and snorkeled around the sunken target ships. A year later he developed a rash that reappeared every year for ten years. Fifteen years, later, his teeth and gums were disintegrating. His thyroid completely disintegrated, requiring him to take medication for the rest of his life.

Barry Kail was in the navy during Operation Hardtack in 1958 when a 4.2 megaton bomb was detonated 250,000 feet over the Pacific. Within a year, and for the next 25 years, he suffered chronic itching, swelling and cracking of his feet, suffers chronic fatigue, and problems with his joints, bones, gastrointestinal system, bronchial system and bleeding from the rectum.

Efforts to measure doses during the Pacific tests were sloppy, inaccurate and incomplete. Many, though by no means all crew members wore dosage badges made with X-ray film. The badges, collected at the end of each day, could record from 0.04 to 2.0 roentgens. At the Crossroads tests, nuclear workers could receive up to 0.1 roentgens per day, a standard adopted by the Manhattan District in 1942. Because of the high levels of radiation expected, a special short-term standard was adopted for the Crossroads tests. Workers could receive up to 3 roentgens, but if they did, they would have to remain rad-free for 30 days.

The legal exposure limit for nuclear workers today is 5 rad per year. A rad is approximately equal to a roentgen. (See Chapter Three for more

about these and other nuclear terms.) Many of the decontamination workers, and even the crew of the operating fleet, therefore, were exposed to levels of radiation that would be considered dangerously high today. In 1946, of course, no one knew how dangerous these low levels of radiation were. Still, there was considerable debate among scientists and doctors, not to mention between military doctors and military officers.

Many of the clean-up workers quickly approached their dose limits, as measured by their badges. Those measured levels were probably far from accurate, however. The badges were worn only during decontamination work. It was estimated that radioactivity in the operating fleet probably accounted for another 10 percent of total dosages.

The badges did little to measure beta radiation, the particles that often burn exposed skin. Radionuclides releasing alpha and beta particles can go from the air or unwashed hands into the lungs or digestive system. Once inside the body, they can continue radiating for many years. Internal radiation is much more serious than the external radiation that exposure badges record.

Machismo apparently worsened the situation as many crew members, feeling nothing from their exposure, covered their badges or "lost" them or otherwise hid the fact that they had exceeded their maximum exposure. Since it impossible to feel, taste, smell or otherwise sense radiation, many of the men did not realize the danger they were in.

Monitored levels became even less meaningful as many of the civilian monitors, hired for the Crossroads project, had to return home. This left untrained monitors taking measurements. There were no standards on how to take radiation readings. Since radiation diminishes rapidly with distance from the source, a reading taken three inches from the deck of a ship would be quite different from one taken at hip height. Radiation monitors had no guidelines on how to take consistent readings.

Within two weeks after the shot, the chief medical advisor of the task force recommended calling off all further work in the area. The target ships were hopelessly contaminated, he said, and the risk to workers was too high. Higher officials did not agree, but they decided to move the fleet further from the lagoon. After considerable protests by the medical advisor, it was decided that most of the fleet could return to Pearl Harbor, Hawaii, on August 10, a little more than a month after the Baker shot. A month later, President Truman announced that the third shot, Charlie, which was supposed to happen under deep water, was canceled.

Displaced People

The displaced Bikinians did not have the option of sailing off to Hawaii. They found themselves stuck on an island much smaller than the one they had always called home. The soil was too poor for planting, and the lagoon where they fished was much smaller than the one at Bikini. They also found out that they could not go home in the foreseeable future. A few weeks after the U.S. ships left, they ran out of food. A year later, an American doctor reported them suffering from malnutrition. Six months after that, a medical officer found them truly starving. Two months later, they were moved to yet another island.

The natives from various Marshall Islands suffered a wrenching odyssey over the next forty years. As more and more bombs were detonated at various sites, more and more islands had to be evacuated. Some were not evacuated until after they had been contaminated. Many groups had to change islands several times, depending on where the bombs were falling and which way the wind blew. Fallout from shot Bravo, a 15 megaton behemoth 1,300 times more powerful than the one that had destroyed Hiroshima, contaminated the islands of Rongelap and Utrik 300 miles away. Children there, thinking they were seeing snow, rolled around in the inch and a half of ashes that floated from the sky. Soon their feet seemed to be burned, their bodies itched terribly, and all their hair fell out. Two days later, some people's fingernails fell out, leaving

their fingers bleeding. The exact dose of radiation that they received was never precisely measured. It has been estimated at about 14 rem.

Prior to most tests, the people on these islands had always been temporarily evacuated until it was certain the fallout would not hit them. After Bravo, however, even though it was clear that winds were blowing clouds of radiation toward the islands, no effort was made to evacuate them until two and three days later. Nearby U.S. Navy ships, instead of coming to rescue the inhabitants, were ordered to leave the area immediately. Later, these inhabitants would claim that it looked a lot like they had been used as guinea pigs who were left in radioactive conditions just to see what would happen to them. The difference between them and guinea pigs, of course, is that true laboratory animals receive carefully controlled diets and are carefully monitored.

As more islands were evacuated, living conditions on uncontaminated islands grew worse. An island near the navy base at Kwajalein was nothing more than an overcrowded labor camp that served American personnel - a hellish environment for people who had lived from fishing and farming. People on some islands had to live off canned food delivered by ships which were often delayed by months of bad weather. The island of Rogelap was approved for resettlement in 1957. Within a year, however, the inhabitants' levels of radioactivity shot up because they were eating food grown there. Radioactive cesium-137, chemically similar to potassium readily rises into plants. When people ate locally grown crops, their bodies accepted the cesium as a nutrient. Likewise their internal levels of strontium-90, chemically similar to calcium, increased to 20 times normal.

In 1954, the Bravo cloud also swept over a small Japanese tuna Trawler, the Fukurya Maru, or Lucky Dragon. The crew members fell ill with eye pain, headaches, and nausea, and their hair fell out. One died after the trawler reached port. Some of the tuna was sold before it was discovered to be contaminated. The tuna in several other ships was also discarded. The AEC denied the possibility of contamination in the other ships, though the U.S. Food and Drug Administration established new

restrictions on imported tuna. After considerable protest by the Japanese government over the loss of a life, a ship, and 457 tons of tuna, the U.S. agreed to pay \$2 million without admitting guilt. The funeral of the dead crew member was attended by 400,000 people, an indication of the loathing of nuclear weaponry by the people of Japan.

Only in 1973 did the United States declare Bikini Atoll safe for habitation. In August, 1978, however, they were again evacuated after tests showed a 75 percent increase in their levels of cesium. They were told that they probably could not return to Bikini for the next 100 years.

In 1980, after a massive and expensive clean-up of their island, natives were allowed to return to Eniwetak, the atoll where the first hydrogen bomb had been tested. Several other tests had taken place there, and fallout had contaminated islands as far as 150 miles away. Eniwetok was declared "relatively uncontaminated." Six months after the people moved back, however, a hundred people left. Despite the supposed safe conditions, fruit trees were not bearing fruit.

One of the moves of Marshallese in 1985 was aboard the Rainbow Warrior, a ship operated by the environmental organization, Greenpeace. It helped 304 people move 100 tons of cargo to a cleaner island, which the U.S. government had neglected to do. For some of the older residents, it was the third move since 1945.

Exposure to radiation seems certainly to have affected the health of people in the Marshall Islands. Since little is known of their health situation before the atomic tests, it is difficult to determine what changes the tests brought on. No accurate, comprehensive surveys were made or records kept after the tests either.

According to reports by the people affected, birth defects and miscarriages increased drastically. From 1954 to 1958, about 30 percent of pregnancies of women exposed to radiation resulted in fetal deaths.

Among women not exposed, the rate was only 14 percent. From 1969 to 1973, the gap narrowed, with the exposed group having fewer fetal deaths and the unexposed group having more - about 22 percent and 20 percent respectively. This was probably due to increased exposure, through food and water, of the "unexposed" group, and lower radioactive conditions among the group that had been exposed several years earlier.

Apparently the number of birth defects also increased, though there are no statistics to prove it. Genetic abnormalities happen in the absence of high radiation. Chemicals, pesticides, heredity and normal background radiation can cause the same kinds of problems, so there is no way to link a given birth defect to radiation. The natives of the Marshall Islands, however, say that birth defects clearly increased and seemed far worse than before. They reported many miscarriages and stillbirths of unrecognizable fetuses. They described the fetuses as looking like jelly fish, bunches of grapes, and the bark of coconut trees.

In 1956, the Brookhaven National Laboratory was hired by the U.S. Department of Energy to conduct annual surveys of the health of people from the island of Rongelap. The surveys compared exposed people to supposedly unexposed people. Any difference in health between the two groups, then, could be attributed to radiation.

The surveys were probably chronically flawed. The supposedly unexposed group was almost certainly exposed to some extent. The entire region was at least slightly contaminated, and when Rongelap was resettled, much of the island was considered contaminated. The contaminated sections were not inhabited, but inhabitants were known to have gathered food and hunted animals there. If virtually everyone was exposed to some extent, the comparison between the two groups would show little difference. The conclusion, then, would be that radiation had no effect on anyone.

After twenty years of Brookhaven surveys, a review report contained a startling paragraph:

Even though...the radioactive contamination of Rongelap Island is considered perfectly safe for human habitation, the levels of activity are higher than those found in other inhabited locations in the world. The habitation of these people on the island will afford most valuable ecological radiation data on human beings.

The report is clear evidence that the high levels of radiation were known and that the people living there were recommended as guinea pigs worthy of observation.

The Brookhaven reports hardly mentioned genetic abnormalities. Even if there were none found, their absence would be worthy of note in any serious report on the effects of radiation. The people of the Marshall Islands claim that the reports were scandalously skewed. The clear invalidity of the group comparison and the blatant lack of attention paid to birth defects and miscarriages, they claim, are indications of either negligence or bias toward the interests of the United States.

In 1983, the people of Micronesia, the vast area of Pacific islands which the United States had been overseeing since World War II, voted to become three independent nations. The Marshall Islands was one of them. The agreement was called the Compact of Free Association. Under the agreement, the United States still has the right to a military presence and to prohibit other countries from establishing bases there. The agreement included a \$75 million payment for problems caused by the nuclear tests. Under the conditions of the Compact, Bikinians will never be able to seek more compensation for problems caused by nuclear testing. For whatever it is worth, the Bikini atoll now belongs to the Bikinians, and the responsibility belongs to no one.

The Nevada Tests

The Japanese and Marshallese were by no means the only victims of American atomic bombs. Approximately 200,000 American citizens and 250,000 American military personnel can also consider themselves victims of the over 200 bombs that have exploded near them. Ironically, except for a handful of people, the American citizens received no compensation for their sacrifice.

The tests had started in the Marshall Islands because President Truman had considered such explosions too dangerous to take place on American soil. In 1949, the commissioner of the AEC, Sumner Pike declared that "only a national emergency could justify testing in the United States.". As tension increased between the United States, the Soviet Union and China, and the war in Korea heated up, President Truman recognized an emergency. He directed the AEC to find a site more accessible to military and scientific personnel, more secure from foreign observation, and more quickly reachable by supplies and test bombs.

The Nevada Test Site (NTS) was chosen as the safest place, though the report on the site said it would be suitable for "a few relatively low-order detonations." Until the army transferred ownership of the NTS to the AEC, the property was known as the Tonopah Gunnery Range. It was called the Nevada Proving Grounds until 1957. Its desolate 1,350 square miles of desert lay in a broad, flat area bordered on the north by high ridges. Las Vegas was about 60 miles to the southeast. The weather was predictable, and the lack of rain would minimize concentrations of fallout. The prevailing winds blew east, away from the densely populated coast of California. No one lived within a radius of several miles, and the nearest urban area was considered, in the words of an AEC memo, "a low-use segment of the population." Another document called the area "virtually uninhabited," creating a new kind of American

who called themselves "virtual uninhabitants." A hundred thousand of them "uninhabited" the areas downwind of the test site. They also became known as "downwinders."

Being so readily accessible, the NTS gave the AEC an opportunity to test not only a variety of weapons but also their effects on troops, buildings, and armored vehicles. One objective of the tests was to develop a wide variety of tactical nuclear weapons, that is, relatively small nuclear weapons that could be used on a battlefield rather than over a city. AEC commissioner Gordon Dean specifically stated that they hoped to develop a variety that paralleled conventional weapons systems, including nuclear artillery shells, torpedoes, rockets, guided missiles, mines and bombs for small battlefield bombers.

The tests had to happen somewhere. The Soviet Union was testing constantly and was keeping up with the United States, megaton for megaton. In May 9, 1951, the United States tested its first hydrogen bomb in the Marshall Islands. In July, the Soviet Union tested its first hydrogen bomb. The nuclear arms race was racing in several directions. Both sides wanted to have not only the biggest bomb but also the smallest, that is, the tactical weapons that could be used without endangering nearby friendly forces. Each side wanted a "clean" bomb that would produce relatively little fallout. They also wanted to know what made a bomb "dirty" or "clean." They wanted to know how many kilotons could explode on the other side of the world without endangering home territory with fallout. They had to study fallout patterns, triggering devices, detonator designs, fuels, and the effects on nearby civilians, troops, equipment and buildings. None of this was possible without detonating experimental weapons, and the side that didn't experiment was going to fall behind in the race. To fall behind, to become weaker, might be to practically ask for attack. Failing to improve nuclear weapons through testing could very well lead to nuclear war.

Each test gave scientists the information they needed to move on to the next stage of weapons development. The urgency often meant sticking to a schedule even if it compromised safety. Test managers, the individuals who had responsibility for each test, were under considerable pressure to stay on schedule. Tests were conducted under less than ideal weather conditions that sent fallout toward populated areas.

As in the South Pacific, each test series had an operation code name such as Teapot, Plumbob, Hardtack, and Ranger. When series of the military and the AEC were combined, they used double names such as Buster-Jangle, Upshot-Knothole and Tumbler-Snapper. Each operation consisted to of several shots with individual code names.

The shots tested all sorts of warheads, triggering devices, delivery systems and fallout effects. In 1951, Shot Able, the first test in Operation Buster, was fired atop a 100-foot tower. It fizzled, yielding under 0.1 kiloton. The next four, dropped from B-29s yielded 2.5, 14, 21 and 31 kilotons. In 1953 Simon was detonated atop a 300-foot tower just 2,000 yards from troops in trenches. Shot Grable, fired from an artillery cannon seven miles away, exploded over trees, buildings, bomb shelters and vehicles that had been set up to test the bomb's effect. Operation Plumbob tested warheads carried by balloons, towers, and air-to-air missiles and also experimented with the results of warheads triggered by a plane crash or other accident. In all, 149 devices were detonated in the air at the Nevada Test Site. Many more were tested underground, especially after the Limited Test Ban that began in 1963.

The first tests in Nevada began in 1951 with Operation Ranger. Pre-shot planning included real concerns for off-site safety. Calculations predicted that 25-kiloton bombs could be exploded above the ground without exceeding the allowed dose of 6 - 12 roentgens beyond a 100-mile radius. Monitors in cars, truck and airplanes would track the drift of fallout.

Since no off-site fallout was expected, citizens were almost never warned of impending danger or what to do if fallout drifted their way.

Since the tests were so important, the AEC did not want to raise protest by revealing possible dangers. It was more important that the public have confidence in its government and the safety of atomic explosions in their country. On the same day that President Truman approved the Nevada Test Site, members of the AEC met to plan not safety but the higher priority issue of public relations. According to a report on the meeting, the talks focused on "the questions of exploring radiological safety aspects in order to make the atom routine in the continental United States and make the public feel at home with atomic blasts and radiation hazards." Years later, a Public Health Service radiation monitor reflected the cynicism of the time when he said, "You can't underestimate the importance of public relations when you are trying to dump radioactive material on people, and we stressed it continually."

The surrounding population consisted of nearby ranches and, beyond that, to the east, several small cities and towns in Utah. East of Utah, of course, lay most of the United States. As it would turn out, the radiation was by no means restricted to the Nevada Test Site. Fallout was detected all the way to the Atlantic Ocean and, depending on which way the wind blew, the it also floated north as far as Canada, south as far as Mexico, and west as far as the Pacific Ocean. In fact, the H-bomb tests in the South Pacific also sent detectable and possibly dangerous levels of radiation across the United States, not to mention the rest of the northern hemisphere.

If the vicinity of the NTS was "virtually uninhabited," one of the virtual uninhabitants was Martha Laird, of Twin Springs, NV, who remembers the ground shaking and rumbling like an earthquake, and once or twice the shock wave blew their front door off. Ena Cooper, of Indian Springs, NV, says gravel on the ground danced a foot in the air. Jamie Stewart, a little girl at the time, saw ashes fall like snow, and when she shook trees, the big, gray flakes showered down on her. Claudia Peterson remembers the big fireball that rose in the distance and the cloud that passed overhead. Men came into her classroom with Geiger counters. She

remembers big piles of dead lambs on her father's farm. Marjorie Black found twelve dead cows and several dead rabbits and magpies in her pasture. Once when snow melted off her truck, all the paint peeled off. LaVerl Snyder was camping when she saw clouds boil over her campsite. A rash broke out over her body, and then her skin burned and blistered. Over the next several days she felt nauseous. Then her toenails and fingernails fell off. Then her hair fell out. At the hospital, doctors diagnosed her problem as sunstroke.

The "low-use segment of the population" included St. George, Utah, population 5,000, 140 miles east of the test site. Tourist brochures often called that area The Land of Color. U.S. News and World Report, however, soon dubbed St. George "Fallout City."

The majority of the people in Utah and rural Nevada - and 90 percent of St. George - were Mormons. Obeying the strict lifestyle guidelines of their religion, they avoided the use of alcohol, tobacco and beverages with caffeine. They were descendants of pioneers and by local tradition were proud of their self-sufficiency. During the 1950s, 55 percent of the people of southwestern Utah drank milk from their own cows. About that many drew their water from a spring. Almost half of all homes had children, and most women breast-fed their babies. Sixty-five percent ate leafy vegetables from their own gardens. Industry and industrial pollution were very scarce. The region was a very healthy place for people, and the people led very healthy lifestyles.

Unfortunately, those lifestyles worked against them. The consumption of local food, water and milk only helped intensify their consumption of radioactive isotopes which cause cancer and immunological problems. If they'd eaten frozen vegetables from California, dried milk from Wisconsin and canned food from New Jersey, they would have been better off. If their city had been larger and surrounded by industries, the bombs would have been tested somewhere else.

People learned to open their doors and windows before a blast, if they received warning. Often plate glass windows popped out of their frames.

Often the AEC set up road blocks to prevent cars from leaving town in the direction of a passing cloud. Sometimes incoming cars were directed to the nearest car wash. Occasionally an announcement on the radio would suggest the people stay indoors, but the announcements often came only after the cloud arrived. Children were warned not to eat snow. Homeowners were advised to hose down their roofs. People generally assumed that fallout was like snow flurries, that it melted away after a few hours.

Still, it would have helped to stay indoors for a few hours after fallout passed by. People only needed a little warning. The AEC maintained a policy of rarely warning people of upcoming shots and of warning people about local fallout only after it had come and gone.

The possibility of warning people and even evacuating them was discussed at AEC meetings in 1951. In a memorandum to a safety committee, Dr. Shields Warren, director of the AEC division of Biology and Medicine, said, "I would almost say from the discussion thus far that in the light of the size and activity of some of these particles, their unpredictability of fall-out, the possibility of external beta burns, is quite real." That committee decided to go ahead and take the risk because it was felt that the information gained would be worth the injuries and the possible public outcry. There was also discussion of evacuation from a 44-mile radius of ground zero, but the evacuation was canceled, probably in fear of causing public panic.

One particularly serious incident happened on one fine May day in 1953. Shot Harry was detonated on a 300-foot tower. The 32-kiloton explosion heaved a vast amount of earth into the air, much of it vaporized, most of it as a fine powder, all of it radioactive. The particles came to earth in a relatively small area, exposing the lower half of Utah to intense radiation rather than exposing a broad swath of North America to relatively diluted radiation. Many people suspect that that particular shot, if not all shots, was a fallout experiment. The citizens of St. George were not

warned even when the shot managers knew where the cloud was going. The whole incident looked a lot like an experiment with a large population of human guinea pigs.

Two Utah state health officials were among the first to experience the cloud. They were driving to a uranium mine north of St. George when their car was swamped in dense black cloud. With visibility at zero, they stopped, got out and ran in fear of oncoming traffic. Minutes later, three other cars collided nearby, and one hit their car. They used their Geiger counter to take a reading. The needle went to the end of the scale, indicating a level above 100 Roentgens per hour, more than a person should be exposed to in 20 years.

JoAnn Taylor, a college student, drove into the same cloud of radiation. It came down on her car as rain, though the AEC denied that it had rained anywhere within a thousand miles downwind of the test. Frank Butrico, the radiation monitor assigned to St. George, took a reading of her car when she arrived in St. George, then directed her to the nearest car wash. She got into a long line of radioactive cars. Local people, unaware of any problem with radiation, were irradiated as they stood near the cars.

Soon the dark cloud was passing directly over St. George. Frank Butrico decided that it would be a good idea to warn the local population to stay indoors. The AEC later claimed that radio announcements had been issued, but apparently Butrico had not heard them. Nor had he been advised that the main cloud of fallout was passing directly over St. George. Even though it wasn't really his job, he reported the problem to the mayor. The mayor had the nearest radio station, 50 miles away in Cedar City, announce the danger and recommend that everyone stay indoors.

By that time, however, the level of radiation had already reached and passed its peak. Many people did not hear the announcement, and many others did not really understand the danger. It sounded no more important than a weather report. People outside of St. George, mostly

farmers who worked outdoors, weren't sure if the warning applied to them.

An elementary school got the word and kept children in during morning recess. Butrico, however, saw children playing outside before the danger had fully passed. Agatha Mannering didn't get the word. She was outdoors working in her garden, not indoors listening to the radio. The fallout burned her skin where it was exposed whenever she leaned over to pull weeds. Soon her hair fell out, and she felt sick all the time. Years later, when she broke her arm, the doctor said she had the porous, brittle bones of an old woman. Elma Mackelprang left her kids in her pickup truck while she got out to give water to the sheep. Later, she came down with a fever, diarrhea and nausea. Then her hair and fingernails fell out. Her children in the truck suffered no symptoms. The AEC told her the problems were caused by her recent hysterectomy. AEC officials who hurried to a uranium mine east of St. George found all the miners vomiting and covered with a sudden rash. Their official report blamed a gastro-intestinal bug and possible stress after hearing the warnings on the radio.

Residents also reported an odd metallic taste in the air as the dark cloud passed overhead. Apparently it was the vaporized remains of the steel tower on which the bomb had detonated.

Frank Butrico, who was probably the only person in town who understood anything about radiation, was also the only person who took appropriate protective measures. He stayed indoors as much as he could, and then, getting high radiation readings from his own hair, bought some new clothes, took a long shower, and threw his contaminated clothes away. He didn't advise anyone else in town to do the same. It wasn't his job to do so. Unfortunately, it was no one's job, and in ten years of atomic tests, it never got done. At no point did the AEC ever admit to levels of radiation coming anywhere close to hazardous.

The AEC was either lying or simply unaware of the actual levels of radiation and the dangers they represented. A few years later, Dr. Harold

Knapp, an AEC fallout specialist, calculated that levels of radioactive iodine-131 in milk had soared during the days after the test. A child drinking a liter per day would have received a dose of 120 to 440 rads to the thyroid, an extremely dangerous amount. Dr. Charles Mays, of the University of Utah, calculated that 700 infants in St. George had received doses to the thyroid that were 136 to 500 times higher than normal.

Frank Butrico was asked to bring samples of milk to the AEC. Rather than buy raw milk at several local dairies, as most people in that part of the country did, he bought a single bottle of pasteurized milk at a store - in no way a representative sample of the milk that people drinking. In the end, it didn't matter. The AEC laboratory made a mistake that destroyed all the sample. No other samples were taken until 1957.

Did the AEC know that I-131 was contaminating food, entering the food chain, and possibly harming human health as an internal source of radiation exposure? A congressional hearing held in 1979 revealed two sides to the story. Richard Stanley, deputy director of the U.S. Environmental Monitoring and Support Laboratory, testified that the AEC hadn't known of the dangers of I-131 and internal doses during the years of atmospheric testing, when, he said, "...analytical equipment and techniques weren't adequately developed for the identification and quantitation of [I-131]. Consequently, [I-131] wasn't recognized as a potential problem, and no protective actions were taken to minimize thyroid doses resulting from the ingestion of milk contaminated with radioiodine...."

At the same hearings, however, Dr. Joseph Lyon, of the University of Utah, said that AEC knew of the potential hazards of radiation taken in with food. "In 1953, Mr. Weiss [a researcher with the Public Health Service] cited monitor's reports in the St. George area [which] were very concerned about the milk, went so far as to sample the milk, actually took it back to Las Vegas; and then given the lack of knowledge, did attempt an analysis on the nuclide levels of iodine. So there was some awareness of this....my impression was that there must have been some

awareness of a risk factor and yet nothing ever seems to be pursued to the end where you can get the precise information...we need for our scientific studies."

Dr. Harold Knapp, who had studied fallout for the AEC, testified that in 1963, as an intense series of tests was beginning, he realized how inaccurate AEC estimates of I-131 doses had been. "...for 11 years we had missed by a factor of 100 to 1,000, perhaps, the doses to the thyroid of infants and young children that drank milk from cows that were grazing downwind in the fallout areas around the Nevada Test Site." He also said that the AEC Division of Operational Safety had dragged its feet to prevent his report from being published. When he suggested changing the guidelines for protecting the public from radiation, the commission refused. An AEC memorandum stated, "To change the guides would require a re-education program that could raise questions in the public mind as to the validity of the past guides...Therefore we recommend the continuation of the present criteria."

A Strange Slaughter of Sheep

Shortly after the Upshot-Knothole series of tests that included Shot Harry, ranchers reported a great number of deaths and odd injuries among cattle, horses and sheep. The animals had been wintering in pastures about 50 miles north of the NTS. A few cattle died, and several horses had lesions on their backs. Sheep, especially hard-hit, died by the thousands. Twelve percent of pregnant female sheep died, and a quarter of newborn lambs died within three weeks of Shot Harry. Many lambs were born stunted, half the normal weight, and they died within a week. Many were born with deformities. Many sheep had open sores on their snouts. When their wool was shorn, it just separated from their bodies, exposing large scabs.

Examination of the sheep by AEC personnel, however, revealed no damage by radiation. The supposed beta burns, they said, were caused

by something else. AEC tests supposedly showed that the amount of radiation received should not have killed the animals. One sheep had liver readings double normal, lung and bone readings four times normal, and thyroid readings 150 times normal, but those levels were considered too little to have killed the animal.

Oddly enough, the AEC inspectors did not examine the gastro-intestinal tracts of the dead animals. That part of the body is especially susceptible to radiation, explaining the nausea and diarrhea that people often felt during times of passing fallout. Injury there might also have explained signs of malnutrition in the dead animals.

AEC inspectors determined that the cause of death was malnutrition and the consumption of poisonous plants. The poison, they said, had made the animals' snouts sensitive to light and thus caused burn marks that coincidentally looked so much like beta burns. Inspectors working for the state of Utah did not agree. A specialist in poisonous plants said that poisonous plants could not have been the cause of the deaths or the burn marks. Robert Thompsett, a veterinarian from the Los Alamos Scientific Laboratory, hesitantly said that the injuries looked the same as those of animals injured by the Trinity test. Radiation, he said, was probably the factor that pushed weak, malnourished animals into death.

The AEC distortion and cover-up of facts worked well enough to hide the truth for many years. The American public heard nothing but the AEC side of the story. A New York Times article, for example, said that "...the commission spared no effort to trace any connection between the [atomic] explosions and the mortality of the sheep," and "The commission's Los Alamos NM scientific laboratory...set to work exposing test sheep to beta rays to see if the sores matched. They did not," and "It was established that the sheep could not have gotten more than one-fortieth of the minimum injurious dose [of iodine-131]."

The AEC opinions held sway. The ranchers were not compensated for their losses. Most surprisingly, the deaths of the animals, undeniably suspicious, never led to warnings that similar exposure among humans

might be dangerous. The AEC did not admit the possibility that radiation had contributed to the deaths or that the supposedly safe levels of radiation might not be so safe after all. Any information to the contrary was classified as "secret" by the AEC and thus could not be used by the ranchers in a court case that came up in 1955. That case and similar AEC cover-up activities are discussed in Chapter Seven.

The truth began to come out only 28 years later, in 1979, when the U.S. Congress began to investigate. In joint hearings with the Senate and the House of Representatives, and then later in a House subcommittee hearing, ranchers, veterinarians, doctors and scientists revealed how they interpreted the death of so many sheep. Some of their testimony is well worth repeating.

Kern Bullock, a rancher, testified as follows:

We were on the trail home from our Nevada range into our Utah range, and I was out on the saddle horse with this herd of sheep just sitting...kind of watching the sheep. They were all grazing, and these airplanes came over...and all at once this bomb dropped...

I wasn't expecting it...it just was an atomic bomb...And of course, the cloud came up and drifted over us...And, it was a little bit later that day that some of the Army personnel that had four-by-fours and jeeps...came through...and they said, 'Boy, you guys are really in a hot spot'...

Well, we had to herd the sheep. We had to move as fast as they walked...and that's not very fast....

We trailed into Cedar City - I guess it was 200 and some odd miles...and when we got into our lambing yards...we started losing sheep....

We they started to lamb, we started to losing them, and the lambs were born with little legs, kind of pot-bellied. As I remember some of them didn't have any wool, kind of a skin instead of wool...

And we just started to losing so many lambs that my father...just about went crazy. he had never seen anything like it before. Neither had I; neither had anybody else.

According to testimony in that same congressional report, the AEC investigation of the deaths was a cover-up, not a real investigation. AEC officials were simply seeking data that they could alter or destroy. Dr. Stephen Brower, Iron County Agricultural Agent, testified as follows:

During the first month or two of the initial investigation, the scientist who were there were, in fact...saying and specifying this was radiation damage...

[But] they were taken off the case. In fact, Dr. Thompsett, who said he would give me a copy of the report and provide a copy of his report to the livestock men indicating the readings and the appearance of the animals were similar to an experimental radiation damage done on animals, told me later that this report was picked up - even his own personal copy - and he was told to rewrite it and eliminate any reference to speculation about radiation damage or effects.

The AEC convened a meeting of AEC people and federal, state and scientific consultants to discuss the problem. There was no agreement between the AEC and the others. However, everyone was asked to sign a paper to record their attendance at the meeting. Later, the AEC presented a document with those signatures. The document stated that the signatures attested to an agreement that radiation had not been

responsible for the deaths. The signers, however, had never seen that agreement, let alone consented to it.

Dr. Harold Knapp, a scientist who later worked for the AEC Fallout Studies Branch and who later conducted health surveys of the effects of radiation on people, was among the scientists who inspected the sheep. He noted facts quite different from those of the AEC inspectors and came to a radically different diagnosis.

The simplest explanation of the primary cause of death in the lambing ewes is irradiation of the ewe's gastrointestinal (GI) tract by beta particle from all the fission products that were ingested by the sheep along with open range forage...The internal radiation doses to the GI tract of adult sheep are calculated to be in the thousands of rads, even though the external gamma dose was within the 3.9 rad limit set per test series established with the AEC acceptable for persons living in areas adjacent to the test site.

The death of the newborn lambs may be attributed to serious damage to their thyroids from doses in the range of 20,000 to 40,000 rads from isotopes of radioiodine present in the fallout from the 24 March 1953 test (Nancy), and ingested by the pregnant ewes 40 - 60 days prior to birth.

Dr. Knapp also testified that the government had known beforehand that low external doses could indicate very high internal doses. The government also knew that iodine-131 eaten by pregnant ewes could be deadly to fetuses. Nonetheless, the AEC carefully avoided any questions or investigations which would bring this information to light.

Dr. Stephen Brower also testified that Dr. Paul Pearson, then chief of the Biological Branch, Division of Medicine of the AEC, told him the motivation behind the dishonest investigation.

Dr. Pearson told me...that the AEC could under no circumstances afford to have a claim established against them and have that precedent set. And he further indicated that the sheepmen could not expect under any circumstances to be reimbursed for that reason.

Although he had no witnesses to back him up, a rancher testified that a deputy test site manager had said to him, "Joe, the easiest thing we could do would be to pay for these sheep, but if we paid for them, every woman that got pregnant and every woman that didn't would sue us."

The issue of precedence was all-important to the AEC. If it was held responsible for the deaths of sheep, it could all the more easily be held responsible for the deaths of people. Whether the AEC feared this as a real possibility is not known, but certainly every doctor and scientist in the world knew that radiation could be dangerous and that a lot of it was boiling into the skies of Nevada.

Radiation Across America

Radioactive fallout was not restricted to the NTS site or even to the surrounding states. Here and there, across the continent, rain and wind focused enough fallout to create "hot spots." One such spot happened to be Rensselaer Polytechnic Institute (RPI) in Troy, NY, where students of physics just happened to have Geiger counters working the morning after a heavy rainstorm. The radiation they detected was from Shot Simon, and they found it everywhere, indoors and out. An average of 16

million atoms were disintegrating each second in each square foot of the campus. Each of those disintegrations released a bit of radioactivity. RPI was more radioactive than some places at the NTS. Years later, Dr. Ernest Sternglass would study the rates of thyroid cancer, leukemia and infant mortality in the Troy area and find all those rates above normal.

Other shots left other hot spots. In the Tumbler-Snapper series, Shot George left 1,400,000 disintegrations per square foot per minute in Pocatello, ID, Shot How raised radiation in Great Falls, MT to 5,900,000 disintegrations per minute. After Shot Annie in the Upshot-Knothole series, the number was 1,900,000 in Knoxville, TN and 1,000,000 in Dallas, TX. There number after Shot Encore was 1,200,000 in Weilliston, ND and 570,000 in Bermuda. After Shot Harry, disintegrations per minute per square foot were at 11,00,000 in Grand Junction, CO, 7,800,000 in Albuquerque, NM, 2,000,000 in Raton, NM, 1,600,000 in Amarillo TX, 1,500,000 in Des Moines, IA, 8,400 in Bermuda, 1,200 in Seattle, WA.

Newspapers in Utah reflected the public concern. Headlines reported the illnesses that followed Shot Harry. They also reported the AEC denials of any possible connection to radiation. An editorial in Salt lake City's Deseret News complained that "the public is never told just what levels of radiation are reached in this area, except that the AEC reassures us that they have been well within the limits of safety." Another editorial in that paper suggested civil defense maneuvers whenever fallout passed over a given city, thus helping to protect the population while also preparing them for what to do in case of war. The AEC never acted on the suggestion, however. Communities rarely advised of upcoming tests, were never advised of fallout until after it had arrived, were never told to what levels they were exposed, and were never honestly informed of how dangerous certain levels were.

Years later, in a court case concerning AEC negligence, Frank Butrico gave insight into the secrecy. He testified that senior officials had told

him that the AEC was going to stop disseminating information. "Let's cool it," they said, as Butrico reported it. "Let's try to get this thing quieted down a little bit because if we don't, then it's likely that there might be some suggestion made for curtailing the test program. And this, in the interest of our national defense, we cannot do."

The AEC's efforts to protect the public from fallout were limited to public relations and public education. The public relations aspect was aimed at convincing people that there was no danger, and the public education belittled the nature of the danger and minimized the possible protective measures. Despite many reports of the Geiger counters of uranium prospectors detecting radiation above 100 roentgens, the AEC claimed that exposures could only be measured in thousandths of roentgens. Despite the deaths of cattle and the horrifying effects on humans, the AEC maintained that the off-site levels of radiation were not harmful. Despite the scientific knowledge that radiation was most harmful when particles entered the body, AEC educational materials never suggested that garden crops, meat and dairy products should be destroyed if exposed to fallout. Although AEC officials knew enough to discard contaminated clothes and thoroughly wash the body and hair after exposure, citizens were merely advised to dust off their clothes, wash their hands and bathe more often. They were against any recommendations that raise suspicions. The chairman of the AEC Military Liaison Committee said that setting up roadblocks and washing cars was the kind of "overreaction" that caused public concern.

In 1954 the AEC scheduled the most intense series yet, Operation Teapot, in which 12 devices would be detonated in two and a half months, starting in 1955. Foreseeing public distress at so many explosions, some of which would be rather large, the AEC beefed up its public relations campaign. It was decided that information given to the public should distinguish between the larger bombs of over 30 kt and

bombs smaller than that and by implication more harmless. An AEC document said the goal should be to separate the larger tests as "unpleasant but necessary...limited to the smallest number possible... [with] small-yield tests as completely controlled experiments which will not affect the public...and will have as their purpose the development of atomic warheads which would be used over our own cities to protect against enemy air attack. In short, these would be sold as 'friendly blasts' offering comforting protection."

Chapter Five

Human Guinea Pigs

Atomic tests tested more than atomic weapons. They also tested people. Whether they consciously, purposefully used civilians as laboratory animals is open to debate. That they used military personnel for experimental purposes is, today, a known fact.

In July of 1951, the military asked the AEC for permission to have soldiers take part in maneuvers that would simulate atomic warfare. The request came just after the first series of tests held in Nevada, Operation Ranger. The original proposal was for 5,000 troops to take up combat positions at a barely safe distance from a test detonation, then advance into the area affected. The chairman of the AEC readily agreed under the condition that the military alone be responsible for the safety and living conditions of the troops.

The military wanted the tests to achieve two objectives: to train the troops to operate during an atomic attack, and to assess their psychological response to a nearby atomic explosion. Documents that were top secret for many years revealed no serious intentions of testing the long-term effects of radiation. Apparently long-term effects were not of concern.

With the approval from the AEC, the army constructed Camp Desert Rock at the Nevada Test Site. The soldiers assigned to the camp were given booklets that explained the importance of secrecy. They were prohibited from talking about the tests, the military maneuvers, or any effects they felt from the tests. They were warned about the dangers of poisonous snakes and insects, but the more deadly danger of radiation was not mentioned. A training film said that radiation was "the least important effect" and that it was fatal only within a mile of the explosion. The men were taught that they could "live through an atomic attack and live to fight another day," that "this explosion is one of the most beautiful sights ever seen by man."

To establish a realistic scenario for the experimental maneuvers, an imaginary war was created for Operation Buster-Jangle, the series that followed Ranger. A hypothetical "aggressor enemy" using tactics and formations common among "Communist armies," had invaded the northwest of the United States. The U.S. army had retreated to a battle line that reached from Los Angeles to Las Vegas. Here the American forces would hold the line. To counterattack, they would have to use tactical atomic weapons. As soon as the bombs detonated, U.S. troops would charge into the hole that had been blown open in the aggressor's lines.

The American forces were to dig into trenches and foxholes a safe distance from ground zero. Following the detonation, they would march forward. One purpose was to simply assess the physical effects: how well the men stood up to the shock wave, how effectively trenches sheltered them, how much the radiation would affect their ability to fight.

The maneuvers would also train the soldiers to operate under those conditions. Most of that training was psychological. An atomic battleground is a frightening place, especially to anyone who doesn't know what to expect. A single experience would prepare a soldier for the blinding white flash of light, the powerful, earth-jolting shock wave, the scorching heat, the debilitating radiation, and the general scene of fire, smoke and destruction.

The first Buster-Jangle test was of a very small tactical bomb with a 0.1 kiloton yield. The most powerful detonation involving soldiers yielded 31 kilotons, two and a half times more powerful than the Hiroshima bomb. Almost 3,000 troops would observe explosions in the Operation Buster-Jangle series. Almost 900 would engage in maneuvers. Still, they stayed more than six miles from the detonation, as required under AEC policy. Radiation experts monitored conditions as the troops advanced.

That experiment went well - too well to simulate realistic war conditions. Military leaders decided that, to be effective, maneuvers would have to come closer to the real thing. The soldiers would have to be close enough to feel fear and to suffer at least some negative effects. In a real war, the troops would not be preceded by radiation monitors telling them where to go and when to stop.

The AEC protested. Dr. Shields Warren, the AEC medical officer, recommended that soldiers not be exposed to increased danger because if some were injured or killed, it would be bad public relations. He officially stated that each test "is experimental and its yield cannot be predicted with accuracy."

But the military insisted. The Department of Defense agreed to accept all responsibility for safety and injuries. The AEC backed down, and in the next series of tests, troops were assigned to foxholes just 7,000 yards (about four miles) from ground zero. Soon the maximum permissible dose for soldiers was doubled from three to six rad, as measured - quite inaccurately - by exposure badges.

Tanks, Jeeps, rifles, artillery, ammunition and other equipment were deployed to see how the explosion would affect them. Cattle were tied to stakes at various distances, and smaller animals were locked in cages.

The men knew nothing about the dangers they faced. They were told that the radiation levels would be minimal and perfectly safe. They were not informed of even the most basic protective measures. Their health was not monitored after the tests, and they were never advised to watch for symptoms of the illnesses caused by radiation. Years later, when the illnesses began to occur, the military and AEC denied responsibility, and the Veterans Administration denied benefits. At the time of the tests, the soldiers were warned never to reveal that they'd witnessed an atomic explosion.

Most of the men were boys in their teens or low twenties - young enough to still feel themselves basically immortal. A certain machismo, or at least a fear of being seen as scared, led them to downplay their concern. While some men were ordered to take positions a few miles from ground zero, others, in later tests, volunteered to take forward positions just a few thousand yards from the explosion.

The men were ordered to kneel in their trenches, put their backs against the wall closest to ground zero, and cover their eyes until after the initial flash of light. Some though by no means all, of the men wore exposure badges to measure gamma radiation. There were no attempts to measure exposure to internal or external beta or alpha radiation.

An hour after the 31-kiloton explosion of Shot Charlie, the troops were trucked into the area where the equipment was deployed. Half an hour later, paratroopers were dropped in. Some of them walked within 175 yards of ground zero, where the radiation was especially probably over 100 roentgens.

Things went well. The observable effects of radiation - no one had any idea what would happen twenty years later - were minimal and temporary. In the next series of tests, Operation Upshot-Knothole, troops

were moved in closer. In fact, some officers were given a little training in the nature of nuclear explosions and then allowed to calculate how close they could go. They had to fill out a little form attesting to the fact that they'd been trained and were volunteering to witness the blast at a distance of their choosing. A trench was prepared just 2,500 yards (1.4 miles) from ground zero. Nine officers manned it and survived the explosion. Three thousand troops took shelter further back, then charged to within half a mile of the explosion.

A month later, Shot Badger featured almost 3,000 participants who were either deployed in trenches 2.3 miles from ground zero or were quickly brought in by helicopter after the explosion. Animals were tied even closer. Radiation in the trench exceeded the 500 roentgen/hour limit of the radiation measuring equipment. A thousand yards from ground zero, where the troops were inspecting test target equipment, readings showed 50 roentgens/hour.

Robert Carter, 17 years old at the time, was among those who witnessed Shot Hood. At 74 kilotons, it was the largest atmospheric nuclear explosion to happen within the United States. Although supposedly a fission bomb, an official at the Defense Nuclear Agency has alleged that it was actually a prototype of a new hydrogen bomb.

The bomb hung from a balloon in the sky. The explosion threw him and the men with him forty feet into the side of a mountain. He describes the ground as so hot he could hardly stand on it. He felt like he was being cooked as the vast fireball rose above them. The men then had to make their way toward ground zero, which, up close, was radiating 500 to 1,000 roentgens per hour. Along the way they saw animals burned in cages. Carter also swears he saw men, alive, inside a chain-link cage. They were wearing denim pants but no shirts. Their skin was peeling and their hair was falling out. Other soldiers in his platoon reported the same thing, and their testimonies later appeared in a legal brief in the Washington Law Review.

Robert Merron, 19 years old, witnessed the same explosion from a trench just 3,000 feet away. He and everyone around him wept uncontrollably as the fireball rose directly above them, searing them as if they at the door of a furnace. Mannequins above the trench burst into flames. After the men dug themselves out of the collapsed trench, they saw a hellish landscape of blackened sand and burning bushes. They were given gas masks before being ordered to march into ground zero.

Robert Merron had six feet of intestines removed by the time he was 30. Then he had a fibroid the size of an orange removed from his gut, and he now has two fused disks in his back.

Carter was very ill on the way back to camp. He had a bad "sunburn" from beta particles, and he was nauseated, dizzy and disoriented. A doctor told him he was suffering from radiation illness. Later his hair fell out in clumps and his health grew worse. When he told a doctor that he'd seen human remains in a cage at the test site, he was sent to a psychiatric hospital in Colorado. There he was accused of treason for what he had said and was warned not to repeat his story elsewhere. He was terrified by the experience, which he described as brainwashing. Today he is confined to a wheelchair and has been diagnosed as clinically paranoid.

Ted Przygucki witnessed 22 blasts. His job was to set up and inspect "Doom Towns," which were model towns that were subjected to atomic detonations to see what happened to them. The bizarre little towns had regular suburban houses with complete furnishings, including curtains, plates of food and mannequin occupants. Cars and school buses stood on the streets and had mannequins riding in them. The blasts completely wiped out the towns, crushing or knocking down the houses, tossing the vehicles through the air, shredding mannequins with broken glass and flying debris.

Przygucki was never told how much radiation he was exposed to. Undoubtedly the dose was very high. In 1956, his teeth fell out. He had a bad case of laryngitis every year until 1976, when he was diagnosed as having cancer of the larynx. He can no longer speak and must breath

through a hole in this throat. The Veterans Administration denies that the cancer was caused by his exposure to radiation. He says that most of his buddies at the Nevada Test Site have died.

Russell Jack Dann participated in maneuvers that started at 3.8 miles from 44-kiloton Shot Smokey in 1957. A tidal wave of dirt, dust, sagebrush and rattlesnakes washed over the men, knocking them down like bowling pins. They wore no protective clothing, goggles or respirators. He could see through his arm as X-rays shot through him. Just after the explosion, they marched directly to ground zero, where they found the shot tower completely gone - vaporized - and tanks tossed over and partially melted. The sand of the ground had been melted into glass. Later, decontamination consisted of being brushed off with a whisk broom and taking a shower.

Marine Major Chuck Brody was assigned to a front-line trench at the detonation of Shot Hood. Although he went within 400 yards of ground zero and spent hours inspecting equipment nearby, his official dose was only 13 millirems, less than a tooth X-ray. Nevertheless, his teeth fell out, he suffered chronic pain, and by 1976 contracted multiple cancers which killed him within a year. Despite repeated claims and court cases, his widow was denied the benefits legally due the widows of veterans who die of wounds.

Infantry personnel were not the only ones exposed to high levels of radiation. As mentioned earlier, naval personnel in the South Pacific received dangerous doses while attempting to decontaminate target ships. Even ships that had stayed away from the detonations were contaminated enough to give sailors dangerous doses.

Pilots and aircraft crews were also exposed to high doses of radiation. After each test, they had to fly into or near the cloud to measure radiation and to track the drift of fallout. Colonel Langdon Harrison flew missions at Nevada and Pacific tests. After the Nevada flights, pilots were lifted from their aircraft by cranes. Their clothing was destroyed and the men took repeated showers. In the South Pacific, however, there

were no such decontamination procedures. Pilots were told that they were intentionally being exposed to high levels of radiation just to see what would happen. Their film badges indicated exposure to 50 roentgens, but cockpit instruments indicated levels more than double that.

When Colonel Harrison contracted cancer, he requested his service records. They showed that he had been exposed to only 8.2 rem. He remembered seeing other data that indicated much higher doses. That data, however, has either disappeared or is being secretly withheld.

Several years after the tests stopped, a reporter began investigating the effects of these tests. While attending the funeral of a pilot who had died of leukemia, the pilot's widow suggested he talk to a certain other pilot. But it turned out that pilot had died of leukemia, too. The reporter found another pilot, but he was unable to speak because his larynx and part of his jaw had been removed when he developed cancer there. The reporter finally found a pilot who was alive and could speak, but he spoke only anonymously because he had open, festering lesions on his head and was still hoping to get the Veterans Administration to cover his medical costs.

Many records have disappeared, but those that haven't indicate that almost none of the military personnel received an excessive dose of radiation. The reason for that may be a case of secret records. In 1982, a former Army medic, Van R. Brandon, admitted that he had been ordered to keep two sets of books. "One set was to show that no one received an exposure above the approved dosimeter reading," he said. "The other set of books was to show what the actual reading was. That set of books was brought in a locked briefcase attached to [an officer]'s wrist by a set of handcuffs every morning." In the absence of records, veterans could not

receive medical disability compensation years later when they contracted any of many other illnesses years later.

NTS Workers

Another group of people exposed to high levels of radiation were the more than 200,000 civilian contracted workers at the Nevada Test Site. In many cases, they received higher doses than soldiers or nearby residents. Many of them witnessed several tests. Some had the job of racing into the ground zero area to recover equipment that had to be assessed immediately after the detonation. Unlike the soldiers, many of them worked at the NTS for several years, gradually increasing their doses. In some cases, their wives came down with cancer, possibly because the workers came home in contaminated clothes. The exposure went on for years after the tests went underground. Highly contaminated tunnels had to be cleaned of radioactive debris, irradiated equipment had to be retrieved, and venting after detonations spread radiation everywhere.

Jack Davis worked in the tunnels. His widow remembers him coming home covered with radioactive dust and ashes. She contracted cancer, as had Jack's first wife, who died of it. Jack was fired when he became so sick he had trouble breathing and couldn't walk back out of the tunnels. At his wife's request, he was fired from the job. His boss died of cancer a few years later. Jack died at the age of cancer at 49, after his voice box and tongue were removed. His son took work at the NTS now, but by age 43 his legs and back were bothering him and he felt fatigued and dizzy from an ailment that doctors can't identify.

Walter Adkins worked at the NTS, too. He was there at the Baneberry accident, one of the worst of 40 or more major leaks of radiation from an underground test. Three hundred feet of earth ripped open not far from the mess hall where he was drinking coffee. For 24 hours, hot gas and dust shot out of the ground. The cloud was swept up by a winter storm

and came down as snow, contaminating ski slopes hundreds of miles away. Since he'd always been told that radiation wasn't harmful, he didn't take shelter in a tunnel where others hid. He had a hacking cough for the next two years. Then he broke out with skin cancer. Then a tumor formed in his throat, then tumors at various points of his body. He had to have a coronary bypass operation to prepare for the removal of a tumor from his lung. Later, the entire lung was removed. Then he died.

Ben Levy worked at the NTS for 27 years. He was part of a crew that built the detonation towers, then cleaned up the remains of highly radioactive steel. Just 30 to 60 minutes after the explosion, while the ground was still smoldering, he and others had to go into ground zero to recover equipment and instruments. They never wore masks to prevent inhalation of dust. Today, most of his crew are dead, and he is suffering from lung problems and severe weakness. He remembers three friends who were contaminated by plutonium after a test to see if an atomic bomb would explode in plane crash. It didn't, but the crash dispersed the bomb fuel. One of the men died of a brain hemorrhage three days later. His family never saw the body and was never given a death certificate. Apparently an autopsy was performed without family permission, but the results are unknown.

Ken Case was a cowboy for the AEC. He drove cattle through ground zero of several tests, following along in the radioactive dust behind the herd. Fifteen or eighteen times he was taken to ground zero in a helicopter, arriving while the scene was still very hot in both senses of the word. When he showed a doctor radiation burns on his arm, the doctor told him to go back to work and not worry about it. He later had several feet of his intestines removed, and cancer spread throughout his body. His wife contracted cancer, and the disks of her spine fused together, a common result of exposure to radiation.

Eugene Haynes spent 20 minutes near ground zero and was exposed to plutonium balls that had been left there to see if the detonation would set off a chain reaction in them. His jeep was so radioactive that the AEC burned it. They also burned Haynes clothes and sent him home. He

would never return. He vomited constantly for six weeks and lost 40 pounds. A doctor told him it was because he was nervous. Then his whole body broke out in boils. He was sterile for many years, but then, unexpectedly, his wife conceived. Their son suffers from learning problems, asthma and other illnesses. Haynes later contracted adenocarcinoma of the lungs, which can only be caused by exposure to radiation or asbestos. After his death, his wife asked for records of his illnesses over the years. Despite years of daily blood and urine tests, the Department of Energy said that it had absolutely no record of him at all. When his wife and other workers and widows sued the government, the court demanded an autopsy first. The family refused because of so many cases in which body parts disappeared into AEC labs, never to return.

When Grace Swartzebaugh's husband worked on the Manhattan Project and then at the NTS. By 1958, he was suffering various problems, including cancer of the kidney. When they operated on him, they compared his insides to the inside of a tree and a big bowl of solid gelatin. A couple of days after his funeral, agents from the AEC came to his house to get "secret papers." While his widow went to get his brief case, the agents took everything from his desk - tax records, personal papers, everything - and burned it all.

Ken Prescott worked at the NTS. He witnessed several atmospheric shots, but most of his work was in the tunnels of underground shots. He later developed multiple myeloma, a cancer of the bones caused by radiation. Later he developed cancer of the bladder. His repeated attempts to sue the government inevitably failed. When Hazel O'Leary became Secretary of the Department of Energy under the Clinton Administration, he hoped that the new attitude there would affect the courts. In the name of himself and five other plaintiffs who had died of cancer, he sued again in 1994. The judge decided that there was insufficient proof that their cancers had been caused by radiation.

The decision upheld a perfect record for the courts. Of 216 NTS workers who have sued the government, none have succeeded. A law known as the Warner Amendment prohibits them or anyone else from suing

contractors for whom they worked. At best, under the Radiation Exposure Compensation Act of 1980 they can claim a lump sum compensation of \$75,000, a pittance compared to the cost of treating cancer, losing years of work time and dying sooner and more painfully, than otherwise might be expected. People have won more over dog bites. Acceptance of that single payment precludes the possibility of suing the government for any damages.

Even though virtually no one has successfully sued the government for damages caused by radiation, citizens are still trying to improve the situation. Almost 10,000 people have joined the National Association of Radiation Survivors, and --- veterans and their widows who have joined the National Association of Atomic Veterans.

The NARS claims that due to illnesses, disability and high medical costs, 42 percent of its members live below the poverty level. About 20 percent of its members have a child with a genetic defect - far more than the three to five percent of the nation as a whole. NARS survivors live an average of only 52 years, 20 years less than the average.

The NARS is trying to obtain health care and compensation for people exposed to radiation not only from nuclear tests, which it says have affected two million Americans, but also people who have been exposed at nuclear power plants, laboratories, weapons factories, uranium mines or during the Persian Gulf War. The organization is demanding a more scientific basis for establishing allowable radiation exposure levels. It has a long list of cancers and illnesses which it feels should be added to the diseases covered by the Radiation Exposure Compensation Act of 1988. It believes that radiation victims have the same right as other Americans to redress through the judicial system. It is pushing for the government to pass a National Nuclear Ethics Law which would make it a criminal offense for government employees or contractors to deceive citizens about potential exposure to radiation. Finally, and most ideally, the NARS is advocating a comprehensive test ban and an end to the development of nuclear weapons.