UNIT 4:

GROUND ZERO

BBS. 96-116

The Crossroads: The End of World War II, The Atomic Bomb and the Origins of the Cold War

This exhibit contains graphic photographs of the horrors of war. Parental discretion is advised.

[*Editor's Note*: The following is the verbatim text of the original Smithsonian script including a few parenthetical indications of material that was to come. This reproduction omits all photographs and their captions, but retains an illustration, a chart and a few facsimiles of documents from the planned exhibition.]

UNIT 4: GROUND ZERO

Before the Bomb: Two Cities At War

HIROSHIMA, JAPAN: A MILITARY CITY

On the morning of August 6, 1945, Hiroshima was the seventh largest city in Japan, with a population of some 350,000. Located on the southwestern shore of the main island of Honshu, where the delta of the Ota River enters the Seto Inland Sea, the city took its name from the Hiro-shima-Jo ("Broad-island-castle"), a fortress established by a local lord in 1594.

Hiroshima was a prefectural capital, and a key economic center for western Japan. In April, 1945, the Second General Headquarters, which would plan and lead the attack against the expected American invasion, was also established in Hiroshima. Supplies for Imperial forces in China, Southeast Asia and the Pacific had passed through the city's Ujina port throughout World War II.

HIROSHIMA AT WAR

Hiroshima had escaped the incendiary bombing campaign that was destroying many smaller towns. Puzzled, some residents of the city speculated that the U.S. Army Air Forces had spared the city because of its beautiful location on the Inland Sea. Others believed that the city was protected because so many Japanese American families had emigrated to America from the region. One wild rumor even suggested that Hiroshima was the birthplace of President Truman's mother.

Convinced that the B-29s passing over the city each night would eventually strike Hiroshima, city officials prepared for an attack. Concerned that flooding would result from the destruction of a dam above the town, they issued bamboo floats to the leaders of neighborhood associations, and ordered that similar floats be constructed for everyone in the city. Students were released from class and put to work clearing firebreaks in the center of the town. Sand

and water buckets were kept filled. When the attack came, the people of Hiroshima were determined to be prepared.

HIROSHIMA, 8:15 A.M., AUGUST 6, 1945

The morning of Monday, August 6, was sunny and hot in Hiroshima. By 7:00 a.m. people were pouring into the city center to begin the work day. In addition to the usual officers and factory workers, merchants and shop keepers, some 8,300 junior and senior high school students were laboring to demolish 2,500 buildings that had been evacuated to create firebreaks in six districts of the city.

The first air raid warning of the day sounded at 7:09, as "Straight Flush," a B-29 weather aircraft piloted by Capt. Claude Eatherly, appeared over the city. "Enola Gay," accompanied by two other B-29s, "The Great Artiste" and "Number 91," approached Hiroshima from the northeast one hour later. At precisely 8:15:17 the Little Boy bomb was released from the *Enola Gay*. Forty-three seconds later it detonated 580 m (1,870 ft) over the Shima Hospital.

NAGASAKI, JAPAN: WINDOW ON THE WEST

Founded in the 12th century, Nagasaki is located on the southwestern island of Kyushu, where the Nakashima and Urakami rivers enter the East China Sea. On August 15, 1549, the Jesuit father Francis Xavier landed on Kyushu and founded the first Christian missions in Japan. Intrigued by the new religion, and by Western firearms, Japanese leaders at first tolerated the Spanish and Portuguese presence at Nagasaki. After 1587, however, they banned Christianity and severely persecuted its adherents.

For two-and-a-half centuries, from about 1600 to 1850, all foreign contacts with Japan were made through Nagasaki, where a small group of Dutch East India company traders were tolerated on the tiny island of Dejima in the harbor. Nagasaki retained its importance as a center of Western economic and cultural influence following the opening of Japan in 1854.

Christians re-emerged who had remained secretly faithful during the centuries of persecution. Nagasaki was once more the center of the Catholic Church in Japan.

NAGASAKI AT WAR

In August 1945, Nagasaki had a population of about 270,000 people and was a major industrial center. One of the most important shipyards in the nation was located in the harbor. The great naval base of Sasebo was nearby. The giant battleship *Musashi* was based here during the closing months of WWII. In addition, the city was home to a variety of factories critical to the war effort, including the Mitsubishi Steel Works.

NAGASAKI, 11:02 A.M., AUGUST 9, 1945

The morning of Thursday, August 9, was mild and humid in Nagasaki. The skies were fairly clear at 8:30 a.m., when a B-29 weather aircraft flew over the city. By mid-morning, however, a weather front moving in from the East China Sea had spread a thick layer of cloud over Nagasaki.

Having been forced to abandon their primary target, Kokura, because of haze and smoke, the B-29s *Bockscar* and *The Great Artiste* were running low on fuel as they approached Nagasaki. The bombardier of *Bockscar* made a radar approach, but released the "Fat Man" bomb through a momentary break in the clouds at 11:02 a.m. The weapon exploded 503 m (1,540 ft) above the Urakami River Valley, 2.5 km (1.5 mi) from the intended target in the center of the city.

NAGASAKI, AUGUST 10, 1945

Mr. Yosuke Yamabata, a resident of Nagasaki, set out with his camera early on the morning of August 10, 1945. He spent the day walking through the shattered Urakami Valley, capturing scenes of the incredible destruction—and the faces of those who, for the moment, at least, had survived. Mr. Yamabata himself died only a few years after the war, probably from his exposure to residual radiation.

"The Incredible Avalanche of Light"

"There was a blinding white flash of light, and the next moment—Bang! Crack! A huge impact like a gigantic blow smote down upon our bodies, our heads and our hospital."

Dr. Tatsuichiro Akizuki, Franciscan Tuberculosis Hospital, Nagasaki

"Flash! The incredible avalanche of light seemed to last for several seconds...momentarily the bright August sun was completely absorbed and negated by it."

Ms. Kimie Akabae, Nagasaki

THE FIRST UNSPEAKABLE SECOND

The two bombs dropped on Hiroshima and Nagasaki were quite different, but the sequence of events after the detonation of each weapon was about the same.

0.0 second: The temperature at the epicenter (burst point) reaches several million degrees within one-millionth of a second following detonation. All of the material composing the bomb become ionized gas and gamma rays—electromagnetic radiation of very short wavelength (0.01 to 10 nanometers).

0.1 second: A fireball with a diameter of 15 meters (50 ft) and a temperature of some 30,000 C (540,000 F) has formed. Radiation in the form of alpha and beta particles, gamma rays and neutrons (3% of the total energy of the bomb) streams out in every direction. Alpha and beta particles do not reach the ground. Neutrons and gamma rays reach the ground almost instantly and are responsible for the initial radiation damage to living organisms as well as the irradiation of soil and structures in the area of the blast.

0.15 second: The fireball is expanding, but a shock wave expands even more rapidly, heating the air until it becomes luminous. As the air begins to cool, the hot inner core of the fireball becomes visible for the first time. It will remain visible for some ten seconds.

0.2 second: The temperature at the core of the expanding

fireball is now about 7,700 C (13,900 F). Thermal energy released by the explosion (35% of the total energy) ranges from near ultraviolet to infrared wavelengths. The vast amounts of infrared energy generated during the 0.2–0.3 seconds following the explosion cause most of the initial thermal burns to human beings.

1 second: The fireball reaches its maximum diameter of 200-300 m. The blast (50% of the total energy) is now complete. The overpressure at the *hypocenter* (the spot directly under the explosion) at Hiroshima is estimated to have reached 4.5 to 6.7 tons per square meter, 45-67% of normal atmospheric pressure. Maximum pressure at the Nagasaki hypocenter may have been as high as 10 tons per square meter. The blast wave generated by the explosions moved through the air and across the surface of the ground at approximately the speed of sound until it dissipated.

PIKA!

"Someone shouted, 'Look, a parachute!' We looked up and saw something falling slowly... Suddenly, 'Pika!' There was a tremendous flash, and everything turned completely dark."

Taeko Teramae, third year student, Shintoku Girls' High School, Hiroshima

Few survivors who were close to the center of the Hiroshima or Nagasaki explosions would remember hearing the sound of the blast. What none of them would ever forget was the *Pika*—the flash of incredibly brilliant light and heat that occurred as a nuclear explosion heated the sky to luminescence. The burst of light was quickly followed by a tremendous air pressure wave that bent steel bridges, toppled buildings and reduced wooden houses to kindling.

"Then a tremendous flash of light cut across the sky...It seemed like a sheet of sun."

Rev. Kiyoshi Tainimoto, from "Hiroshima" by John Hersey (1946)

"The moment there was a flash, it felt as though thickly mixed

paint was thrown at me, and I thought that heaven had fallen. At that instant, I was burned from face to shoulder to navel."

Tada Makiko, housewife, Nagasaki

"Suddenly there was a brilliant flash, like a photographer's magnesium flash...Then came the blast with a deafening bang and I felt as though I had been kicked in the guts...The world was black."

F.J. Johnston, Australian prisoner-of-war in Nagasaki, 1945

A MOMENT FROZEN IN TIME

The flash of light generated at the moment of detonation cast shadows on walls, steps, buildings and even stands of bamboo in Hiroshima and Nagasaki. The unbelievable heat, which reached 3,000 to 4,000 C (5,400 to 7,200 F) at ground level under the explosions, altered the color of the surrounding material, etching the shadows in place. Human flesh was horribly burned and, near the hypocenters, people were vaporized altogether.

People caught in the open within one kilometer of the blast experienced temperatures so high that the dark, heat-absorbing pattern of their clothing was burned into their flesh.

HIBAKUSHA

Hibakusha ("explosion affected person") is a term that has been applied to atomic bomb survivors for the past half century. Some hibakusha still bear the mark of their experience in the form of keloid scars. They have suffered the psychological pain of surviving an experience that took the lives of friends and loved ones. Many have suffered the post-war prejudices of their countrymen, who believe that survivors were tainted by exposure to radiation. All of them are aware of the fact that they have a higher than average chance of developing leukemia or some other cancer. Only they can tell you what it is like to survive an atomic explosion.

Two Cities in Chaos

HIROSHIMA: THE FIRST HALF HOUR

Hiroshima stands on a flat river delta, with few hills to protect sections of the city. Moreover, the bomb was dropped on the city center, an area crowded with wooden residential structures and places of business. Beneath the column of smoke that rose over the city following the explosion, tens of thousands were already dead or dying.

Even before the fires began to race out of control, the physical destruction of buildings and other structures within 2 km (1.2 mi) of the blast was virtually complete. The sheer force of the explosion had shifted the position of a large steel bridge close to the hypocenter; flattened all wooden buildings and steel frame structures; and collapsed the floors and roofs of reinforced concrete buildings designed to withstand earthquakes.

NAGASAKI: THE FIRST HALF HOUR

The pattern of destruction in Nagasaki was shaped by the geography of the city. The bomb was dropped over the Urakami Valley, a residential and industrial area. The center of Nagasaki, the harbor, and the historic district were shielded from the blast by the hills flanking the Urakami River. In the affected area, however, an estimated 12,000 buildings were destroyed by blast or burned in the fires resulting from the bomb.

As a result of a more powerful bomb and the focusing effect of the surrounding hills, physical destruction in the Urakami Valley was even greater than in Hiroshima. Virtually nothing was left standing. Worshippers in neighborhood shrines and temples and in the great Urakami Cathedral, died at their prayers. Children died in their classrooms, prisoners in their cells, workers at their machines.

"Houses and trees were leveled as far as the eye could see, and fires were beginning to break out in the ruins. At the side of the road I saw the corpse of a man who had been guiding a horse cart, still on his feet with his hair standing on end like wire...The river was filled with dead and half-dead; burned children were

screaming, 'Mommy! Mommy!'; and mothers searched for their children, calling out names in faltering voices."

Ms. Hide Kurokawa, Nagasaki

FIRESTORMS

In both cities, the intense heat generated by the explosions created fires near the hypocenter. Fed by broken gas and electrical lines, the initial fires spread out of control. Fire stations and equipment had been destroyed, fire fighters were dead or injured, water pipes were ruptured.

High winds created fire storms within one half hour of the blast. In Hiroshima, where conditions for such a conflagration were perfect, winds within the firestorm reached a maximum velocity of 65 km/h (40 mph) 2-3 hours after the blast. In the center of the firestorm, temperatures reached 1,899 C (3,450 F). Wood and fabric burst into spontaneous flame. The steel structures of bridges and buildings twisted out of shape. Objects of metal, glass and stone were shattered, melted and fused.

A SEA OF FLAMES

The gigantic firestorm in Hiroshima ultimately destroyed 13 square kilometers (5 square miles) of the city. Almost 63% of the buildings in Hiroshima were completely destroyed and nearly 92% of the structures in the city had been either destroyed or damaged by blast and fire.

Because of the hilly geography of Nagasaki and the location of the hypocenter away from the city center, the conflagration there was limited to the Urakami Valley and part of downtown. It was nonetheless devastating—some 22.7% of Nagasaki's buildings were consumed by the flames.

THE FIRST HIROSHIMA MUNICIPAL GIRLS' HIGH SCHOOL

On the morning of August 6, 1945, 544 first and second year students and eight teachers of the First Hiroshima Municipal Girls' High School were clearing rubble to create a fire break

near the south side of the Seifukuin Temple in the district of Zaimoku-cho, some 300-500 m (1000-1650 ft) from the hypocenter. They took the full force of the blast and heat. Most died instantly. A few apparently survived the initial explosion only to die in the flames that followed. It is estimated that perhaps 16 of the 544 girls survived.

"...on the following morning I bandaged my head—I too was burned and injured—and went to the work site. Many of the students'...eyeballs had popped out, all the way out. And their mouths were ripped open by the blast, their faces were burned, their hair gone, their clothes were burned off all over their bodies, and they were blown helter-skelter by the blast... the girl's school uniforms were burned off completely; they were completely stripped...naked. It was just like, well, a scene from hell."

Zoroku Miyagawa, Principal, Hiroshima First Girls' High School, December 3, 1945

SHATTERED LIVES

Many individuals who were close to ground zero in the two cities were never found. Their bodies were consumed by the heat and blast of the explosion, or burned beyond recognition in the firestorms that followed. Scattered here and there among the ashes, a handful of objects survived to remind family members of cherished loved ones who had simply vanished.

SCENES OF DESTRUCTION: HIROSHIMA AND NAGASAKI, AUGUST 7–10, 1945

"They all had skin blackened by burns...They had no hair because their hair was burned, and...you could not tell whether you were looking at them in front or in back... They held their arms bent [forward]...and their skin—not only on their hands, but on their faces and bodies too—hung down... I can picture them in my mind, like walking ghosts..."

A grocer, Hiroshima

"And one thing that has never disappeared from my mind was...a girl in the rain of about eighteen or nineteen years old,

and she had no clothing on her body but half of her panties, which did not cover her. She took a few steps toward me, but, as she was ashamed of her situation, she...crouched on the ground...and asked me for help...and when I looked at her hands, I saw the skin was burned off, as if she were wearing gloves. Her hair was disheveled and her breast was red from burns...I was at a loss."

A Hiroshima factory worker

"Many corpses were found at places where there was water—rivers, old wells, cisterns, ponds and the like. People who did not die instantly had, it appears, exerted themselves to the limit in their search for water."

A member of the Marine Transport Rescue Team, Hiroshima, 1945

"At the side of the road I noticed a young boy standing beside a...pine tree, and the vision made me stop in my tracks. His legs were spread open in a running posture and his hands were thrust forward as though he were about to grasp something. It was the corpse of a boy, frozen like a statue...I noticed a dead kitten clamped to the...pine tree in front of the boy...obviously having jumped onto the tree to avoid his grasp, and its body was covered in the scorched and frizzled remains of fur. Without disintegrating or falling from the tree, it glared with eternally locked eyes in the direction of the boy."

Ms. Chise Setuguchi, Nagasaki

COPING WITH CHAOS

In Hiroshima, and in the Urakami section of Nagasaki, the devastation was staggering. Hiroshima had suffered the loss of city and prefectural officials, military leaders, hospitals and medical professionals who might have organized the relief effort. A steady stream of half-naked, bleeding and burned survivors staggered away from the center of destruction. Surviving doctors and nurses established make-shift relief stations, but beds, essential medical supplies, and trained personnel were in desperately short supply.

Relief parties moving into the devastated areas discovered

that there were few people left to rescue. Their biggest task was the recovery and disposal of tens of thousands of corpses. Those who had died immediately were buried beneath the rubble of the city. Those who had lived for a few minutes or hours longer were piled deep on bridges and along the river banks, or floating in the rivers, where they had sought to escape the firestorm.

"Some time after dark, a whistle and a horn blew; the Relief Train and an Army truck had arrived. The train was packed...But the truck was even worse; bodies were piled so high [that] surely another could not have been added. Neither dead nor living, nor male and female, could be distinguished among the overlapping bodies...their hair was burned crisp and wrinkled; their clothes were in tatters; exposed skin was badly burned and blood soaked...their faces, backs, arms and legs had been pierced by countless glass, wood and metal splinters...and some kind of pitch-black substance, like coal tar, stuck to their heads and bodies."

An intern on duty at the Omura Naval Hospital, Nagasaki, August 9, 1945

"I threw myself into the search for my family and cast about the still hot rubble. Before long the tips of my shoes burned and my toes stuck out, and my hands became swollen with blisters...looking on the road, I found a charred corpse that seemed to be my wife in front of our neighbor Mr. Baba's house. I intuited that the dead baby on her back was our one year old daughter Takako. However, I was never able to find our eight year old son Tateki and our eldest daughter Mariko."

Tsuneo Tomimatsu, Nagasaki

"On the fifth day of duty we were assigned to disposal of the countless corpses floating in the rivers, bobbing up and down with the waves caused by the ebb and flow of the tide. The corpses were retrieved by boat and transported to shore. Several dozen bloated, naked bodies was a sight too gruesome to look upon. When we reached out and grabbed the hand of a decayed corpse, the skin just slipped off; it was very difficult to haul them into the boat."

A member of the Marine Transport Rescue Team, Hiroshima, 1945

A STORY OF SURVIVAL

"I thought she was dead, but finally found her alive. I hoped that she could at least die at home, so I borrowed a cart from a neighbor and went to Kuba to take her home. I had brought her up since she was two years old after her father died...I took her to the Red Cross Hospital every day. I remember someone taking our picture on the way back from the hospital... She was so pitiful, burned on the left side of her body, face and arm. I still cry when I think of it."

Mrs. Kohide Matsuda, 1973

"We gathered scraps of lumber and made a neat pile...We carried the children's bodies over and placed them on the pile with Umito in the middle. I dressed Umito in a nightshirt of Michiko's I found in the ruins of our house and on top of that put his uniform trousers that had a tag saying 'Matsuo 1-6' sewn on the lining. I covered little Hiroto and Yukiko with blankets—the last gesture of love I could make for my children. We stacked another heap of wood over their bodies. I said a small prayer, lit the fire below their heads, and then passed the match to the four corners of the pile."

Atsyuki Matsuo, Nagasaki

COUNTING THE DEAD

The chaotic conditions in both cities following the disaster made it difficult to prepare an accurate account of the human dimension of the tragedy. This was complicated by the fact that death from radiation poisoning incurred at the time of the bombing might not claim its victim for days, weeks, months or years after the event.

Several studies based solely on the disposal of bodies set the initial toll for Hiroshima at between 42,000 and 93,000 individuals. Those counts are, however, undoubtedly low and incomplete. A more accurate survey combining body counts, unresolved missing person reports and interviews conducted by neighborhood associations during the year following the bomb-

ing suggests that as many as 130,000 individuals lost their lives as a direct result of the bomb up to the beginning of November 1945.

A similar survey by the Nagasaki officials set the final death toll for that city at 60,000 to 70,000.

A Deadly New Threat: Radioactivity

RADIOACTIVE FALLOUT: THE "BLACK RAIN"

Following the atomic explosions, nuclear fission products of uranium and plutonium, radioactive isotopes that had escaped fission, and other material irradiated by neutrons from the bombs, were carried high into the atmosphere. The enormous amount of material thrown into the air, combined with the heat and thermal currents generated by the growing firestorms, led to rain in both cities within 30-40 minutes of the bombing.

The "black rain," as it came to be known, carried the radioactive materials back to earth in the form of fallout. The sticky, dark, dangerously radioactive water stained skin, clothing and buildings. Contact with the skin, ingestion through breathing, or the consumption of contaminated food or water resulted in radiation poisoning.

"I went to report to the dean of the college that the patients had been evacuated, but I found him covered by a raincoat and lying asleep on a hill-side vegetable patch with terrible wounds all over his body. Large drops of black-colored rain were falling and spattering on the raincoat. I thought to myself for the first time that Japan had lost the war."

Dr. Takashi Nagai, Nagasaki

THE INITIAL RADIATION FROM THE BOMB

The nuclear weapons dropped on Hiroshima and Nagasaki expended about 3% of their total energy in the generation of ionizing radiation—high-energy particles and rays with sufficient energy to "ionize" neutral atoms, that is, to strip electrons away from them. While some of this ionizing radiation is absorbed by

the air, neutrons (electrically neutral sub-atomic particles) and gamma and X-rays (extremely high energy forms of light), did reach the ground and damage living tissues exposed to them. Close to the hypocenters of the explosion, dosages were high enough to be immediately lethal, provided the exposed person was not already killed by flash, blast or fire.

INDUCED RADIOACTIVITY

The Hiroshima and Nagasaki bombs also created induced or residual radioactivity. The initial burst of radiation from the bombs irradiated the soil and all other materials in the area of the blasts. The absorption by all kinds of substances of slow neutrons from the explosions was particularly important. New forms (isotopes) of chemical elements were created that themselves emitted ionizing radiation.

On August 13–14, 1945, Japanese physicists investigating the area near the hypocenter at Hiroshima found unusual levels of radioactivity in the soil, in the bones of a horse, and in the sulphur of electrical insulators on utility poles. Ultimately, scientists would identify a variety of unusual radioactive elements in the soil, roofing tiles, asphalt, and concrete near ground zero in the two cities.

RADIOACTIVITY AND LIVING TISSUE

Living tissue may be exposed to ionizing radiation either directly, as in exposure to an atomic explosion, or through exposure to or ingestion of materials emitting residual radiation. In either case, the danger is the same.

Ionizing radiation transforms a neutral atom into a charged ion that may bond to another atom, altering the structure of the original molecule, the way it reacts chemically, and the function it performs when part of a living organism. These altered molecules may act as poisons, hindering the normal functions of the cell of which they are a part.

MANHATTAN PROJECT SCIENTISTS AND THE RADIATION EFFECTS OF THE BOMB

The American, British and refugee scientists who designed the Hiroshima and Nagasaki bombs were aware of the dangers of radioactivity. Since the beginning of the twentieth century, experimenters with radioactive materials had suffered ill-effects, as had workers who had painted radium watch-dials and instruments.

At the time of the first atomic bomb test in New Mexico in July 1945, Manhattan Project scientists had expressed concern over the possibility of radioactive fallout on people downwind of the test site. The very high level of radioactivity produced by the "Trinity" test explosion nonetheless came as something of a surprise.

Most scientists, however, continued to believe that radiation poisoning would not claim many victims when the atomic bomb was dropped on Japanese cities. Those individuals most in danger of such poisoning, they reasoned, would already have died as a result of blast and heat.

THE MYSTERIOUS "A-BOMB DISEASE"

At first, the medical professionals who treated bomb victims in Hiroshima and Nagasaki were overwhelmed with the traumatic effects of the bombs. Individuals had been crushed, struck by flying objects and burned. The severe nature of the burns suffered by survivors exposed to the initial flash were [sic] particularly shocking and surprising. In some cases, the fabric pattern of clothing had actually been burned into the skin.

The real puzzle, however, came from individuals who suffered from unexplained loss of appetite, nausea and vomiting, abnormal thirst, diarrhea, and a general malaise. In up to 30% of the survivors, the symptoms occurred alone or in combination within a half-hour to three hours after the explosion. By August 17 in Hiroshima(?), 181 unexplained fatalities had resulted from these types of symptoms.

"The bodies of the dead students from the school where I taught

had been collected for the most part, but now an increasing number of students who had no visible injuries were dying. They developed a fever several days after the explosion; their hair fell out completely; and thick blackish-red blood began to flow from their gums. Finally, they sputtered hysterically in the throes of fever and then died one after another. There were others who went insane, and apparently seized by some unknown fear, refused to come out of the toilets and closets. The school dormitory had to be closed temporarily, and I began to receive word that many of the young girls who had gone home to recuperate were also becoming sick and showing the above symptoms."

Ms. Chie Setoguchi, Nagasaki

"My sister soon developed diarrhea, and unsightly purple blotches appeared on her skin. This was the final signpost. She began to mumble deliriously. I had heard that water was not good for an injured person, but I gave her as much as she wanted because I knew the end was near."

Ms. Hisae Aoki, Nagasaki

THE MYSTERY IS SOLVED

New symptoms appeared during the days and weeks following the bombing. Skin hemorrhages and lesions appeared on the face, chest, neck and upper arms, often complicated by infections. There was widespread hair loss, internal hemorrhaging, and reddening and pain in the larynx, gums and palate. The symptoms appeared in some 61% of all Hiroshima survivors who had been within one kilometer of the hypocenter, and only 7% of those who were exposed over five kilometers from ground zero.

By the end of the first week of September 1945, it was becoming clear to physicians in the two cities, and to American authorities, that the A-bomb survivors were suffering from radiation poisoning. This was confirmed by analyses of blood and bone-marrow samples from victims. It had also become apparent that individuals exposed to fallout, and those who had been exposed to induced radiation during the hours and days following the explosion had also contracted radiation poisoning.

"An old woman...died within a few days of the bomb, showing many spots on her body...I know it is terrible to say this, but those spots were beautiful. They were just like stars—red, green-yellow and black—all over her body, and I was fascinated by them."

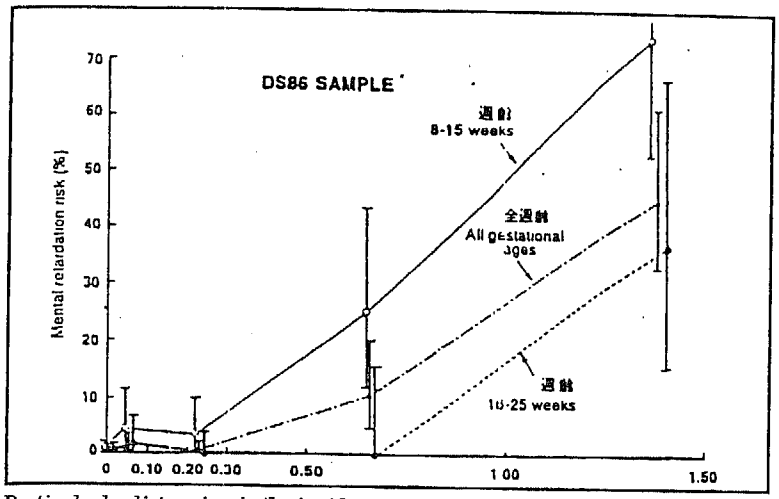
Physician, Hiroshima

"We heard the new phrase, 'A-bomb disease.' The fear in us became strong, especially when we could see certain things with our eyes: a man looked perfectly well when he rode by on a bicycle one morning, suddenly vomiting blood then dying...Soon we were all worried about our health, about our own bodies—whether we would live or die. And we heard that if someone did get sick, there was no treatment that could help. We had nothing to rely on, there was nothing to hold us up."

A Buddhist Priest, Hiroshima

SHORT-TERM MORTALITY AT HIROSHIMA AND NAGASAKI

Over 90% of individuals within 500 m (1600 ft) of the hypocenters at Hiroshima and Nagasaki died. At a distance of 1.5 kilometers (roughly one mile) over 2/3 of all people were casualties, and 1/3 died. Half of the individuals exposed at a distance of 2 km (1.2 mi) were casualties, 10% of whom died. Casualties dropped to 10% at distances over 4 km (2.4 mi). Most of those who received high dosages of radiation close to the hypocenter died immediately or during the first day. One third of the total number of fatalities had occurred by the fourth day; 2/3 by day 10; and 90% by the end of three weeks.



Particularly distressing is the incidence of mental retardation among those exposed during their first 8 to 25 weeks in their mothers womb. Those who received a dost of 1 Gray, in the womb, had approximately a 20% risk of mental retardation. These children had both unusually small head size and later were found to have low IQ and school performance. IQ scores showed a linear decline with increasing radiation dose.

LONG-TERM RADIATION EFFECTS IN HIROSHIMA AND NAGASAKI

The immediate crisis in Hiroshima and Nagasaki had passed by the end of December 1945. Individuals who had suffered from radiation poisoning had either died or, apparently, recovered. It soon became obvious, however, that exposure to radiation created longer-term health problems.

Thermal burns were covered with disfiguring scars known as keloids. Severe anemia and other blood disorders, cataracts, sterility in both sexes, and menstrual irregularities appeared. Children exposed to radiation while in the womb faced a 20% risk of being mentally retarded. Some exposed children were born with unusually small heads or other deformities.

"In April 1952, Yoshimasa entered T. Elementary School.

When the name Yoshimasa Yoshida was called, he responded, but, unable to understand the teacher's order to rise, he remained seated blankly...The result of the [intelligence] test we requested was, after all, really quite low... We left the school gate just when the cherry blossoms were in full bloom. Hearing the healthy children's voices singing behind us, I burst into tears. Yoshimasa, who was skipping ahead of me, looked back and smiled..."

Mrs. Jirokichi Yoshida, mother of a retarded child exposed to radiation in utero

CANCER AMONG SURVIVORS

Fifty years after the atomic bombing of Japan, it is apparent that the incidence of some cancers is significantly higher among bomb survivors than in a normal population. The first cases of leukemia (a cancer of the blood) appeared in Nagasaki in 1945 and Hiroshima a year later. The disease climbed to a peak among survivors during the years 1950-1953. A survivor who received 1 gray (100 rads of ionizing energy absorbed per kilogram of body tissue) in August 1945 is almost five times more likely to contract leukemia than a normal individual.

The incidence of cataracts of the eye and cancers of the urinary tract, breast, lungs, colon, esophagus and stomach are also higher among atomic bomb survivors. Genetic damage is apparent in the non-reproductive cells of atomic bomb survivors. The impact of this damage on the offspring and descendants of survivors has been studied carefully, but there is no significant evidence that genetic problems have been passed to future generations.

"How would people look at me. The more I thought about it the more apprehensive I became...The burns on my back did not heal for fifteen years, and I had to receive treatment for them continuously. After a skin transplant operation in 1960 the wounds finally covered over, but ulcers soon formed in the [keloid] scars. The ulcers got worse and five years ago I entered another hospital and received another operation to remove them. Subsequently, I have been in and out of the hospital repeatedly...

According to my doctor, modern medical science still knows of no efficient method to treat these lesions."

Sumiteru Taniguchi, Nagasaki

THE ATOMIC BOMB CASUALTY COMMISSION

Anxious to obtain a better understanding of the effects of radiation on large populations, the U.S. government established an Atomic Bomb Casualty Commission (ABCC) under the auspices of the National Academy of Sciences in 1947. The ABCC would eventually identify 120,000 bomb survivors, establish their precise location and radiation dosage, and monitor their health over an extended period.

The ABCC was bitterly criticized in Japan for its refusal to provide health services to victims. The decision was based on a reluctance to draw patients away from Japanese physicians and on the American perception that treating the survivors would amount to an admission of guilt for the bombing. From the Japanese perspective, it simply appeared that the U.S. government, through the ABCC, regarded the atomic bombing of Japan as an experiment and the survivors as guinea pigs.

In an attempt to ease the situation, the ABCC was reorganized in (yr.?) as the Radiation Effects Research Foundation (RERF), with joint Japanese–American participation.

The Radiation Effects Research Foundation, still active today, has proven invaluable in advising on the treatment of victims of subsequent nuclear disasters, including the 1986 explosion of the Soviet reactor at Chernobyl.

SADAKO AND THE THOUSAND PAPER CRANES

Sadako Sasaki was two years old when she was exposed to radiation 1600 m (1 mi) from the hypocenter in Hiroshima. In 1955, the healthy twelve-year-old girl, the fastest runner at the Noborimachi Primary School, was diagnosed as suffering from acute leukemia. According to Japanese folk belief, cranes live a thousand years and are a symbol of good health. Sadako spent the last months of her life attempting to fold one thousand paper

cranes. When she died in October 1955, she had completed only 964. Her classmates finished the rest.

Determined to raise funds for a monument to Sadako and the other child victims of the atomic bomb, the young people of Hiroshima began a letter writing campaign to schools across Japan. The effort captured the public imagination, raised seven million yen ($20,000) and established Sadako as a symbol of the cost of war in the nuclear age. Today her statue stands in the Hiroshima Peace Memorial Park, adorned with thousands of the paper cranes that arrive each year from school children around the world.

UNIT 5: THE LEGACY OF HIROSHIMA AND NAGASAKI

The introduction of nuclear weapons into the world, and their first use at Hiroshima and Nagasaki, left powerful legacies beyond the long-term radiation effects on the survivors. For Japan, the United States and its Allies, a horrific war was brought to an abrupt end, although at a cost debated to this day; for the world, a nuclear arms race unfolded that still threatens unimaginable devastation. The bombings of Hiroshima and Nagasaki cannot be said to have simply caused either the end of the war or the nuclear arms race, but they have exercised a profound influence as military and political acts, as symbols of the arrival of the nuclear age, and as a glimpse of the realities of nuclear war.

Japan Surrenders

The sudden surrender of Japan on August 14, 1945—only eight days after the bombing of Hiroshima and five days after Nagasaki—have led many to believe that the atomic bomb alone forced the Japanese government to accept defeat. Actually, the bombings were one of two major shocks to Japan. The other was the Soviet Union's declaration of war on August 8/9, which destroyed the hopes of the Japanese elite for a compromise peace through Moscow. The Soviet declaration was immediately followed by a massive surprise attack on the Japanese Army in north China.

The bombing of Hiroshima and Nagasaki nevertheless played a crucial role in ending the Pacific War quickly. Some have argued that no atomic bombs were needed to shock the Japanese leadership, because a peace agreement was already possible if Emperor Hirohito's position had been guaranteed. Others have argued that only one bomb was needed and that the destruction inflicted on Nagasaki was unnecessary. These matters remain hotly contested, but the surrender of Japan was doubtlessly a critical legacy of Hiroshima and Nagasaki.