The first atomic bomb dropped at Hiroshima
on August 6, 1945, killing 140,000 people.
Below, the former Hiroshima Prefectural Building for Promotion of
Industry, which was preserved as the "Atomic Bomb Dome."
Both images at pegasus.phys.saga-u.ac.jp/peace

Amerasia Journal 27:3 (2001)/28:1 (2002): 153-166

Why Does a Pediatrician Worry about Nuclear Weapons?

James N. Yamazaki

Present War, Past Wars

When my wife, Aki, called me to the television that morning, I first thought it was a scenario of what could happen to the World Trade Center, but the caption read: "live"—the real thing. Suddenly a cascade of memories beginning before World War II began to tumble out and become entangled with the terrible scenes that now confronted us.

Aki and I have warm memories of Lower Manhattan—we were married at Grace Church at Broadway and Tenth Street on April 1, 1944. The *New York Times* took note of the occasion with a photo captioned "Japanese American soldier and his bride, a student at Columbia's Teacher's College." The photo is the only picture we have of the wedding. Aki was able to go directly to New York from the Santa Anita Assembly Center, where she had been ordered to report along with other Japanese Americans after the Japanese attack on Pearl Harbor. She thus avoided going to the Amache Concentration Camp, where her parents were interned. Terri, Aki's sister, was a graduate student at Julliard School of Music, having been awarded a scholarship following a nationwide audition. Aki then left Teacher's College to be with me at Carlisle, Pennsylvania where I was attending the U.S. Army Medical Field Service School at Carlisle Barracks.

The best man at our wedding was Minoru Yamasaki, the husband of Aki's sister—and, later, the architect who designed the World Trade Center. When Yamasaki went to New York for the first time after graduation in the mid-1930s, no architectural job was available. He finally found work wrapping dishes in a Japanese import firm, even though he had graduated with the most

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outstanding architectural credentials at the University of Washington. Such was the lot of Asians in America in those days. Nevertheless, it was the universities, especially the state institutions, that provided the education for our later advancement in society. From the early 1960s to the late 1970s, Yamasaki planned the construction of the World Trade Center. Ironically, he paid considerable attention to safety for the future occupants and the surrounding structures during the building's planning stages.

When President Bush declared that the crushing blow of September 11 was WAR, all the images of the earlier war that had shaped my life came back to me. My adolescent years were filled with anxiety that a war between Japan and America might happen. So when war was declared after Pearl Harbor, my concern was how the wrath of America toward Japan and all things Japanese might be turned onto us. I worried about what would happen to our families who were summarily dispossessed, uprooted, and incarcerated in camps in desolate areas of the western United States. During those dark days, the stark and violent reality of survival and killing was a part of daily life for everyone on both the battlefields and cities of Europe and in the vast Pacific theater of war. It was a world at war for survival! We must not forget that over fifty million members of our family of man were sacrificed in that conflict.

Like many young Japanese American men, I fought in the European theater, where I was imprisoned by the Germans following the Battle of the Bulge. This distanced me from the Pacific War until I returned home. Back in America, at the rehabilitation facility for veteran POWs, I heard the news of the atomic bombing of Japan and of the surrender that followed. We were all relieved that the killing had finally ended.

I became aware of the enormity of the atomic bombing when I was persuaded to join the Atomic Bomb Casualty Commission in the spring of 1948, just as I was completing my pediatric residency. I was sent to Japan to study the effects of nuclear radiation on surviving children in Hiroshima and Nagasaki. Their tragedy has left a lifelong impact on me. When I was in Nagasaki, the Korean War broke out on the Korean Peninsula, June 1950. Separated by only a few minutes by jet from Nagasaki, U.S. soldiers of the First Calvary were shipped out on a day's notice and immediately sent into combat to halt the North Korean Army approaching Pusan. The initial encounter was disastrous for our soldiers.

Years later, my son, Paul, who was five months old when we went to Japan, expressed his intent to go to Viet Nam with his

classmates (jocks). I was able to dissuade him from enlisting. He protested at the time, but a year later he was an activist protesting the War—for which he received a jail sentence of six months in solitary.

World War II: With the U.S. Army

In the early summer of 1941, I felt the first chilling winds of war. An embargo on steel followed by an embargo on oil clinched my decision to immediately fill out an Army application posted on the bulletin board at Medical School of Marquette University. I barely received my Reserve Commission, following a careful review of my citizenship status by the U.S. Army, one week before Pearl Harbor. I hoped this would settle the question of "loyalty" of Japanese Americans that we faced at that time.

However, following Pearl Harbor, applications for service in the U.S. Army were initially denied to Japanese Americans. Moreover, we were branded as enemy aliens—without a country, despite being citizens. But before long, Washington inexplicably asked these young Nisei, confined behind barbed wire, to volunteer for combat in the armed forces. Yet, when we made our decisions to serve, the government refused to release our parents from their imprisonment!

Following my internship at the City Hospital in St. Louis, I was the last of the interns to receive my order to report for active duty at the U.S. Army Medical Field Service School at Carlisle Barracks in Pennsylvania. En route to Carlisle, I stopped by to visit Aki, a friend from UCLA, who I last met over a year earlier during a stopover in Chicago on her way to study in New York. A month-and-a-half later we were married in New York.

When I completed the Army Medical Field course at Carlisle, Aki and I went on a brief honeymoon in the Poconos before I began a tour of duties that eventually sent me to the 106th Infantry Division, encamped at Franklin, Indiana, during the period of D-Day in Normandy (I was the only Asian in the Division). The Division was preparing to join the Army in their advance toward Germany. Even before our departure, the Division soon dispatched a large contingent to help replace the casualties of D-Day. The Division departed Camp Attebury, arriving at Camp Myles Standish in Massachusetts. From there, we crossed the Atlantic, arriving in Liverpool. We then crossed the Channel to Le Havre, leaving for the front. Our weapons were examined and casmoline removed on the outskirts of St. Vith in Belgium before we depart-

ed to our position at the boundary of Belgium, Luxembourg, and Germany in the Ardennes Forest. Less than a week after our arrival, the Germans unleashed the largest counterattack of the war on a seventy-five-mile front. This was the Battle of the Bulge.

Of the 10,000 soldiers of the 106th engaged in the combat, most-ly kids barely out of high school, about 8,000 became casualties: KIA, MIA, POWs. Eventually one million men fought in the snow-covered Ardennes Forest. After nearly a month of fighting, we had 80,987 casualties, including 19,000 killed and 15,000 captured. We treated the wounded—both ours and theirs—in our aid station in a farmer's house on the mountain ridge. In the heat of the battle, I recall Sgt. George Pinna from Rhode Island carrying a stretcher over his shoulders. Others in our medical detachment joined him, responding to the cries of "Medic! Medic!" in the midst of incessant barrage from the Germans. They were firing at us from the mountain side into the valley where the 590th Field Artillery Batallion was located: vehicles, 105mm howitzers, artillery cannon, and men were overwhelmed. Major Irving Tietze, a senior officer of our group, realizing our untenable position, walked by us with a white cloth and surrendered. Germans allowed us to search for the wounded and to treat them for the next six hours, until our captors ordered us to leave the rest of the wounded men behind.

As we were led out of the forest, we marched by a crossroad in the snow. We saw the dismembered bodies of our black soldiers—a massacre seared forever in my memory. The people in the nearby hamlet of Wereth near Manderfield have erected a cross in memory of the massacred American black soldiers, perhaps the same bodies we came upon.

As prisoners of war inside Germany, we felt the onslaught of Allied Air Power coming up from countries below. Thousands of planes approached overhead to unload their bombs. Sometimes a black cloud would suddenly burst in the carpet of planes overhead, and the plume's trail would plummet earthward. Amazingly, some of the airmen survived and would later join our POW group.

A few days after the surrender, from inside a boxcar at the marshaling yard at Hanover, we could hear the cacophony of roaring planes accompanied by the bleating air raid sirens that repeated at shorter intervals as the planes came closer. Meanwhile, the guards locked us into boxcars and ran for the shelters. The thudding of the bombs shook us and levitated the boxcar. When the raid was finally over, only our boxcar was still in one piece. A close call. I have been unable to find out what happened to the other boxcars.

A day or two later we arrived in Falingbostel, our first POW camp, filled with Frenchmen, British paratroopers wearing red berets captured in Arnhem, and Russians. As the prisoners had no access to the progress of the war in recent weeks, they were anxious to learn the latest news at the front. Were the Germans able to hold back the Allied assault from land and air? I exchanged our tales with the Mongolian Russians in their green uniforms. We spoke sufficient elementary German that we were able to converse. At first they wanted me to explain how I had ever been able to don a uniform of the U.S. Army and come so far from home. I replied it seemed they too were a long ways from home.

The barbed wire fences and the guard towers around the Falingbostel camp reminded me of the incarceration of our families back home in the Jerome, Arkansas, where I had visited my father, mother, and sister before I left for the war in Europe.

During our 800-mile trek by foot and by rail we saw the devastation and terror that the air war rained over Germany. The carpet bombing would sometimes last for hours. As we were marching out of Nuremberg one morning, the raid began after dawn and lasted until midafternoon. The tail of our column was still in the city, and one of our buddies in the 590th Field Artillery of the 106th to which I was attached was among those killed in that Nuremberg bombing.

I would be remiss if I didn't relate how a Task Force of Patton's 4th Armored Division came to rescue us, attacking their way for 50 miles ahead of the battlefront to liberate us from the POW Camp at Hammelberg: 450 men were assigned to fifteen tanks and twen-ty-five half-track carriers led by Capt. Abe Baum that fought their way to our camp to liberate the prisoners. Underestimating the number of prisoners, they were only able to take a small number back with them. I decided to go with the task force while most of the prisoners returned to camp. I was able to get on a tank and then told to jump on one of the armored carriers. Not long after the column began their return we heard tanks in the distance, and soon we could see their cannon barrels on the ridge of an elevation. Knowing the accuracy of their 88mm guns, we immediately fled into the forest. Before the day was over, all of the tanks and carriers of the Task Force were destroyed and many men were killed. The next day we were flushed out of the woods and recaptured. How do you thank those who would risk their lives for you? The rescue expressed the same indomitable courage as the firemen and police at the World Trade Center.

After our failed liberation in March of 1945, during our march toward Nuremberg, we walked into chambers and showered with delousing fluid. We were relieved to see the first group emerge from the building, for, by then, word of the holocaust began to filter down to us. Jews from throughout Europe were herded into hundreds of camps throughout Germany. In Treblika alone it is reported that 900,000 were killed or died. The utter disregard for our fellow human beings reflect the depth of depravity to which we can sink in war. Among the Allied forces that first opened the gates to Dachau were the Japanese American soldiers of the 522d Field Artillery Battalion of the 442 Regimental Combat Team who had volunteered from America's concentration camps. They came face-to-face with the starving and dying inmates of Dachau.

General Patton's tanks liberated us for the second time at Mooseberg near Munich at a camp of over 50,000 POWs in late April. In the early morning of May 7, the train stopped at Rheims where the Germans surrendered to the Allies. By the next day we arrived at Camp Lucky Strike, where tens of thousands of troops awaited their passage home. The convoy had left Le Havre towards the end of May (1945) packed with veteran POWs. An ocean later, we passed the Statue of Liberty as fleets of small vessels came to greet us. We passed by fireboats that saluted us with arches of water bursting from their fire nozzles. Boats were filled with lovely ladies who blew kisses at us and tried to get us to join them singing refrains. But we weren't quite ready yet to sing. On debarking, Red Cross women at phone banks connected us with our families. They found Aki in nearby Mamaronek for me.

Following my discharge from the Army in March of 1946 at Lovell General Hospital in Massachusetts, I was able to continue medical training with residencies in pediatrics at the Childrens Hospitals, first in Philadelphia and then in Cincinnati. During those years, Aki worked and I am grateful to her. Together with supplements from the GI Bill of Rights, I was able to obtain training from exceptionally fine pediatricians for the next three years.

September 11 and Nuclear Weapons

Why does a pediatrician worry about nuclear weapons? Why does he worry about a satellite in space carrying a nuclear passenger eerily headed toward some human target? How do others in distant lands feel and react if they think they may be suddenly targeted someday?

In 1949, I had just completed my third year of a pediatric resi-

dency when I arrived in Japan for the first time, hardly speaking the language, with Aki and my five-month old son—to begin my assignment with the Atomic Bomb Casualty Commission (ABCC). The Commission was established by the National Academy of Sciences and the National Research Council. The NAS/NRC was designated by Congress to advise the government on matters of vital national interest. President Truman, appraised of the findings of the Joint Commission of the Medical Effects of the Atomic Bomb in Japan, directed the NAS/NRC to extend the study of long-term consequences of exposure to radiation among the survivors. A major part of the investigation would involve children. I was assigned to look for malformation among the children who were in the wombs of the mother at the time of the bombing. I was also instructed to visit Dr. James Neel, a geneticist at the University of Michigan, who would need pediatricians to examine the infants of the next generation whose parents were exposed. Dr. Neel had developed a study endorsed by leading geneticists which has continued now for over fifty years. Before my departure, Dr. Joseph Warkany, who was at the forefront of studying environmental factors, including radiation, that would result in congenital malformations, instructed me in conducting a field study of a large population. My training, heretofore, had only involved the treatment of a single child.

However, not long after reporting to ABCC, in Hiroshima, I was given an additional assignment which had not even been discussed in Washington. I was to go to Nagasaki to foster a relationship and rapport with the community and the physicians in order to develop a program to complement the studies in Hiroshima. A clinic and laboratory would need to be established. I would be the sole American physician in Nagasaki affiliated with the ABCC.

Meanwhile, Aki and Paul had to remain in Tokyo because available housing for ABCC representatives in Hiroshima—controlled in this sector of Japan by British Occupation Forces—was available only for those of European descent. You would think that Washington would have straightened this out before our departure or at least informed us about this. The last place I expected that segregated housing would continue to plague us after our return from Europe was in Japan. A private home was eventually found for us in the village of Aga, where I also headed the ABCC program. The village of AGA is several miles from the British compound. Soon we were en route to Nagasaki.

Nagasaki lies on the southwestern shores of Kyushu, the

southernmost of the major Japanese Islands. Japan's relationship with Portugal and Spain had begun early in the sixteenth century. In subsequent centuries, it was through Nagasaki that Japan maintained relationships with the West. Most notable was the influence of Christianity, which, despite prohibition for nearly two centuries, reemerged when Japan "opened its doors to the West" under prodding from Commodore Perry's visit in 1853. In Nagasaki, about 20 percent of the citizens were Christians compared to about 1 percent in Japan as a whole. Western medicine was first introduced to Japan in Nagasaki about 1857 by a very enterprising Dutch physician and was the forerunner of the current Nagasaki University Medical School.

The city encircles the head of a long and beautiful bay. On the western side of the bay is Urakami Valley, dominated in the war years by the large Mitsubishi Industries, enterprises engaged in shipbuilding and armaments. The eastern side, separated from the Urakami Valley by a mountain ridge, has the main commercial and residential sections.

The atomic bomb was detonated 500 meters in the sky midway in the Urakami Valley. The mountain ridge served as a shield affording considerable protection to the eastern central section of the city. The atomic attack, incredibly devastating, was over in a flash. Eight hundred meters from ground zero, the concrete walls of the University Hospital building partially shielded the effects of the bomb. Forty percent of the staff survived, whereas those in wooden structures and those in the surrounding township all perished. The doctors who survived were as close as people could be to an atomic bomb explosion. They became my mentors and disclosed without being killed what they had personally experienced.

I wore the nominal Captain's hat of the U.S. Atomic Bomb Team, and I thought my relationship with the community was forth-right. However, it soon became clear that the Japanese believed that the ABCC had come to Nagasaki to obtain information that would better prepare America in the event the U.S. was attacked by an atomic bomb. Yet, the doctors of the city, the practitioners as well as the Medical School faculty, wanted to know what would happen to atomic bomb survivors in the future. A joint collaborative undertaking with the ABCC was thus initiated in good faith. This collaborative investigation is still ongoing over fifty years later. Yet there has been a considerable delay in telling the American public the real human toll of Hiroshima and Nagasaki.

When our government first issued its official report on the making of the bomb, published in August 1945, the author of the report, Princeton physicist Henry DeWolf Smyth, who contributed prominently in the Manhattan Project, wrote:

> A weapon has been developed that is potentially destructive beyond the wildest nightmare of imagination; a weapon so ideally suited to sudden announced attack that a country's major city might be destroyed overnight. . .
>
> The people of the country must be informed if they are to discharge their responsibilities wisely—in a free country like ours such questions should be debated by the people. . .[1]

Yet the Joint Commission Report on the Medical Effects of the Atomic Bomb in Japan by physicians of the Manhattan Project, U.S. Armed Forces, and the Japanese Government conducted from October to December of 1945 was classified "Secret" and was not available even to our staff at ABCC. Their report was eventually published for the Manhattan Project's National Nuclear Energy Series in 1956, but did not receive a wide public distribution. So, eleven years after the bombing, the American public remained virtually uninformed about the only human beings who can tell their story of surviving nuclear weapons. In Japan, soon after the occupation of Japan began, a press code was established that in effect prohibited the dissemination of information about the bomb by the media, including some of our own scientific studies. So in Japan, except for the initial bulletin from Hiroshima and Nagasaki, the conditions of the survivors in the aftermath were disclosed only after the end of the occupation in 1951.

A commemorative exhibit of the atomic bombing fifty years later at the Smithsonian Institute that initially was to include serious treatment of the effects of the bombs on the people of Hiroshima and Nagasaki aroused strong objections from a veterans' group, Congress and the press. They felt that the exhibit highlighted the plight of the victims, rather than honoring the valor of U.S. servicemen. Many of my classmates at Marquette University Medical School were assigned to serve in the final phases of the assault in the Pacific War: George Collentine landed on the beach on the first wave at Iwo Jima; John Conway was on a destroyer hit by a *kamikaze*; Ed Lau and Ed Turic were on ships treating casualties evacuated from Iwo and Okinawa; and Bob Fox in the Philippines was assigned to prepare general hospitals to treat casualties from the anticipated invasion of Japan. Of course, they all felt

that the atomic bomb ended the war and spared them from the invasion of Japan that might well have cost them their lives. But by canceling the exhibit, one that eventually millions of citizens would see, the public remained uninformed about the effects of the atomic bomb upon human beings.

After September 11, I have often wondered, what if the terrorists had carried an atomic bomb on their plane? I thought about Trinity at Alamogordo, New Mexico, where the first atomic bomb was tested; about Hiroshima and Nagasaki; about the underwater burst at Bikini Island in 1946, and radioactive fallout from the fifteen megaton hydrogen bomb that was tested in the Marshall Islands in 1954. I thought about the horrendous Chernobyl reactor meltdown in the Soviet Union in 1986.

Had the World Trade Center been ground zero in a nuclear attack, an expanding 400-foot red fireball would cover the top floors of the towers. A brilliant-hued flash of light would illuminate all of lower Manhattan, and reach the city's center. The fireball temperature would be like a giant heat lamp with a temperature of the interior of the sun (millions of degrees), in contrast to the several thousand degrees when the planes' fuel burst into flame on September 11. An atomic explosion would emit thermal radiation at the speed of light, together with penetrating gamma radiation and neutrons, perhaps one hundred times the amount of radiation required to kill. Such heat could penetrate concrete floors and walls, followed by a roaring blast that, in an instant, would crush the supporting frame of both building towers, as well as the three satellite buildings. Debris of concrete, steel, and glass would be flying like missiles. At ground zero there would be no survivors. Then the crumbled debris would be violently stirred, forming a massive dust cloud that would eclipse the sun, plunging lower Manhattan into darkness. All of lower Manhattan would be covered with radioactive dust, and at the same time the intense heat would suck up the mixture to form a mushroom cloud, the unmistakable insignia of an atomic explosion. Fires would be ignited as far out as a mile-and-a-half. Within a radius of 800 meters, the streets would be lined with bodies burned black and felled by the blast wind and penetrating nuclear radiation. The spreading cloud of radioactive dust would cover all of lower Manhattan and the prevailing southeast wind would drift toward Brooklyn.

The first atomic bomb test took place at Alamogordo, New Mexico. A bomb whose blast was equivalent to 20 kilotons of TNT, identical to the Nagasaki bomb, perched on a one-hundred-

foot tower, was detonated on July 16, 1945. Radioactive fallout was traced to the Chapudera Mesa fifty to sixty miles from ground zero, where the fallout was deposited on the skin of grazing cattle. The beta radiation of the fallout particles caused hair loss and discoloration and thickening of the skin, later, skin cancer developed in these animals.

In 1946, a year after the bombing of Hiroshima and Nagasaki, naval vessels of every category from aircraft carriers to submarines were anchored in a lagoon of Bikini Atoll twenty-five miles long to assess the tactical use of nuclear weapons in naval warfare. A twenty kiloton bomb, identical to the Nagasaki bomb, was detonated underwater with a massive eruption of the sea water forming a three-mile wide lethal radioactive foamy umbrella that developed into a thick cloud drifting downwind for several miles. It released a downpour lasting for an hour. The radioactivity in the lagoon became so high that one could not approach the vessels for several hours, and then for only brief forays.

Dr. Stafford Warren, head of Health and Safety in the Manhattan Project and later the first Dean of the UCLA School of Medicine, observed:

> The tests give far clearer warnings of the insidious nature of radioactive agent which makes it such an ideal weapon for use on a civil population. An entirely new danger of atomic war has so saturated every crevice of target ships that scientists and service personnel could visit the vessels on only hurried forays. Were a Bikini-type bomb dropped in New York Harbor under favorable meteorological condition maximum distribution radioactive particles, two million people would die.[2]

In Nagasaki, on August 9, 1945, Dr. Raisuke Shirabe, a professor of surgery, dug himself out of the debris that covered him. When he thought of returning to his office to retrieve some valuables, the smoke and fire was already billowing out of the windows. He was unable to reenter the building. He saw bodies entangled in the window frames. He could hear the roaring fire that already engulfed the neighborhood surrounding the hospital.

Dr. Nishimori, then a student, was sitting at a desk with other students at a seminar when the blast threw him to the floor, senseless. When he regained consciousness, the others at the desk were stacked in the corner lifeless, apparently hurled into this position by the vortex of the blast wind. The hospital ground was littered with bodies, dead and dying, traumatized by the injury, burns,

and radiation. When Dr. Stafford Warren arrived at the gutted hospital three weeks later, he saw a mound of skeletal remains, apparently cremated, three feet deep in a circle fifty feet in diameter.

Instantaneous and subsequent death for those without burns or trauma revealed the presence of a puzzling disease that subsequently was called "atomic disease." Different parts of the body respond differently in their reaction to nuclear radiation. Immediate death follows when the brain is overwhelmed with the absorption of massive amounts of radiation. The gastrointestinal tract regularly responds with nausea, vomiting, and extreme thirst. Epilation is a sensitive and early indicator of radiation injury. The blood forming system is among the most sensitive parts of the body that results in hemorrhage in all tissues. Immunity is impaired so that severe infection develops even following minor trauma. In Japan, the majority of the deaths occurred within the first two weeks after the bombing, caused by the synergistic effect of burns, radiation and trauma, although burns were believed to be the major cause of death.

In Nagasaki's Urakami Valley, only a mile wide and three miles long, enclosed by a mountainous spur that shielded central Nagasaki, 70,000 people perished in the ten days that followed. In Hiroshima, situated in a flat delta, 120,000 died, even though the Hiroshima bomb was less powerful than the one that fell on Nagasaki.

I became increasingly aware of the enormity of nuclear destruction beginning in 1950, when our clinic in Nagasaki was completed. We could examine children who survived the Nagasaki bomb, checking for the first time for effects of radiation exposure during pregnancy. This was just the beginning of an involvement that would extend through the rest of my life. My earlier observation of pregnant mothers who received pelvic X-Ray radiation treatment complimented by experimental studies by others, had demonstrated the sensitivity of the developing brain to radiation. Even so, I was seeing for the first time the terrible effect of the atomic bomb on the unborn: mentally retarded stunted children with small, malformed heads. These mothers also had a high incidence of miscarriages, still births, and neonatal deaths. Later, other children who had been in the womb when the bomb was dropped developed seizures and learning disorders.

Cancer is the major late effect of radiation among the survivors of the atomic bomb, but in children, leukemia developed during the first ten years after exposure with a considerably high incidence. In adults, the leukemia appeared years later and with

a lower incidence compared to the children.

What would happen to the coming generations of children, offspring of parents exposed to the atomic bomb radiation, was of considerable concern both in United States and in Japan. If the studies revealed that there was a definite increase in miscarriages, stillbirths, and congenital malformations, this might be attributable to the atomic bomb. Thus, every pregnant woman in the two cities was registered and their outcome recorded. In a five-year period in both Hiroshima and Nagasaki, each newborn was examined in the home. Over a five-year period 70,000 pregnancies were evaluated, coupled with requests for autopsies for stillbirths and neonatal deaths. However, statistical evidence of genetic injury has not been demonstrated so far. In subsequent years, new methods to detect radiation injury were utilized in the genetic study. Today, DNA technology is being applied as radiation-induced mutation and links to cancer and immune disease are revealed. To insure continuance of this program, blood samples of the most heavily exposed parents, their children and a control group are being preserved to be made available as new developments in genome research occur.

So far, however, convincing evidence of genetic injury has not been found in the continuing epidemiological investigation that is now reviewed by international experts. At the outset of the studies, it was recognized that the surviving population received relatively low amounts of radiation compared to those who were killed by the bombs. The deaths of the latter victims reduced the likelihood of demonstrating a genetic effect.

Still, for fifty years children of the survivors have been haunted by fears that their progeny, the third generation, might perhaps be tainted by the bomb. Significant advances have been made in understanding the mechanisms by which radiation induces cancer and genetic disorders when DNA is damaged by radiation.

Increasing the power of nuclear weapons a thousandfold with the fifteen megaton hydrogen bomb revealed that thousands of square miles could be contaminated by radioactive fallout; that the fallout can be lethal 120 miles from ground zero; and that radioactive iodine is the principal biological hazard that is ingested and concentrates in the thyroid, leading to thyroid tumors and cancer, especially among the young. This consequence has been repeated in the nuclear reactor meltdown at Chernobyl, where the fallout at considerable distance resulted in increased incidence of thyroid cancer in children, again revealing their particular vulnerability.

Miniaturization of nuclear weapons now allows several one-megaton weapons to be placed in the warhead of a single missile. It has been calculated that a one megaton nuclear weapon can ignite fires ten miles from ground zero and ignite an enormous firestorm to consume a population already immobilized by the effects of irradiation and the powerful hurricane blast waves. Weapons have been developed now that can be put into a backpack.

Just one year into the Atomic Era in 1946, Dr. Stafford Warren observed the human consequences in Hiroshima, Nagasaki, and at Crossroads and noted:

> It would seem that little imagination is required to accept the fact that nuclear weapons can be the ultimate destructive weapons for all mankind, and that the way to peace, unclear and difficult to obtain though it be, must somehow be attained by the people of the world.[3]

When he designed the World Trade Center, "with its location facing the entry of New York Harbor," Minoru Yamasaki expressed hope that his great creation "could symbolize the importance of world trade to this country and its major metropolis and become a physical expression of the universal effort of man to seek and achieve world peace." On September 11, that vision was shattered. But, Minoru, the strong advocate for peace that he was, may have created another vision in its place.

We have reached a critical junction in man's history for survival on this planet that requires our combined intellect, resources, and compassion for our fellow man to prevent another atomic holocaust. Neutralizing the threat of nuclear weapons and other weapons of mass destruction must be the primary objective of all people. We must recognize and struggle for the right of all people of the world and of future generations to live in peace.

Notes

1. Henry DeWolf Smyth, *Atomic Energy for Military Purposes: The Official Report of the Development of the Atomic Bomb under the Auspices of the United States Government, 1940-1945* (Stanford: Stanford University Press), 223, 226. Originally published in 1945 by the United States Government.
2. Stafford L. Warren, "The Role of Radiology in the Development of the Atomic Bomb," in Radiology World War II (Washington D.C.: Surgeon General's Office, 1966), 916.
3. Stafford L. Warren, "What Science Learned at Bikini," *Life*, August 11, 1947.