HIROSHIMA & NAGASAKI

THIRTY SIX YEARS LATER, THE STRUGGLE CONTINUES

BY JOANNE SILBERNER

This is the first of two articles on the medical and psychological aftereffects of the atomic bombing of Japan 36 years ago.

HIROSHIMA—Within a millionth of a second of the atomic bomb explosion over Hiroshima, the temperature at the blast center was several million degrees centigrade. A millisecond later, a 300,000°C sphere formed, sending out a tremendous shock wave. The wave, losing energy as it expanded, was powerful enough to break windows 15 kilometers from the hypocenter.

A few days later, after the dust settled and the fires burned themselves out, the damage closer in could be seen. At 4 kilometers, buildings were charred. At 3 kilometers about 90 percent of the buildings showed extensive fire and blast damage. And within a 2-kilometer circle there were only ashes, fist-sized pieces of rubble and a few shells of reinforced concrete buildings. Thirteen square kilometers were leveled in the flat delta city of Hiroshima; a few days later, 6.7 square kilometers were wiped out in Nagasaki, where large hills protected parts of the city.

As a direct result of the bomb, 130,000 of Hiroshima's total population of 340,000 were dead by November, and an additional 70,000 died by 1950; of the approximately 270,000 people present in Nagasaki on August 9, 1945, roughly 60,000 to 70,000 died initially and another 70,000 died by 1950.

The physical sequelae to the dawn of the nuclear age have for the most part been defined and quantified. The signs of destruction are gone now, the rebuilding spurred by a determined populace and the booming economy of post-war Japan. Though Hiroshima's population dipped to 200,000 after the war, it is now up to 890,000; Nagasaki has climbed from 128,000 to 442,000. And though the people at first thought that nothing would grow for 70 years, the cities are green. Nagasaki today has regained its port city charm; Hiroshima is a beautiful city of wide streets and new buildings.

Unfortunately for the people in the path of the shock wave — the survivors who did much of the rebuilding — the medical aftereffects of the atomic bombings have proved far more elusive and more difficult to repair. Today the people who survived the blast, and the resulting nausea, vomiting, diarrhea, weakness and blood disorders of acute radiation sickness, wonder if the power of a bomb that exploded in a war 36 years ago will yet prove lethal. Many of the survivors, burdened by their memories of the past, remain anxious about their future health, as they have been for over three decades. And they still bear the psychological scars from having seen their world literally crumble in a flash that for a moment was brighter than the sun.

Although an enormous body of data exists on the *hibakusha* (explosion-affected persons), medical researchers and physicians cannot predict whether individual survivors will be struck by radiation-induced cancer. Nevertheless, the expanding data base is giving scientists growing insight into the aftereffects of atomic blasts, according to James Neel, a University of Michigan geneticist responsible for much of the early genetics work.

The Radiation Effects Research Foundation (RERF) has collected data on 110,000 residents of Hiroshima and Nagasaki. These data, as well as results from biennial exams on 20,000 of the study participants, provide "probably as complete an epidemiological study as the world has ever seen," says Kelly Clifton, chief of research at the RERF. The Research Institute for Nuclear Medicine and Biology at Hiroshima University has been collecting information since it was established in 1961 to determine the best method of treatment for the survivors and to study the long-term effects of radiation. Researchers in Nagasaki have recently finished putting one million pieces of information into a computer.

All this information does not protect the *hibakusha* from A-bomb-related diseases, nor does it suggest how the survivors can avoid them. But it does offer some good news. Of great relief to the intensely family-oriented Japanese, no effects have been seen in the children of survivors. And the survivors themselves do not seem to be suffering a higher than normal incidence of any non-cancerous condition — in fact the death rate for non-malignant disease is lower than that of the general population. Researchers suggest this may be because only the healthiest survived the bomb, and these survivors get frequent check-ups. Keloids — scar tissue as thick as a few centimeters that formed over cuts, burns and surgical scars—have tended to disappear.

But the news has not been good on the cancer front. Since an increase in the leukemia rate in Hiroshima and Nagasaki was first noticed in the late 1940s, each decade has seen an increase in at least one type of cancer. "Leukemia began increasing among survivors within two years," says Kenjiro Yokoro, director of the Research Institute for Nuclear Medicine and Biology. By the mid-1950s risks among the more heavily exposed ran as high as 30 or 40 times the norm. By 1971, the overall risk had dropped to five times normal. "It's a little above control level now," says Yokoro. "The epidemic is over."

But leukemia was only the first wave — following it came the

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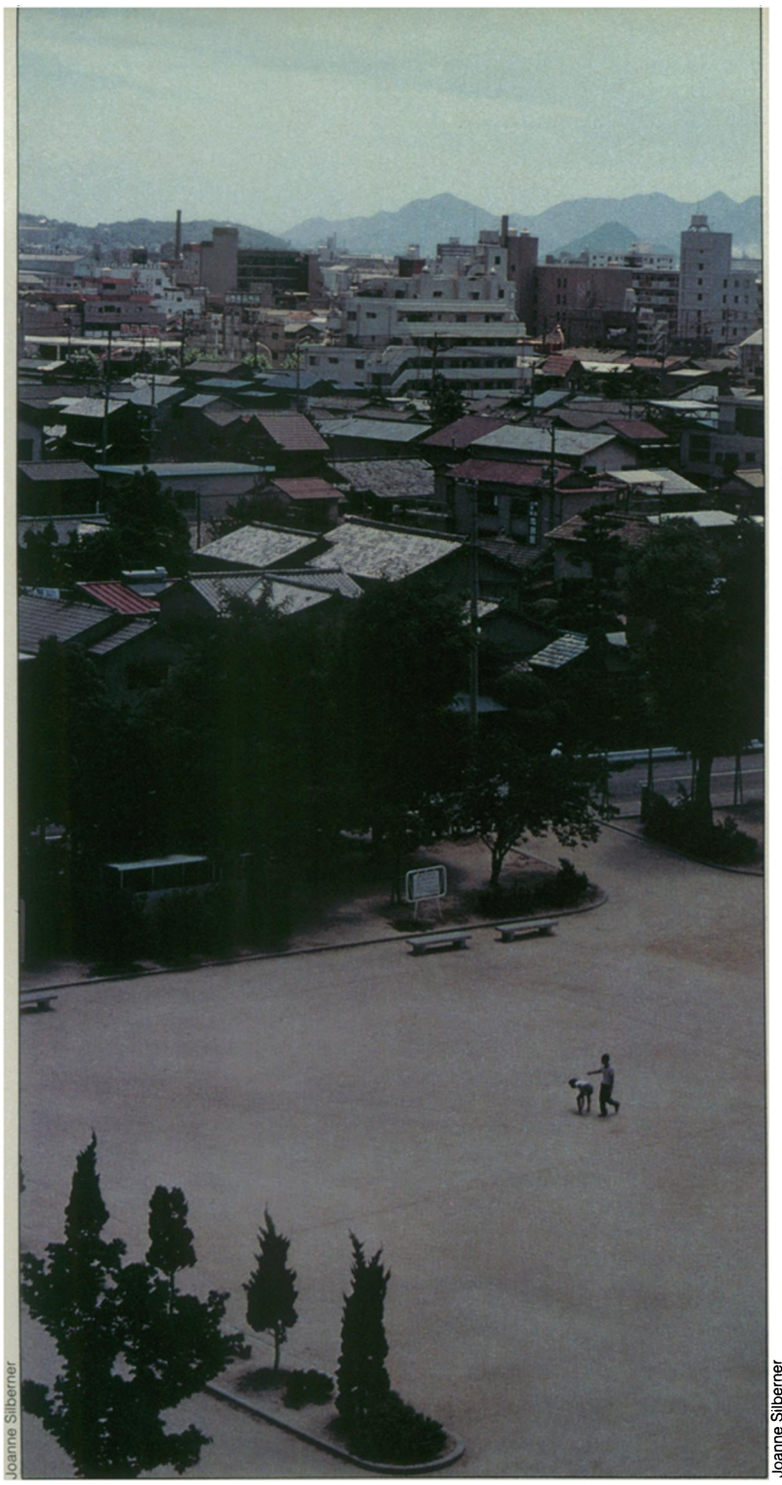
Joanne Silberner is a Washington-based science writer and former SCIENCE NEWS *intern who traveled to Japan on a grant from the Hiroshima International Cultural Foundation.*



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Left: Hiroshima, August 1981. The city has been completely rebuilt.

Below right: All over Japan, stone markers commemorating the dead are decorated each year as part of the bon *festival. Most of the markers in this temple yard in Hiroshima are for A-bomb victims.*

Bottom: A composite panorama of Hiroshima after the bombing.

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Shigeo Hayashi

solid tumors. An increase in thyroid gland cancer was noticed in the late 1950s. By 1958, lung cancer among the *hibakusha* was four times the expected rate. In the 1960s and 1970s came reports of increases in breast cancer and salivary gland tumors. In the past few years an elevated risk of colon cancer and multiple myeloma has been noted. The list is by no means exclusive; other cancers are suspected. While leukemia has been the most prevalent, the risk for all the other cancers combined is higher than the peak incidence of leukemia.

In a survey of 285,000 exposed people, RERF estimates that of 70,500 deaths between 1950 and 1974, 500 were due to radiation-induced cancers.

The *hibakusha* who were close to the hypocenter and received more radiation are at greater risk than those who were further away. Both current age and exposure age are also factors. Persons under 10 and over 50 years of age at the time of the bomb were at higher risk of leukemia. Women who were between 10 and 19 are at higher risk of breast cancer than are women in the other age groups, suggesting a hormonal involvement in the development of the cancer. The cancers generally appear at the same age as they do in the general population, so as the exposed population grows older they move into the cancer age. "Since the risk of cancers other than leukemia has increased in the exposed group compared with the controls only after the exposed individuals reach the age at which cancer of the site is prone to develop—and that age differs according to the organ—there may be observed in the future an increased risk for these cancers," reports Hiroo Kato, an epidemiologist at RERF. And, says Maahide Asano, a pathologist at RERF, "There's no way of knowing what cancer is next."

In addition to occurring at the same age as the "regular" cancer, there is no difference in the pathology of the radiation-induced cancer—the course, except for leukemia, is the same. "The cancer is the endpoint of the process," says Yokoro. This lack of distinguishing features makes it impossible to pin any one particular cancer on radiation; information must be gathered epidemiologically.

Genetically—at least for now—there appear to be few or no effects passed on to descendents. Of 70,000 pregnancies conceived in the late 1940s, no increase in stillbirths, birth defects, or infant mortality was seen. The RERF has sponsored two long-term searches for genetic effects. Akio Awa and co-workers are inspecting lymphocytes from thousands of survivors and their children. There are still very definite effects in the survivors—chromosome breaks, rings, and extra constrictions—and these aberrations are found in proportion to the radiation dose. But no aberrant chromosomes have been found in their children. There were several dozen microcephalic children born to *hibakusha* following the bombings, but the microcephaly was caused by fetal exposure to radiation, not genetic damage.

Many *hibakusha* say they have not married because they or their parents fear their children would be deformed; some say they were rejected by potential suitors who found out they were *hibakusha*. "I've been asked by many people if the genetic effect continues to subsequent generations," says Awa. "In this respect my optimistic answer is no."

Similarly, Chiyoko Satoh, a biochemist, has checked 28 blood proteins in 15,000 *hibakusha* and found mutations in two people—roughly the same rate as that in drosophila, she notes.

Germ cells, being hard to come by, have not been looked at directly. But researchers feel confident enough to tell worried *hibakusha* that, at least for now, there are no known genetic effects related to bomb exposure. But there are other medical problems more difficult to research or quantify. Many *hibakusha* say they tire easily. Some people still have glass embedded in their bodies from the blast. One Nagasaki man, five feet six inches tall, cannot gain more than four pounds above his usual weight of 100 pounds or his burn-scarred skin will stretch painfully. These and other medical problems preoccupy many *hibakusha*. □

Next week: social and psychological aftereffects.