HIROSHIMA/NAGASAKI

Atomic Bomb Casualty Commission Perseveres in Sensitive Studies

Hiroshima. The atomic bomb which destroyed this provincial port city on Japan's Inland Sea in August 1945 ushered in a new generation of terrifying weapons. The immediate physical damage and casualties caused by the bomb were stupendous. More than 60,000 buildings, mostly of frame structure, were leveled within a radius of about 3 miles, and anywhere from 64,000 to more than 240,000 people—depending upon whose figures you believe—died from mechanical, thermal, or radiation injuries.

In the scale of horrors by which one measures the efficiency of modern warfare, such widespread devastation was not completely without precedent. The massive air raids on Tokyo and Dresden during World War II caused as much, if not more, death and destruction. But the atomic attacks on Hiroshima and, shortly after, on Nagasaki seemed substantially more frightful than previous air raids. For one thing, a single plane carrying a single atomic bomb—and a primitive one at that—had produced devastation comparable to that which had previously required hundreds of bombers carrying conventional fire bombs and explosives. Moreover, the atomic bomb seemed frighteningly different in kind from previous weapons. In addition to blast and thermal effects, it emitted massive amounts of radiation, an invisible contaminant that could, in sufficient doses, strike down its victims years after the event.

No one was certain at the time of the bombings just what the long-term effects of this radiation might be, but there were enough grisly predictions to panic even the most optimistic survivors of the holocaust. There were rumors that everyone exposed to the bomb would be dead within 3 years; that trees and flowers would never again grow in Hiroshima; and that Hiroshima would be uninhabitable for 75 years. Hiroshima, the saying went, would be an "atomic desert." Some of the wildest predictions were quickly proved false. The flowers did bloom again; and people continued to live in the devastated city, some in makeshift shacks built right in the area of maximum destruction. But the fear remained that those exposed harbored deep in their bodies a lingering, invisible contamination. It was clearly desirable—from a scientific, humanitarian, and military standpoint—to ascertain just what the true long-term effects of the bombing would be.

The task of unraveling these effects has fallen to the Atomic Bomb Casualty Commission (ABCC), a unique research organization which has been conducting epidemiological studies in Hiroshima and Nagasaki since 1947. The ABCC operates in what must surely be one of the most sensitive research environments in the world. It is nominally a joint enterprise of the American and Japanese governments, but in actuality the Americans have always dominated the organization and the ABCC has thus come to represent "the victor" studying the effects of his horrible new weapon on "the vanquished." Not surprisingly, the ABCC has been feared and hated by many Japanese, and it has been accused of committing any number of ghoulish crimes in the name of science. But over the years the ABCC has won at least grudging acceptance—and many plaudits as well—from its Japanese hosts. This is a tribute partly to the ABCC's ever-increasing awareness of Japanese sensitivities, and partly to the significance of its scientific contributions. The ABCC's findings have become enormously important in the world-wide effort to define radiation hazards, for nowhere else in the world has such a large fixed population been so closely followed from a medical standpoint for so many years. As Frederick Seitz, former president of the National Academy of Sciences, once wrote in a glowing tribute to the ABCC: "Today your investigations of the medical history of a large population stand without parallel in the world."

The ABCC's origins date back to the period of the American occupation of Japan under General Douglas MacArthur. Almost immediately after the Japanese surrender, teams of scientists from various American military agencies raced to Hiroshima and Nagasaki to assess the effects of the bombings. These teams, in conjunction with Japanese scientists who had previously launched their own investigations, evaluated the short-term physical and medical effects, and then recommended that the United States sponsor a study of the long-term medical effects, since such a large-scale project seemed clearly beyond the capabilities of the war-shattered Japanese government. The upshot of all this was that the Atomic Energy Commission agreed to provide most of the financing for the study, the U.S. National Academy of Sciences agreed to supervise the design and operation of the research program, and the Japanese National Institutes of Health agreed to become a formal participant. The National Academy was chosen to conduct the study in an effort to separate the project as widely as

possible from any direct connection with the U.S. military—a difficult feat of diplomatic tightrope walking in view of the weapons-producing role played by the project's underwriter, the AEC.

In its more than two decades of existence, the ABCC has evolved into a rather sizable, sophisticated, and expensive operation. In fiscal year 1969 the AEC contributed about $3.8 million to support the project, bringing its total outlays since the project's inception to almost $47 million. Additional small sums have been provided by the Japanese government and the U.S. Public Health Service. The ABCC had a total staff of 754 as of last June 30. The great majority of these employees—namely 721—were Japanese citizens, but the organization's top leadership and most of its key professionals are American, a point which often miffs Japanese critics.

Yale and UCLA Succession

For more than a decade, Yale University had supplied the ABCC's medical chief while UCLA undertook for a period to provide pathology chiefs. The director since 1957 has been George Darling, who is on indefinite leave as professor of human ecology from Yale. Darling has somehow managed to avoid learning the Japanese language (one of the most difficult in the world), despite 13 years of residence in the country, but he has nevertheless given the ABCC its longest period of sustained leadership and he is credited with improving the ABCC's previously precarious relations with its host country. As one American diplomat told me in Tokyo last fall: "Darling took over when some people thought the project was heading for the rocks. He kept it going and he's made it respectable now." So respectable, in fact, that Darling and his wife were even invited to the Emperor's garden party at the Akasaka Palace Gardens in Tokyo in November 1968, and Darling was the first American to receive the supreme award of the Japanese Medical Association.

The scope of the ABCC studies is staggering—perhaps 200,000 Japanese have been included in one or more of the research investigations. One of the earliest and most important of the ABCC studies was a 6-year investigation of the genetic effects of the atomic bombs. The need for such a study was deemed particularly crucial in view of the dire predictions of long-term disaster made just after the war and in view of the well-known fact that radiation can indeed cause genetic damage. Using registration lists of expectant mothers who applied to receive extra rice rations from the Japanese government during the food-short postwar years, the ABCC tracked down and examined more than 71,000 newborn and stillborn infants between 1948 and 1953. Some of the mothers had been exposed to the bomb and some had not. The thoroughness of this study is evidenced by the fact that the ABCC examined an estimated 93 percent of all the pregnancies that came to term in the two cities during the 6-year period. All of these children were examined immediately after birth and about 30 percent of the newborns were examined again 8 to 10 months later. The results were reassuringly negative. The radiation had no demonstrable effect on the frequency of stillbirths and malformations or on other indicators of genetic damage, such as birth weight or growth during the first year of life. There was one possible positive genetic finding reported in the 1950's—a change in the sex ratio, or proportion of males to females, among offspring of those exposed. But a subsequent investigation of 47,624 newborns delivered in the two cities between 1956 and 1962 failed to confirm this finding and even suggested it was dubious to begin with. These genetic studies do not preclude the possibility that some mutations were produced, but statistical tests suggest the studies should have detected a twofold increase in mutation rates.

The ABCC's current investigations were given shape in the mid-1950's when there was a major reorganization of the research programs to put them on a more stable long-term basis. A fixed population of about 100,000 persons was selected for study in Hiroshima and Nagasaki, some of whom had been exposed to the bomb in varying degrees and some of whom had not. This population serves as the base for three major research programs, as well as a host of minor ones. There is a life expectancy study—based on the 100,000 sample—which uses Japanese death records to determine mortality and cause of death. There is a pathology study which seeks to perform autopsies on every person in the sample of 100,000 who dies. And there is an adult health study—based on a subsample of 20,000—in which detailed clinical examinations are conducted on people every other year in an effort to determine the type, frequency, and course of diseases occurring in those who were exposed to the bomb as compared to those who were not. "Often we're looking for a needle in a haystack—the 4th or 5th case in 1,000," says Joseph L. Belsky, chief of the ABCC's department of medicine. "The real strength here is in the statistics, the contacting (of patients and relatives) and the study plan that identified the closed population groups."

What are the major findings of the ABCC's research so far? No unknown new diseases have been discovered despite popular fears that a wholly new "A-bomb disease" might afflict the survivors. But the incidence of some known diseases was clearly increased by exposure to the bomb. The incidence of leukemia was abnormally high among survivors, reaching a peak about 1951 and declining thereafter. There was also an increase in thyroid cancer and probably other forms of cancer as well, though some of the findings are in dispute. Those who were exposed *in utero* showed a marked increase in microcephaly and mental retardation, as well as in infant and fetal mortality. And many of the survivors of all ages were also found to have complex chromosomal abnormalities, but these abnormalities do not seem to have demonstrably damaged the health of the subjects studied.

Long-Term Findings

Many other effects that have been attributed to the bomb radiation have been relatively small in magnitude. As summarized in a review article by Robert W. Miller, chief of the epidemiology branch at the National Cancer Institute, these include an increase in general mortality exclusive of leukemia during the first 10 years after exposure; a small retardation in growth and development; infrequent radiation cataracts, which did not greatly diminish visual acuity; and a polychromatic sheen on the posterior subcapsule of the lens of the eye, which caused no disability (see *Science*, 31 October 1969). All in all, in the words of a news report published by the National Academy, the findings have been "grim beyond doubt, yet not as grim as many had feared." Still, the final results are not yet in, and much of the population under study is just entering the age at which further cancers might be expected to show up.

The ABCC has increasingly tried to express its findings in terms of

the specific dose of radiation that produces a particular effect. This has required a massive effort to determine just how much radiation each of the various survivors actually received. The calculations are complex and depend on a number of variables, including the precise position of the bomb when it exploded, the yield of the bomb, and the location of the survivor at the time of the explosion. Survivors have been interviewed to determine just where they were and what shielding they were behind; replicas of Japanese houses have been tested for shielding effects at the AEC's Nevada test site; and the epicenter of the explosion has been determined as precisely as possible by studying thermal ray shadows burned into gravestones and other granite objects. The yield of the bombs has also been recalculated. It turns out that the 20-kiloton yield attributed to the Hiroshima bomb by President Truman's original announcement was way off—it was probably only 12.5 kilotons. The upshot of all this refining and recalculating is that Oak Ridge National Laboratory has developed sophisticated equations for estimating the dose of gamma and neutron radiation actually received by any given individual. There is considerable disagreement over how accurate the estimates are in any individual case, but on a statistical basis the errors are believed to cancel out. The ABCC has already been able to express some of its findings in dose-specific terms, and it hopes to expand and refine the effort in the coming years. The results are expected to be particularly helpful in establishing the maximum radiation exposure which can be safely tolerated by man.

The ABCC's investigations have occasionally been challenged on scientific grounds—but the critics seem not to have shaken the confidence of experts in the ABCC's findings. Some Japanese scientists, primarily those of leftist political leanings, have long accused the ABCC of suppressing information and distorting data in an effort to minimize the horror of the A-bomb. Some Japanese scientists also contend that the ABCC's negative findings are meaningless because, they allege, the ABCC's control groups actually contain large numbers of people who were exposed to residual radiation or to fallout from the bombs. Thus, they argue, the ABCC is actually comparing various groups of exposed people and naturally no difference is found between these groups. This argument has been taken up and adapted by Ernest J. Sternglass, the University of Pittsburgh radiologist, who has loudly proclaimed that low doses of fallout from nuclear weapons tests have caused fatal genetic damage to hundreds of thousands of children in the United States since the early 1950's. Faced with contradictory evidence from the ABCC—namely, the extensive studies which were unable to detect any significant genetic effect in the offspring of survivors in Hiroshima and Nagasaki—Sternglass has charged that the ABCC control groups are contaminated and he has suggested other reasons why the ABCC findings are not incompatible with his assertions. However, ABCC

Academy of Sciences Selects New Members

The National Academy of Sciences has elected five new Council members and 50 new members. It also reelected Harrison Brown, from the California Institute of Technology, to a 4-year term as Foreign Secretary.

Elected to 3-year terms as Councilors were: Kingsley Davis, University of California at Berkeley; James V. Neel, University of Michigan; James A. Shannon, Rockefeller University; and Robert L. Sinsheimer, California Institute of Technology. Clement L. Markert, Yale University, was elected to a 1-year term to fill the unexpired term of William D. McElroy.

The 50 new members, elected in "recognition of their distinguished and continuing achievements in original research," are:

Robert M. Adams, University of Chicago
Berni J. Alder, Lawrence Radiation Laboratory at Livermore
John D. Baldeschwieler, Stanford University
Jerome A. Berson, Yale University
Paul D. Boyer, University of California at Los Angeles
Lewis Branscomb, director, National Bureau of Standards
Bernard F. Burke, Massachusetts Institute of Technology
Stanley A. Cain, University of Michigan
Robert B. Corey, California Institute of Technology
James W. Cronin, Princeton University
William G. Dauben, University of California at Berkeley
Edward E. David, Jr., Bell Telephone Laboratories
Ralph Emerson, University of California at Berkeley
Sterling H. Emerson, California Institute of Technology
Albert E. J. Engel, University of California at San Diego and U.S. Geological Survey
Robert A. Good, University of Minnesota
Richard M. Goody, Harvard University
Harold Grad, New York University and Courant Institute of Mathematical Sciences
James D. Hardy, Yale University and director, John B. Pierce Foundation Laboratory
Leon A. Heppel, Cornell University
Harold Hotelling, University of North Carolina
Armin D. Kaiser, Stanford University
Nathan O. Kaplan, University of California at San Diego
Irving M. Klotz, Northwestern University
Rebecca C. Lancefield, Rockefeller University
Walter B. Langbein, U.S. Geological Survey
Peter D. Lax, New York University and Courant Institute of Mathematical Sciences
Daniel S. Lehrman, Rutgers, The State University
Aldo S. Leopold, University of California at Berkeley and director, Sagehen Creek Field Station
Cyrus Levinthal, Columbia University
Milton S. Livingston, Massachusetts Institute of Technology and director, National Accelerator Laboratory
Willem J. Luyten, University of Minnesota
Rudolph A. Marcus, University of Illinois
Carl V. Moore, Washington University
Eugene P. Odum, University of Georgia
Ruth Patrick, Academy of Natural Sciences of Philadelphia and University of Pennsylvania
Gerald L. Pearson, Stanford Unversity
Alexander Rich, Massachusetts Institute of Technology
Herschel L. Roman, University of Washington
Paul A. Samuelson, Massachusetts Institute of Technology
Arthur L. Schawlow, Stanford University
Menahem M. Schiffer, Stanford University
Stephen Smale, University of California at Berkeley
George D. Snell, Roscoe B. Jackson Memorial Laboratory
Jack L. Strominger, Harvard University
Michael Tinkham, Harvard University
Benton J. Underwood, Northwestern University
Bruce Wallace, Cornell University
Abraham White, Yeshiva University
Arthur S. Wightman, Princeton University

NEWS IN BRIEF

● **HARVARD FILES:** Harvard University announced that it and the Department of Health, Education, and Welfare (HEW) have agreed upon a procedure "which will protect the privacy of the individual and enable the HEW investigators to resume their survey" of allegedly discriminatory employment practices against women. Personnel Director John Butler, who had closed the files (*Science*, 1 May), declined to elaborate on the details of the procedure, but said Harvard will release some information from specific files when HEW suspects discrimination against an individual.

● **BUREAU OF STANDARDS CUTS BACK:** A number of professionals at the Bureau of Standards have lost their jobs as an indirect effect of budget cuts at other agencies, including the space agency and the Defense Department. The Bureau, which receives about one-third of its funding through these other agencies, has had to reduce its work force since last December. About 60 people have received or will receive letters of dismissal; about half that number will actually leave government employment—others will retire, take a cut in pay or grade, or take jobs in another agency. Hardest hit by the cuts, according to the Bureau's personnel chief, have been chemists, physicists, and physical science technicians. The cuts have been evenly split between the Bureau's facilities at Gaithersburg, Md., and Boulder, Colo.

● **BRITISH MUSEUM:** With the intent of deterring the vacation migration of scholars to its famous reading room, the British Museum has sent notices to 162 leading universities in Europe, North America, and Australia asking scholars to avoid using the museum's facilities this summer. Museum officials cited a shortage of space and a growing crowd of scholars as the reason for their request. Officials warned that anyone wishing to get a seat would have to arrive within an hour of the opening of the reading rooms.

● **FACULTY COMPENSATION:** The compensation for American professors rose less than 2 percent last year in terms of real purchasing power, according to the American Association of University Professors. The AAUP Report on the Economic Status of the Profession (1969–70) further showed that only 43.1 percent of the institutions participating in the survey could claim an increase in real faculty salaries of 1 percent or more. The dollar level of average compensation had increased by 7.1 percent, but the rise in the consumer price index of 5.4 percent diminished the increase in real purchasing power to only 1.7 percent.

● **KUDOS:** Bryce Nelson, formerly of the *Science* news staff, and Richard D. Lyons, of the *New York Times*, have received the Albert Deutsch Award for distinguished journalism for their reporting last year of security clearance procedures in the Department of Health, Education, and Welfare. The recipients were selected at the suggestion of the American Orthopsychiatric Association.

● **ESTROGEN AND THE PILL:** The Food and Drug Administration has announced that it will advise physicians prescribing birth-control pills to recommend brands low in estrogen, one of the two hormones contained in the pill. The announcement was prompted by research findings here and in Britain and by a report published late last month in the *British Medical Journal*, data from which will be mailed by the FDA to American physicians and pharmacies immediately. The British data showed, according to the FDA statement, a "sufficiently clear relationship" between estrogen and the incidence of blood clotting to impel the FDA to make their recommendation.

● **FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY CATALOG:** The Federal Council for Science and Technology has published a reference catalog for use by laboratories and universities interested in exploring the possibility of establishing joint laboratory-university programs. The "Catalog of Federal Laboratory-University Programs and Relationships" provides a description of the many types of training programs and cooperative relationships that exist among federal laboratories and contract centers and universities. The catalog may be obtained for 75¢ from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

scientists have examined the question of whether fallout or residual radiation might have contaminated the control groups and have concluded that any such contamination is negligible—a finding with which some reputable Japanese scientists told me they agree.

The majority of experts, both in the United States and in Japan, seems to put considerable faith in the validity of the ABCC's studies. Susumu Watanabe, head of the pathology division at Japan's National Cancer Research Institute in Tokyo, told *Science* that while some Japanese scientists occasionally differ with the ABCC's interpretations, the major Japanese studies "don't disagree much with the ABCC." Similarly, scientists at the Research Institute for Nuclear Medicine and Biology at Hiroshima University told me that while they had some quibbles with the ABCC's published results, they felt that the study had been well designed and that its findings are valid. The major bodies which set permissible standards for radiation exposure in the United States—namely, the Federal Radiation Council and the National Commission for Radiological Protection—consider the ABCC studies a major source of pertinent data. And even such a well-known critic of the existing radiation standards as John W. Gofman calls the ABCC studies "crucial and invaluable." But Gofman does have at least one complaint. He says that all cancers are not *automatically* searched out in the ABCC studies, and he suggests that the failure to detect an increase in any particular kind of cancer thus far may primarily reflect a failure to look for it diligently. But Gofman says his complaint is "not terribly serious" and that ultimately the ABCC should provide data on every major form of human cancer induction by ionizing radiation.

In addition to the scientific criticisms, the ABCC has been attacked on a variety of political and emotional grounds. The ABCC contactors who swoop down on grieving relatives in an effort to obtain permission to conduct an autopsy have been likened to "vultures." The ABCC's professionals have been accused of using the Japanese victims as "guinea pigs" to determine the effect of their horrible weapon in order to make ready for another war. And the ABCC has been pictured as heartless and uncaring because it merely examines people and seldom offers any treatment (a circum-

stance which apparently resulted from the fact that the Japanese medical profession strongly opposed competition from the ABCC). The ABCC has even been accused of stealing bodies and of irradiating pregnant women to observe the effects on the fetuses. These and other anti-ABCC themes continually reappear in Japanese literature and journalism and are often repeated by survivors today. As described by Robert Jay Lifton in his monumental book, "Death in Life—Survivors of Hiroshima," the ABCC has become symbolic of the American presence in Hiroshima, and the attacks on the ABCC reflect every kind of anxious and hostile image of America held by the survivors. Specifically, Lifton says, the ABCC is viewed as an "A-bomb-wielding annihilator, causer of social and economic suffering, destroyer of the Japanese essence, dispenser of counterfeit nurturance, and Svengali-like experimenter, rapist and desecrator of the dead." The most extreme attacks on the ABCC seem to have little or no basis in fact—they are often made for propaganda reasons or else stem from unreasoning fear. Officials of the ABCC note that the Japanese government has had its employees working intimately with the ABCC since 1948 and certainly would not allow the ABCC to perpetrate the heinous crimes of which it is sometimes accused.

The people who are most important to the success of the studies—namely, the subjects and the local medical profession — have generally been cooperative. Whatever their feelings of fear and hostility may be, about 85 percent of the participants in the adult health study, who are asked to come in for clinical examinations every 2 years, show up as requested and more than 40 percent of those asked to permit autopsies do allow the ABCC to conduct a postmortem. This last figure is particularly remarkable in a country where autopsies are seldom performed. As time wears on, and as the ABCC becomes increasingly sophisticated in human relations, the volume of criticism continually drops. Indeed, many Japanese political leaders and several newspapers have recently praised the ABCC's work and urged that its studies be continued. The praise was stimulated largely by the fact that the American side, tired of footing the ever-increasing cost, and of struggling to staff the enterprise, has suggested that the Japanese government should assume more responsibility, financial and otherwise. The Japanese, who have their own budget priorities to worry about, have not been noticeably eager to discuss the suggestion, particularly since the ABCC, as a focus for fear and hostility, might become a political liability for the government. But spokesmen on both sides have stressed that the work should continue until the full effects of the atomic bombings have been delineated—perhaps another 20 years or so into the future. Some even suggest that there is a moral obligation to assess fully the results of one of mankind's most violent acts of warfare.—PHILIP M. BOFFEY

Italy: Political Turmoil Kills Plan for First Doctoral Program

Naples. When last reported on in these columns (21 March 1969), the International Laboratory of Genetics and Biology (ILGB), Italy's pioneering wedge into modern biology, was enveloped in political agitation, and work had been halted on a joint U.S.-Italian government plan to use the laboratory as a seedbed for Italy's first program of Ph.D.-level studies. A recent visit here finds ILGB quieted, though mainly from exhaustion rather than from resolution of issues. The research staff appears to have dwindled in number, though whether it really has—and, if so, why—is a subject of contention, along with many other matters. ILGB's controversial, reformist founding director, Adriano Buzzati-Traverso, resigned last July and went to head up scientific affairs for UNESCO in Paris. His departure, following a 38-day occupation of the laboratory by left-wing researchers and technicians, is said to have been precipitated by a sense of despair over the laboratory's future. After Buzzati-Traverso left, ILGB's normal rules of administration were suspended by government decree, and his place was taken by an all-powerful government-appointed Commissario, who functions as a sort of receiver in bankruptcy. Meanwhile, plans for the Ph.D. program, titled the Studium, have been laid to rest, and this is confronting the U.S. National Science Foundation (NSF) with a possibly historic event—the return of an untouched grant; the $486,000, channeled through the University of California, was to have been the U.S. contribution to the Studium.

For a time, however, it appeared that the Studium might actually be born. In a last-minute rescue attempt last fall, Buzzati-Traverso and six senior researchers from ILGB sought to set up the Studium in Rome. But, though approval had been received, or so it seemed, from the Italian National Research Council (NRC) as well as from NSF and the University of California, the plan foundered overnight when a building that had apparently been promised was mysteriously taken over as a dormitory for customs officers. The Studium team first became aware of the take-over when they saw beds being carried in.

The Commissario, Thomaso Patrissi, professor of public health at the University of Rome, seems to be a suitable choice at this point for heading up ILGB's cast of hair-trigger ideologues. Elderly, impassive, and of no apparent political persuasion, he is credited by all with an even-handed, soothing approach to his duties. He is acknowledged to be there for the purpose of bloodless pacification, and not as a research administrator, an area in which he had had no experience. With the assistance of an advisory committee drawn from the laboratory staff, Patrissi has been attending to various details of administration which had been overlooked during the period of open strife. These have ranged from securing extensions for a group of fellows whose support was inadvertently not renewed to formulating research programs for submission to the National Research Council, which finances the laboratory.