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Symposium Paper

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Greetings: 50 years of Atomic Bomb Casualty Commission–Radiation Effects Research Foundation studies

ITSUZO SHIGEMATSU

Radiation Effects Research Foundation, 5-2 Hijiyama Park, Minami-ku, Hiroshima, 732 Japan

ABSTRACT **The Atomic Bomb Casualty Commission was established in Hiroshima in 1947 and in Nagasaki in 1948 under the auspices of the U.S. National Academy of Sciences to initiate a long-term and comprehensive epidemiological and genetic study of the atomic bomb survivors. It was replaced in 1975 by the Radiation Effects Research Foundation which is a nonprofit Japanese foundation binationally managed and supported with equal funding by the governments of Japan and the United States. Thanks to the cooperation of the survivors and the contributions of a multitude of scientists, these studies flourish to this day in what must be the most successful long-term research collaboration between the two countries. Although these studies are necessarily limited to the effects of acute, whole-body, mixed gamma-neutron radiation from the atom bombs, their comprehensiveness and duration make them the most definitive descriptions of the late effects of radiation in humans. For this reason, the entire world relies heavily on these data to set radiation standards. As vital as the study results are, they still represent primarily the effects of radiation on older survivors. Another decade or two should correct this deficiency and allow us to measure definitively the human risk of heritable mutation from radiation. We look to the worldwide radiation and risk community as well as to the survivors who have contributed so much to what has been done already to accomplish this goal.**

It is my pleasure to have been given an opportunity to present my greetings at this symposium. On behalf of the Radiation Effects Research Foundation (RERF), I express my profound appreciation to the National Academy of Sciences (NAS) for having taken up at its 134th annual meeting the Japanese/Academy cooperative studies conducted over the past 50 years on the Hiroshima and Nagasaki atomic bomb survivors and their children.

After the atomic bombs were dropped on Hiroshima and Nagasaki in August 1945, the U.S.–Japan Joint Commission began to study the medical effects of atomic bomb radiation in September the same year. Based on the findings of this Commission, the Atomic Bomb Casualty Commission (ABCC) was established in Hiroshima in 1947 and in Nagasaki in 1948 under the auspices of the NAS. The purpose was to initiate a long-term and comprehensive epidemiological and genetic study of the atomic bomb survivors. The Japanese National Institute of Health under the Ministry of Health and Welfare (MHW) joined the ABCC 1 year later to assist in the studies and improve the cooperation of the survivors.

This arrangement continued for 28 years until it was replaced in 1975 by the RERF. The RERF is a nonprofit Japanese foundation binationally managed and supported with equal funding by the governments of Japan, through the MHW, and the United States, through the NAS under contract with the Department of Energy (DOE) (and its predecessors). Thanks to the cooperation of the survivors and the contributions of a multitude of scientists, these studies flourish to this day in what must be the most successful long-term research collaboration between Japan and the United States.

The first of the major programs to be initiated, in 1947, was a genetic study of the first-generation children of survivors (commonly known as F1). The current research program began as a series of platform protocols based on a fixed cohort of 120,000 survivors who were listed in the Japanese National Census of 1950. The Life Span Study follows this entire cohort by means of a national death certificate retrieval system. The Adult Health Study follows a subsample of 20,000 survivors using biennial health examinations. Recently, the mortality studies have been enhanced by cancer incidence studies using the ABCC–RERF developed tumor registries in Hiroshima and Nagasaki. Finally, a cohort of several thousand individuals who were *in utero* at the time of the bombings also is being followed.

Because the ABCC–RERF fixed cohorts do not include persons who died between the time of the bombings and 1950, the results may reflect a resistant subpopulation of survivors who are not representative of overall human risk. However, study after study has failed to show any difference in the radiation sensitivity of the survivor's cells as a function of the survivor's radiation dose.

The ABCC–RERF genetics investigators have searched vigorously for heritable effects of radiation in the offspring of the survivors. To date, not a single one of the many end points has shown a significant effect. An active effort is under way to verify this conclusion through the use of new technology such as the direct examination of DNA for mutational differences between survivors and their children.

All ABCC–RERF studies are dependent on radiation dosimetry. Currently, we use Dosimetry System 1986 (DS86), as created and monitored by a binational group of experts. Dosimetry-related efforts at RERF involve the use of biological end points and the newly evolving and promising method of electron spin resonance of tooth enamel.

ABCC–RERF studies are necessarily limited to the effects of acute, whole-body, mixed gamma-neutron radiation from the atom bombs, but their comprehensiveness and duration make them the most definitive descriptions of the late effects of radiation in humans. For this reason, the entire world relies

Abbreviations: ABCC, Atomic Bomb Casualty Commission; RERF, Radiation Effects Research Foundation; MHW, Ministry of Health and Welfare; DOE, Department of Energy; NAS, National Academy of Sciences.

*To whom reprint requests should be addressed. e-mail: shigematsu@rerf.or.jp.

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heavily on ABCC–RERF data to set radiation standards, as demonstrated in the reports of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP), the International Atomic Energy Agency (IAEA), and the Committee on Biological Effects of Ionizing Radiation (BEIR).

Because of the accelerated aging of atomic bomb survivors, it is becoming more and more difficult to identify the effects of radiation from those of other factors, and health effects that are still unknown may appear with aging phenomena. On the other hand, those exposed at younger ages are just now reaching the cancer-prone ages. Furthermore, ≈50% of the survivors are alive as of the present time. By age at the time of the bombings, 82% of those <30 years of age and 91% of those <10 years of age are still alive.

Some evidence points to an even greater risk in the very young. We estimate that it will be another 20 years before the question of age sensitivity can be addressed properly, making this issue one of the primary reasons for continuation of the studies into the future.

It is true that ABCC had been regarded with distrust and disfavor by atomic bomb survivors. The fact that the results of the study in the early days of ABCC were published only in the scientific journals in the western countries and little was known in Japan also gave rise to criticism of the secrecy and the closed nature of ABCC. Furthermore, the atomic bomb survivors were displeased much with ABCC for only conducting studies and tests and providing no apparent treatment.

Nevertheless, every research program of ABCC and RERF has the positive cooperation of atomic bomb survivors, as is evident by the fact that their participation rate in the Adult Health Study initiated in 1958 has been maintained at a high level of ≈80% on an average for ≈40 years. This is attributable to the understanding and cooperation of atomic bomb survivors, but it also must be borne in mind that it is, at the same time, because of the untiring efforts of the Japanese and American research scientists and all employees of ABCC–RERF.

It also may be worthwhile to add that RERF has been widely involved in the Chernobyl and South Urals health studies directly in cooperation with the former Soviet Union and indirectly through the various Japanese, United States, and international organizations. We believe that it is our duty to disseminate the lessons obtained from Hiroshima and Nagasaki as widely as possible.

Although RERF studies continue, disturbing developments in the past few years casted a shadow on the future of the organization. The primary issue is budgetary constraints stemming from the dramatic changes in the yen–dollar relationship and finances of the DOE. Since 1992, RERF has experienced sharp reductions in its budget, more than halving operating expenditures and preventing the replacement of retirees.

A secondary issue involved management changes from the United States concerning the continued involvement of the NAS as the U.S. manager of RERF. Announcement of this intention from the DOE raised a chorus of criticism in the United States, including a resolution signed by 191 members of the NAS, a petition from 31 members of the Radiation Research Society, and strong letters from the Commission on Life Sciences of the NAS and the American Nuclear Society. The Japanese radiation community also responded to the DOE's intention in a similar manner. We fully agree with their indication that the NAS provided an important buffer between the atomic bomb survivors and the U.S. government, thus contributing to the remarkable cooperation of the survivors and the credibility of the results.

In such circumstances, the RERF Scientific Council recommended at the April 1995 meeting that views of a high-level international committee of distinguished scientists (Blue Ribbon Panel) should be sought concerning future RERF activities. This recommendation was approved at the RERF Board of Directors meeting in June the same year, and the governments of the two countries were requested to take action for its materialization.

In November 1995, the DOE and the MHW appointed Professor Roger H. Clarke, Chair, National Radiological Protection Board, U.K., as Chairman of the Blue Ribbon Panel and eight scientists from six countries as members. After the intensive investigations on the scientific activities of RERF, the Panel submitted its final report including the recommendations for the future direction of RERF to the two governments in July 1996.

In response to the Panel's recommendations, RERF prepared its reform plan and the new five year research program, both of which were examined at the RERF Councilors' meeting in November 1996. We now expect that the new direction of RERF will be implemented immediately after approval of the RERF Board of Directors meeting in June 1997 and the 50 years relationship between NAS and ABCC–RERF will be maintained in the future.

The RERF must finish its important task. As vital as the study results are, they still represent primarily the effects of radiation on older survivors. Another decade or two should correct this deficiency and allow us to measure definitively the human risk of heritable mutation from radiation. We look to the worldwide radiation and risk community as well as to the survivors who have contributed so much to what has been done already to accomplish this goal.