Cover-up of Injuries from Atomic Bombing and Severe Effects of Internal Exposure to Residual Radiation

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Present Situation of Atomic Bomb Survivors and Estimation of Radiation Effects

Now, after sixty-five years of Hiroshima and Nagasaki atomic bombing, many atomic bomb survivors are still suffering aftereffect diseases. The Japanese government has provided special medical and livelihood assistance to survivors whose diseases are verified to be from the effects of the atomic bomb radiation, however, the criteria adopted by the subcommittee of Atomic Bomb Survivors Medical Care of the Ministry of Health, Labor and Welfare are very strict and far removed from the actual situation of many survivors. The numbers of legally accepted atomic bomb survivors who hold a health note book was 380,000 in 1980 and the number of survivors who were certified as suffering from diseases caused by the atomic bomb radiation effects by the Japanese government was 4,400 at that time. After 1980, the number of certified survivors rapidly decreased from above 4,000 to about 2,000 which was less than 0.8% of the total survivors of 270,000 in 2003 reflecting only the political and financial grounds of the government. Now a collective lawsuit has been going on from 2003 in 17 local courts by 306 atomic bomb survivors against the Japanese government demanding withdrawal of rejection of application to certify atomic bomb disease. Prior to the collective lawsuit seven successive judgments including those by the Supreme Court and by two high courts had pointed out that the criteria for atomic bomb disease certification by the government is not consistent with the actual conditions of survivors and decided to withdraw the rejections. However, the Japanese government had introduced more severe criteria about probability of causation by which even the applications of survivors who got favorable judicial decisions will be also rejected.

The criteria, the probability of causation, of atomic bomb disease certification has been based on the Atomic Bomb Radiation Dosimetry System 1986 (DS86) and results of the epidemiological research that has been done at the Radiation Effect Research Foundation (RERF) which is the successor of the Atomic Bomb Casualty Commission (ABCC). The epidemiological survey of RERF put emphasis only on the initial radiation (gamma rays and neutrons) which were emitted within 1 minute after the explosion and the effects of the residual radiation had not been considered. The initial radiation had caused acute external exposure meaning irradiation from outside of human body. There are two sources for the atomic bomb residual radiation; one is from radio-activated matter induced by the initial neutrons and the other is the radioactive fallout which include the fission products, neutron-induced equipments of the atomic bombs and fissile materials (uranium and /or plutonium) leaving without fission. Beyond external exposure effects, the major effects of residual radiation are chronic internal exposure due to intake of radioactive matter by respiration, ingestion and other forms.

The nuclear weapon states, among which the US takes a leading role, have hidden the severe effects and inhuman character of internal exposure, in order to maintain their arguments that the injuries from a nuclear explosion can be restricted. The International Commission on Radiological Protection (ICRP), which has set international standards of radiation protection, has been influenced by the policies of governments of the US and Soviet Union and especially has relied on the epidemiological studies of RERF. Then the international standards of radiation protection set by ICRP have the same problems. Therefore to clarify the severe effects of internal exposure from the scientific standpoint is an important task for the future of human beings.

After 6 successive lost cases of the collective lawsuit the Japanese government revised their criteria for atomic bomb diseases by abolishing the probability of causation and accepted the effects of exposure to residual radiation in March 2008. On the memorial day of Hiroshima, 6 August this year, after 19 successive lost cases including 5 decisions of higher courts, the prime minister signed a note of confirmation with the Japan Confederation of A- and H-Bomb Sufferers Organizations, which have promoted the collective lawsuit. In the note the government promised that the government will be subjected to decisions of local courts and withdrew appeals to the higher courts.

Cover-up Policy of the US on Nuclear Injuries

Just after the beginning of Japan’s occupation by the Allied Forces, on 6 September 1945, a brigadier general T. Farrel, who was a commander of the research commission of the Manhattan Project gave a press interview and published a statement that "In Hiroshima and Nagasaki, at present, the beginning of September, anyone liable to die has already died and no one is suffering from atomic radiation." This was disputed by a journalist W. Burchett who had seen the real state of Hiroshima, where one hundred survivors died each day. Farrel made a counterargument that denied the facts: "In order to remove risk from residual radiation the bomb was exploded at considerable altitude, so it is impossible that radioactivity exists in Hiroshima at present, and if someone died at present it will not be owing to residual radiation but from the effects of damage received at the time of bombing. "Farrel was in charge of research on the human effects of radiation including experiments on the human body in the Manhattan Project so he would already have known that if a few fine radioactive particles accumulate in the lung it produces fatal effects.

On 19 September 1945, the General Headquarters of the Allied Forces issued a press code that controlled by severe inspection press reports and literature concerning the atomic bomb and by demanding permission before publication of research results on the damage of atomic bombing, practically forbidding publication. This was the beginning of the US cover-up policy regarding radiation damage, especially of the problems of internal exposure to residual radiation.

All the results obtained by Japanese scientists just after the bombing and the results of research done by the Special Committee for Investigation and Research on Injuries from the Atomic Bomb established by the Japanese Academic Council were brought to America. Late in September 1945 the US Army and Naval surgeon group organized the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan by making the Medical Faculty of Tokyo Imperial University the collaborator and investigated for about one year, but they carried back to the US all collected materials.

ABCC and RERF

The US, having decided to dominate the world with nuclear weapons, had been compelled to study, from both offensive and defensive aspects, effects on the human body of use of nuclear weapons, especially of the effects of initial radiation. On 26 November 1946, President Truman ordered establishment of a Commission on Atomic Bomb Casualties (CAC) and the CAC decided to found Atomic Bomb Casualty Commission (ABCC). After preparatory investigations the ABCC built permanent institutions at Hiroshima and Nagasaki in 1950 and began investigation of atomic bomb survivors. In interviews investigating the experiences of survivors the ABCC made a thorough examination of the exposed place (indoors or outdoors, thick or thin sheltered house, etc.) and of the posture of the survivor at the instant of bombing in order to estimate exposed dose from the initial radiation of the atomic bomb. On the other hand, the ABCC did not inquire into the behavior of survivors after the explosion which was necessary to estimate residual exposure for the survivor.

Due to the occupier’s closed manner of the ABCC and frequent change of American expert staffs as well as bad feeling among citizens of Hiroshima and Nagasaki, the activities of the ABCC stagnated around 1955. Following the Francis Committee's recommendation based on the examination of ABCC activities, the ABCC restarted the Adult Health Study (AHS) on about 20,000 survivors in 1958 and the Life Span Study (LSS) on about 100,000 survivors in 1959. At long last in 1975 the ABCC was closed and the RERF was started up, but the ABCC's staff, institutions and projects were left to continue under the RERF as well as intrinsic problems of the ABCC. The epidemiological research in the RERF remains unchanged completely ignoring the effects of residual radiation.

The Bikini H-Bomb Tests and Studies on Radiation Damage

A hydrogen bomb test Bravo Shot at Bikini atoll of Marshall Islands on 1 March 1954 made a very big impact on the Japanese people. A nationwide movement against nuclear weapons arose and the first World Conference against A & H Bombs was held in August 1955 at Hiroshima. On the basis of this movement many scientists and experts in various fields, such as radiation physics and chemistry, radiobiology and fisheries science, took an active part in investigation of health effects from the Bikini nuclear tests and clarified that the effects from fallout of hydrogen bomb tests had been spread over a wide region of the Pacific Ocean. These investigations and researches by Japanese scientists pointed out that the radiation effects of fallout from these nuclear tests were very severe. Reflecting these findings the Russell-Einstein Manifesto in 1955 pointed out the dangerous situation of radioactive fallout:

"... Such a bomb, if exploded near the ground or under water, sends radioactive particles into the upper air. They sink gradually and reach the surface of the earth in the form of a deadly dust or rain. It was this dust which infected the Japanese fishermen and their catch of fish.

No one knows how widely such lethal radioactive particles might be diffused, but the best authorities are unanimous in saying that a war with H-bombs might quite possibly put an end to the human race. It is feared that if many H-bombs are used there will be universal death--sudden only for a minority, but for the majority a slow torture of disease and disintegration."

Exposure of Marshall Islands People

In the case of the Bikini test, not only the crew members of the 5th Lucky Dragon boat and the inhabitants of Rongelap atoll but all the people of Marshall Islands were exposed simultaneously to radiation from fallout. Although the inhabitants had received strong exposure from fallout they were left unattended for a while. Moreover, in 1967 inhabitants of Rongelap atoll were brought back by the US army to their atoll because of “absence of radioactivity”. However due to frequent occurrence of injuries among inhabitants including those not exposed to fallout, they departed by themselves again from their atoll in 1985. Recently it was found that the US Atomic Energy Commission which conducted these nuclear tests had made a thorough observation of radiation from fallout during these tests but did not open the observed results to the public.

Even now inhabitants of Rongelap atolls are forced to leave and robbed of their own birthplace for more than half a century. When the Marshall Islands Republic became independent in 1989, it concluded a Free Alliance Agreement with the US which includes compensation for the use of Kwajalein atoll, the largest atoll of Marshall Islands, as a military missile test site plus compensation for the damage from nuclear tests. In the 2004 revision of this agreement, compensation for nuclear test damage was discontinued by the US who asserted that there are no effects of residual radiation.

In Fig. 1 an investigation of abnormal births among Marshallese show that the rate of abnormal births in each atoll of the Marshall Islands decreases with distance from

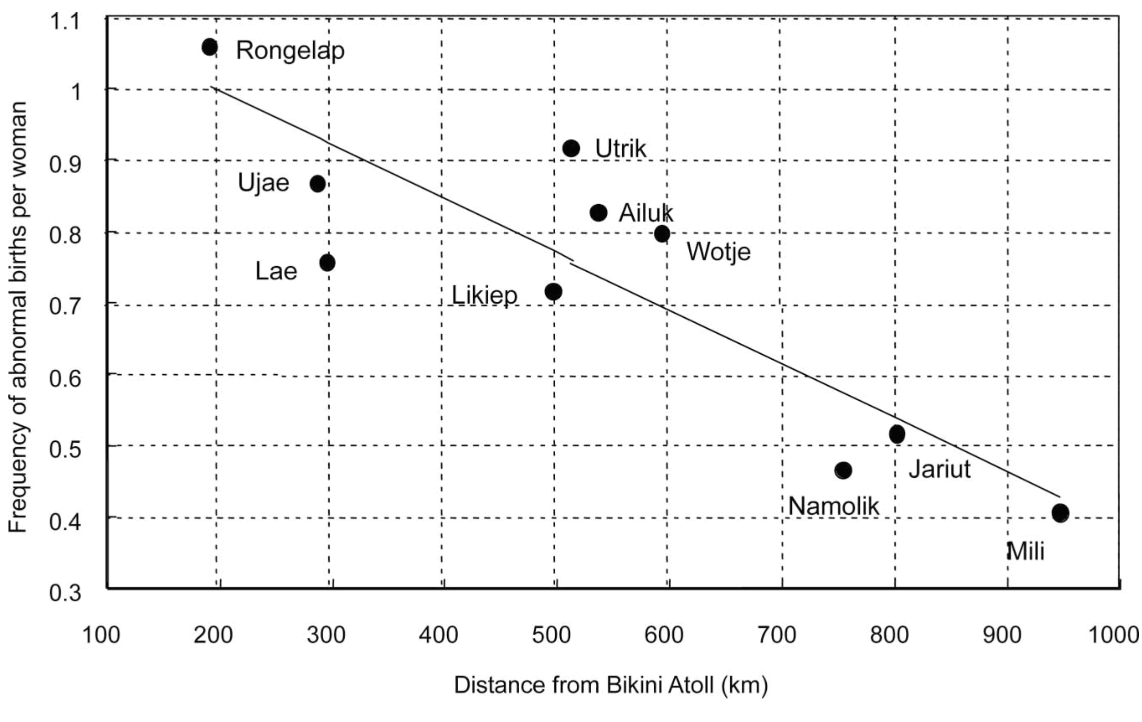

Figure 1. Abnormal Birth Rates among Marshallese Islanders

Bikini atoll and clearly indicates that effects of fallout of nuclear tests extend to the whole region of Marshall Islands (The average rate of abnormal births among Marshall Islands women before the nuclear tests was 0.04.) Now the people who were inhabitants of the severely contaminated atolls, Enewetok, Rongelap, Utrik and Bikini atolls, set up an organization ERUB on the occasion of the 50th anniversary of the Bravo Shot and began a petition for compensation to the US Congress.

Revision of Dosimetry System of Atomic Bomb Radiation from DS86 to DS02

It is necessary to estimate the exposed atomic bomb initial radiation dose of survivors for the epidemiological studies by the ABCC and RERF. For this purpose the US had made an estimation of radiation dose, the T57D (Tentative Dose 1957) and the T65D (Tentative Dose 1965), on the basis of nuclear tests. The atomic bomb dosimetry system DS86 is the first computer calculated estimation of the initial radiation dose from the Hiroshima and Nagasaki atomic bombs. The DS86 put emphasis on the initial radiation reached at short distances and showed little concern for, or neglected, residual radiation from fallout and induced radioactive matter.

The Dosimetry System 2002 (DS02), a substitute of the DS86, was published in 2005. In the DS02 in order to rectify an over estimate of initial radiation doses at short distances in the DS86 the height of explosion of Hiroshima bomb is changed from 580m to 600m and the yield of explosion from 15 ktTNT to 16 ktTNT. Leaving aside the problem of a discrepancy between estimated values from the DS86 system and experimentally measured values in the distant region without further explanation, the preparation of DS02 is justified by a US side argument that measured values at greater distances include natural background radiation effects other than bomb radiation. The DS02 did not contain a single description of the residual radiation.

Since the estimation of initial radiation (both of gamma rays and neutrons) from measurements systematically exceed the estimation of the DS86 and DS02 in the region more distant than 1.5 km from the hypocenter and the discrepancies increase with distance, the DS86 and DS02 estimates cannot be applied to the distance beyond 1.5 km from the hypocenter of atomic bombing even confined to the initial radiation.

Physical Consideration of Internal Exposure

Among fallout of the atomic bomb of Hiroshima and Nagasaki (1) 3.6×10^{24} nuclei of fission products, (2) (2—5) $\times10^{24}$ nuclei of neutron-induced radioactive matter of bomb fragments and casing, (3) 1×10^{26} nuclei of uranium-235 or 2.5×10^{25} plutonium 239 which did not participate in the fission chain reaction were included respectively. After explosion of each atomic bomb a fire ball of plasma was formed and all radioactive nuclei listed above were included in this. The fireball turned into the mushroom cloud. The central part of cloud rose breaking through the tropopause up to 15 km or more and the peripheral part of cloud spread along the tropopause over a region with radius more than 15~20 km. The region where fine particles of the fallout fell can be assumed to have been larger than the region covered by the mushroom cloud. In the fallout a huge number of fine particles were included which had been contained in the fireball.

The atomic bomb survivors were externally exposed by initial radiation from outside their bodies. This exposed dose can be estimated roughly if the location of the survivor is known. Survivors and people who entered the regions near the hypocenter were also exposed to radiation emitted by residual radioactive matter induced by the initial neutron beam. The doses experienced by survivors from the induced radioactive matter can be estimated roughly by use of physical calculations and measurement data if their actions or behaviors were known. It is difficult, however, to estimate the radiation dose of fallout in terms of physical measurement long after the explosion because most of the fine particles of the fallout were carried by the wind and the radioactive matter accumulated on the surface of the earth or sank into the earth which had been brought by so called black rain or other form of fallout were washed away by heavy rains accompanying typhoons. It is more difficult to estimate the effects of internal exposure by inhalation or ingestion of radioactive matter of the fallout and/or induced matter by physical methods.

When some radioactive substances are taken into the body, if they are water or oil soluble then they will spread throughout the whole body at the level of atom or molecule and some radioactive materials will concentrate and/or deposit in special organs depending on the types of chemical elements. For example, iodine concentrates in the thyroid, and phosphorus and cobalt are concentrated in bone marrow. In this case amounts of absorbed radioactive materials taken into body can be estimated from excrement such as urine. By contrast, if insoluble radioactive fine particles are absorbed there are possibilities that the fine particles are deposited in some organ while preserving their size and that radiation emitted from these fine particles irradiate continuously and intensively surrounding cells. In this case it is difficult to detect these radioactive particles from outside the body and also to estimate them from excrements. Effects from such radioactive fine particles largely depend on their size and also on the type of radioactive elements and type of radiation (the average life-time and alpha, beta or gamma ray). It is difficult to represent these effects in terms of a simple factor such as the absorbed energy per weight, the unit of absorbed dose, Gy, or by use of the relative biological effectiveness, the unit of equivalent dose, Sv. The difference between external uniform exposure and internal exposure by a radioactive fine particle is illustrated in Fig. 2. Therefore the biological estimation of effective exposure dose which includes both external and internal ones is required on the basis of analyses of the investigation of incidence rates of the acute and clinical radiation diseases and the rate of chromosomal aberration especially where it appears among distant survivors and entrant survivors who were not severely exposed to the initial radiation.

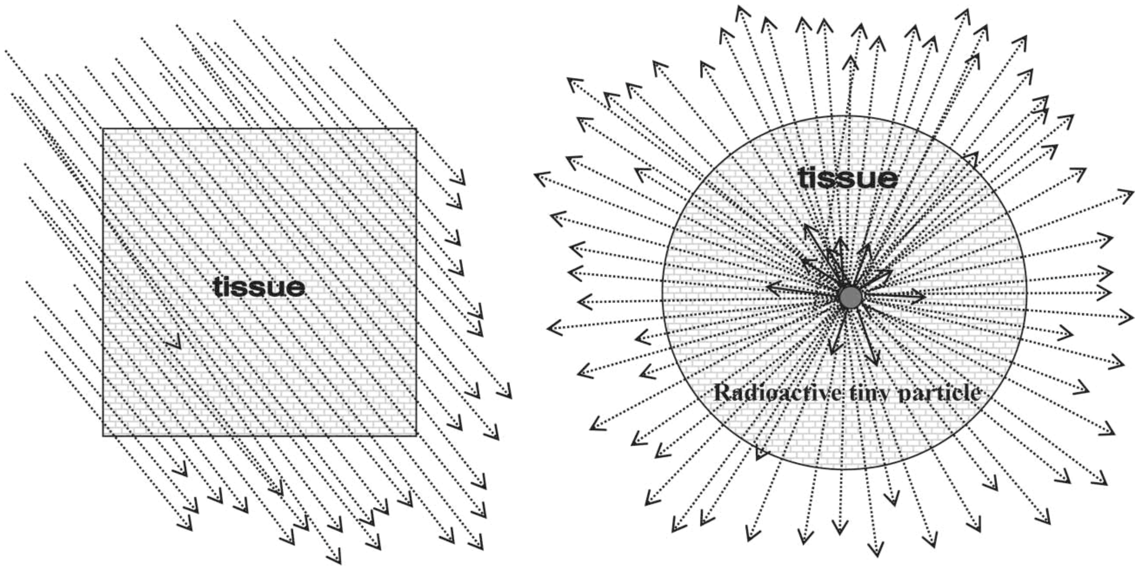

Figure 2. External and Internal Exposure to Radiation

Estimation of Residual Radiation in Terms of Incident Rate of Acute Radiation Disease

In order to estimate actual effects of both initial and residual radiation it will be useful to analyze examined data of acute radiation disease among survivors of the atomic bombings in Hiroshima and Nagasaki.

Around 1950 the ABCC obtained incidence rates for the heavy epilation (above 67 % hair loss) which appeared within 60 days after the detonation of the bomb. Preston et al of RERF reported separately the incidence rates of epilation of Hiroshima and

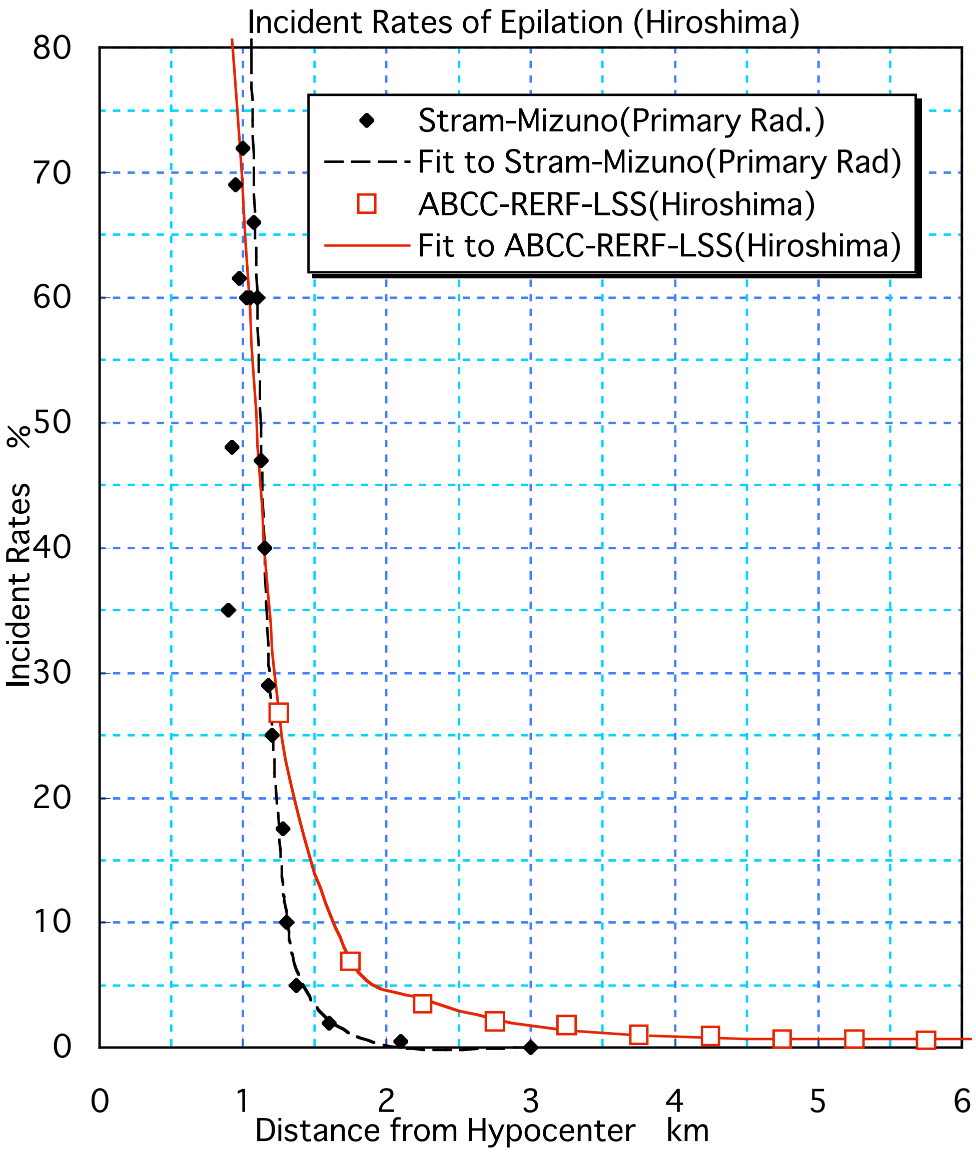

Figure 3 Incident Rates of Epilation among the LSS Hiroshima Group

Nagasaki survivors among the LSS group. Preston et al reported the dependence of the incidence rates of epilation of 58,500 Hiroshima survivors among the LSS on distance from the hypocenter which is shown by squares in Fig. 3 (D. L. Preston, et al. Magazine of Nagasaki Medical Society (in Japanese)). Incidence rate 100 % at 0.75 km is scale out from this figure. Although the initial radiation could scarcely have reached beyond 2 km from the hypocenter, small but non-negligible rates of epilation occurred.

From incidence rates among the LSS group Stram and Mizuno of the RERF derived a relationship between absorbed dose of acute exposure from the atomic bomb

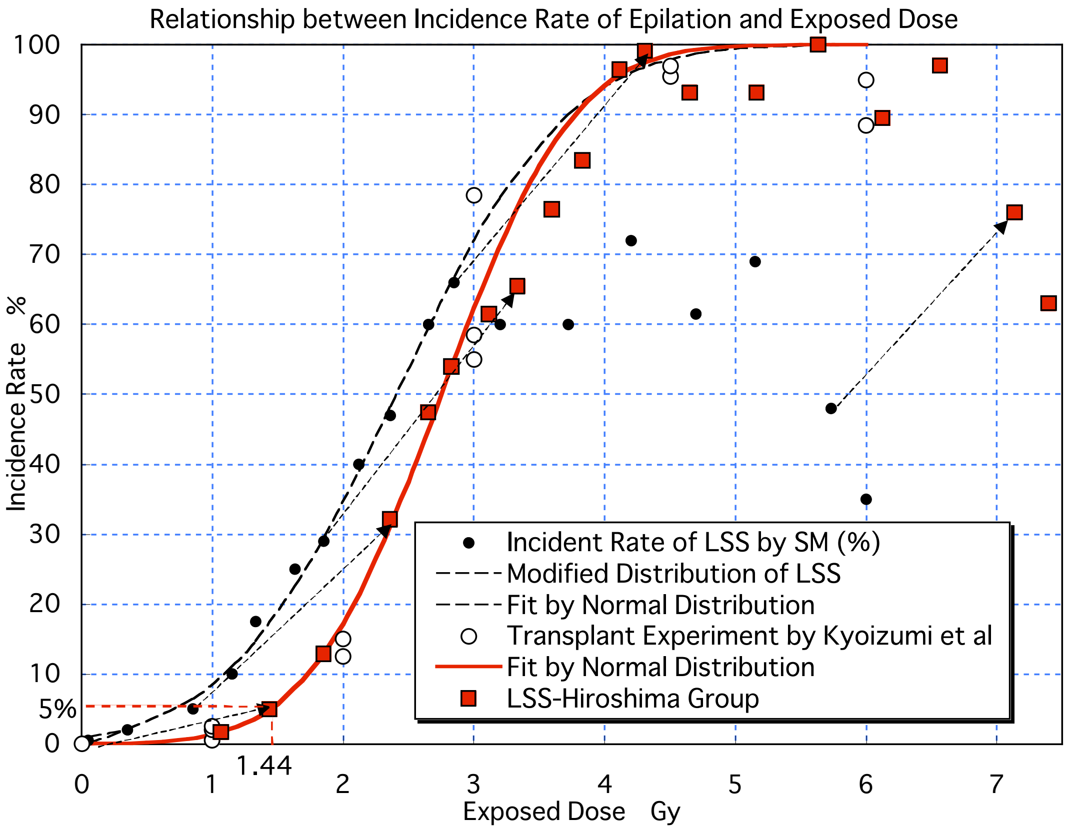

Figure 4 Relation between Incidence Rate of Epilation and Exposed Dose

initial nuclear radiation and the incidence rates of epilation based on the assumption that epilation in the distant regions was caused by background effects other than radiation, such as mental effects. Results obtained by Stram and Mizuno of incidence rates among the LSS group for initial radiation dose estimated by the Dosimetry System 1986 (DS86) are shown by small closed circles in Fig. 4 (Radiation Research 117, 93-113(1989)). As shown in Fig. 4 the incidence rate rapidly increases above 1 Gy and exceeds 50 % at around 2.4 Gy. However, beyond 3 Gy the rates do not increase and even *decrease* as dose approaches 6 Gy. This unnatural behavior of the incidence rates in the high dose region can be explained by the fact that the LSS group contains only people who were left alive in 1950 though they had been exposed to nearly or more than a half-death dose of about 4 Gy as pointed out by Stewart et. al.(Health Phys. 58, 782-735 (1990): 64, 467-472 (1993); Int J Epidemiology, 29, 708-714 (2000)) as well as over subtraction of background incidence rates.

Incidence rates of epilation shown by open circles in Fig. 4 are those obtained by Kyoizumi et al. (Radat Res 194, 11-18 (1998); RERF Update 7(2);4-5(1995)) by means of radiation exposure to transplanted human head skin onto immunodeficient mice. As seen in Fig. 4 the incidence rates increase very slowly in the low exposure region compared to those given by Stram and Mizuno and increase to 95.5 % and 97 %, and almost 100 % at exposure of 4.5 Gy. From experimental studies with animals it is known that most of dose dependence of incidence rates or death rates are represented by a Normal(Gaussian) distribution. The incidence rates given by Kyoizumi et. al. over the whole range of the exposure region can be fitted well by the normal distribution with an expectation value of 2.751 Gy and standard deviation 0.794 Gy and shown by a solid curve in Fig. 4. At this expectation value 50% of people will experience epilation.

When it is recognized that the results of Stram and Mizuno shown in Fig. 4 were obtained from examination data of the LSS group based on the assumption that the epilation was caused only by the exposure to initial radiation regarding the fallout radiation as the background, it is expected that the black circles in Fig. 4 shift toward higher dose and higher incident rates, i.e. toward the relationship obtained by Kyoizumi et al as shown by arrows if the exposure to the fallout radiation is included. When the exposures indicated by black circles in Fig. 4 for initial radiation dose are translated into distance from the hypocenter by use of the DS86 estimation neglecting shielding effects, we obtain results which are plotted by black diamonds in Fig. 3. If the shielding effects are taken into account the diamonds shown in Fig. 3 will move to the left towards the hypocenter and the distance between the squares will increase. It is assumed that the systematic difference between squares and diamonds shown in Fig. 3 represents exposed effects from fallout radiation.

By use of the relationship given by Kyoizumi et al, total exposure at 2 km from the hypocenter of Hiroshima can be obtained as follows. The incidence rate of epilation at 2 km is about 5% as seen in Fig. 3. From the relationship of Kyoizumi et al shown in Fig. 4 this 5% rate corresponds to exposure of 1.44 Gy. The initial radiation exposure is estimated as 0.04 Gy by assuming the shielding effect is 0.5. Then the exposure from fallout is estimated as about 1.4 Gy. By use of a similar statistical method the exposed effects from the radiation of the Hiroshima atomic bomb are obtained as shown in Fig. 5 from the incidence rates of epilation among the LSS Hiroshima group. The doses of total, initial nuclear radiation and fallout exposure are shown by a bold dashed curve, a thin dashed curve and a bold solid curve, respectively and the initial nuclear radiation doses estimated by DS02 are also shown by a thin solid line in Fig. 5. As seen in Fig. 5, the effects of fallout exposure increase with distance from the hypocenter up to 1 km, but this has large ambiguity because the incidence rates in the region below 1 km were not employed in the present analysis. Exposure from the initial radiation rapidly decreased with distance from the hypocenter and at about 1.2 km the fallout effects cross over that of initial nuclear radiation and beyond this distance the fallout effects become dominant. The estimated exposure from fallout radiation reaches about 1.5 Gy at around 1.45 km then decreases slowly. Beyond 4 km the exposure effect of fallout takes an almost constant value of 0.79 Gy. This result from the incidence rates of epilation, one of the actual accepted and universally agreed conditions of the bombed

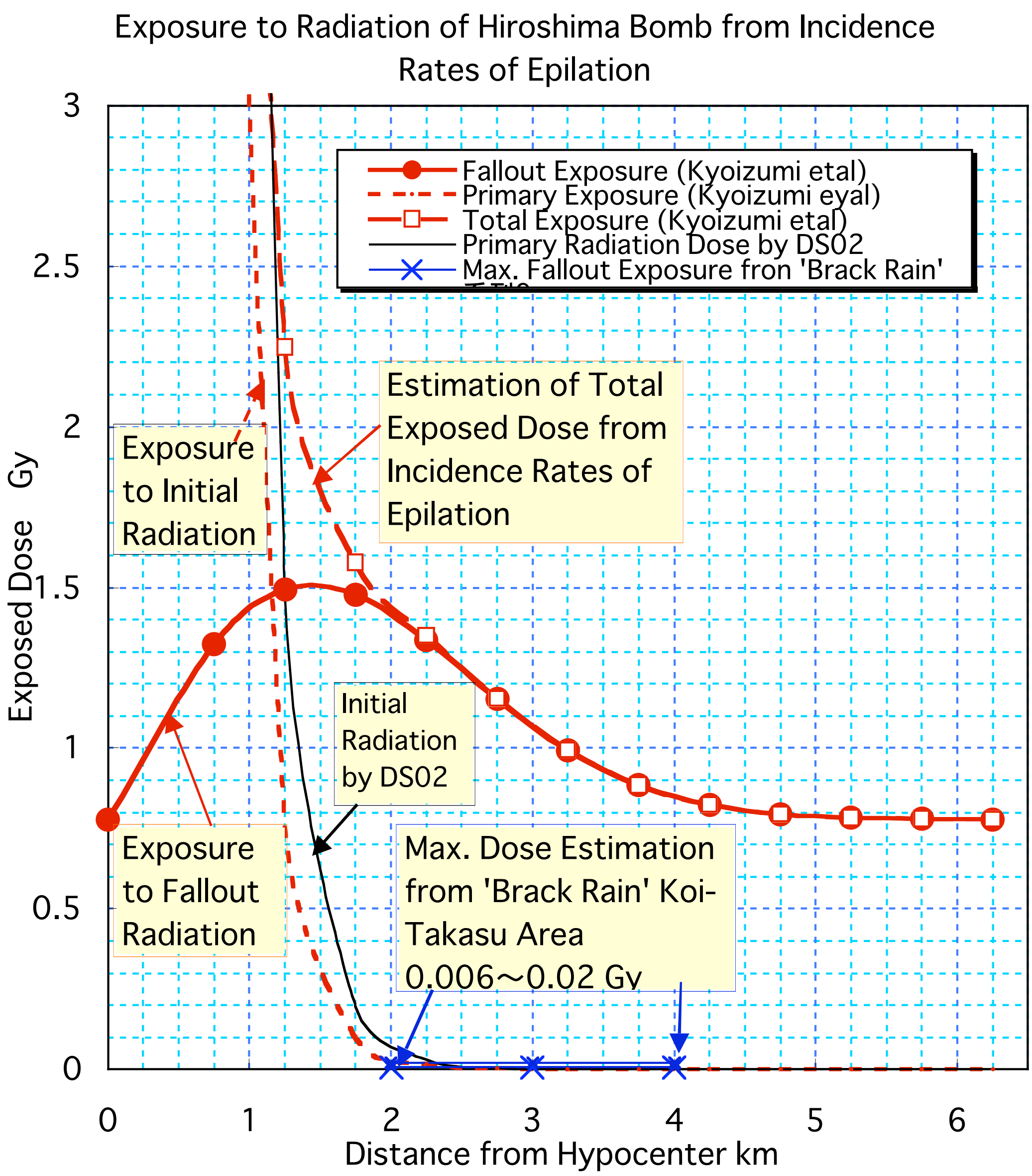

Figure 5 Exposure of Hiroshima Atomic Bomb Radiation Estimated from Incidence Rates of Epilation among LSS Hiroshima Group

survivors, indicates overwhelming effects of fallout beyond about 1.5 km from the hypocenter of Hiroshima. For example at 2.25 km and 2.75 km from the hypocenter the dose estimation of the initial radiation by DS02 are 0.0302 Gy and 0.0053 Gy while the incidence rates of epilation among the LSS-Hiroshima group at these distances are 3.5 % and 2.1 %. The estimated fallout exposure effects from these incidence rates are 1.34 Gy and 1.16 Gy, about 44 and 219 times the DS02 initial radiation.

The maximum cumulative exposure from fallout of the Hiroshima bomb has been considered hitherto between 0.006 and 0.02 Gy in the Koi-Takasu region mentioned in the DS86 report and adopted by the Japanese government as the criteria of atomic bomb diseases which are shown by cross marks in Fig. 5. These absorbed doses were obtained from measurement of radiation from fallout matter retained in the soil of these regions which are located between 2 and 4 km to the west of the hypocenter where light radioactive fallout rain fell but heavy rain caused by the big whole city fire did not. As seen in Fig. 5 exposure from fallout estimated from epilation incidence rates in the 2 to 4 km region are 1.4 Gy to 0.85 Gy which are 40 to 230 times the physically obtained values. This large discrepancy suggests that the physically measured values are only measurements of a part of fallout and that large effects of internal exposure should be taken into account which can be deduced only by biological methods. It is noteworthy that the values obtained here are average exposures in the same distant regions from the hypocenter irrespective of direction. This result supports the understanding that fallout particles were distributed in the air very widely under the mushroom cloud.

There are many examinations of incidence of epilation, for example by the Joint Commission for the Investigation of the Atomic Bomb and Tokyo Imperial University in 1945 and investigated by a medical doctor O-ho in 1957. These examinations give results that almost coincide with each other indicating the reliability of all these investigations. Then from analysis of incidence rates of epilation of these examinations almost the same results are obtained.

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Comparison of Fallout Exposure Estimated from Incidence Rates of Three Different Acute Diseases

The incidence rates of epilation, purpura and diarrhea among Hiroshima survivors who were exposed indoors and did not enter the central region examined by O-ho (G. O-ho; I-Ji Shinpo, No.1746,21-25(1957)) are shown in Fig. 6. As is seen in Fig. 6 incidence rates of purpura shown by closed circles are of similar behavior to those of epilation shown by squares. Then for the relationship between incidence rate of purpura and exposure dose the same normal distribution for epilation is used. Incidence rates of diarrhea shown by triangles are very large compared to epilation or purpura in the distant regions beyond 1.5 km where the fallout exposure produced significant effects. The incidence rates of diarrhea were rather small in the short distance regions where the initial radiation exposure dominated. Therefore in the case of diarrhea, a larger expectation value for the normal distribution than those of epilation and purpura is required for external exposure from the initial nuclear radiation, and a smaller expectation value is required for the fallout exposure. The adapted normal distributions for the relationship between incidence of diarrhea and exposed dose have an expectation value of 3.026 Gy and standard deviation 0.873 Gy for the initial radiation and an expectation value of 1.981

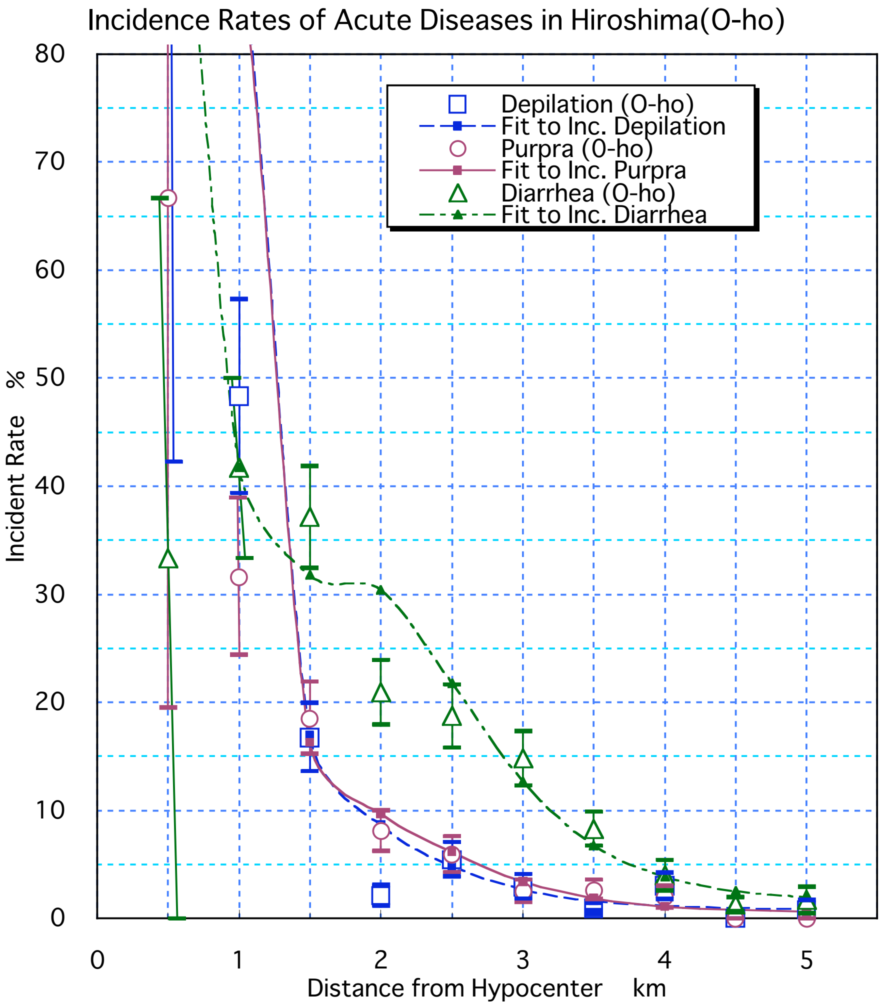

Figure 6 Incidence Rates of Acute Diseases examined by O-ho among Hiroshima

Gy and standard deviation 0.572 Gy for the fallout radiation, respectively. By use of these normal distributions the incidence rates of epilation, purpura and diarrhea in Fig. 6 are fitted and the resulting incidence rates are displayed by thin dashed, solid and chain curves for epilation, purpura and diarrhea as shown in Fig. 6.

The results of exposure doses obtained in order to reproduce these three different acute diseases are shown in Fig. 7 by bold broken lines, thin broken lines and bold full lines for total, initial and fallout radiations, respectively given the same marks as in Fig. 6. As seen in Fig. 7 incidence rates of three entirely different acute diseases are reproduced with high accuracy by almost the same exposure doses. This fact tells us that epilation and diarrhea as well as purpura occurred in the regions where the initial radiation could scarcely reach, and were caused by fallout radiation not by mental shock nor by poor sanitary conditions.

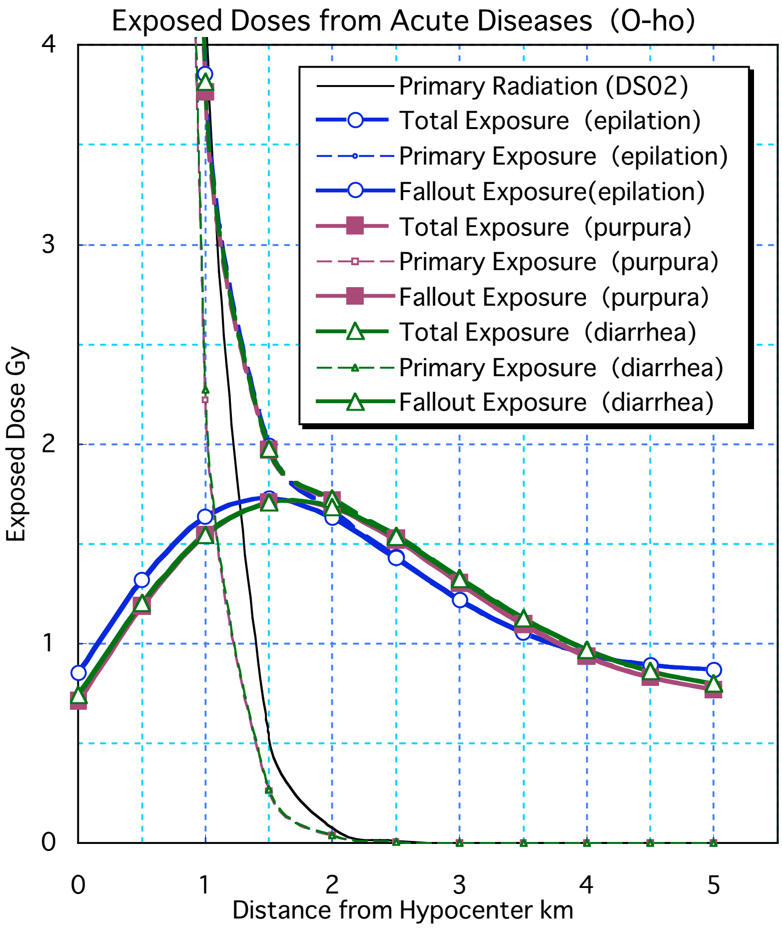

Figure 7 Exposed Doses of Hiroshima Atomic Bomb from Three Different Acute Diseases

The fact that the expectation value of the normal distribution of diarrhea incidence is small for fallout exposure while large for the initial nuclear exposure can be explained by means of the difference between external and internal exposures as follows. In the case of fallout exposure radioactive fine particles and radio-nuclides with specific affinity for biological materials and tissues among fallout were taken into the body, reached the intestinal wall and were retained there for a period of time. Then the emitted radiation of weak penetration power produced dense ionizations and caused heavy damage to the thin membrane and diarrhea followed. The exposure was chronic as the particulate and chemical radio-isotopic material (e.g. Sr-90, Cs-137) was retained for some time. On the other hand in the instantaneous acute initial nuclear radiation exposure case only strong penetrative radiation such as gamma rays could reach from outside the body to the intestinal wall but passed through the thin membrane leaving scarcely any damage. The present result of fallout effects shows that fallout came down over very wide regions under the atomic cloud as illustrated in Fig. 8.

The RERF epidemiological study selected as the control cohort (non exposure group) for practical purposes those among the survivor group who were exposed to a radiation dose estimated as less than 0.005 Sv on the basis of the DS86 or DS02 systems.

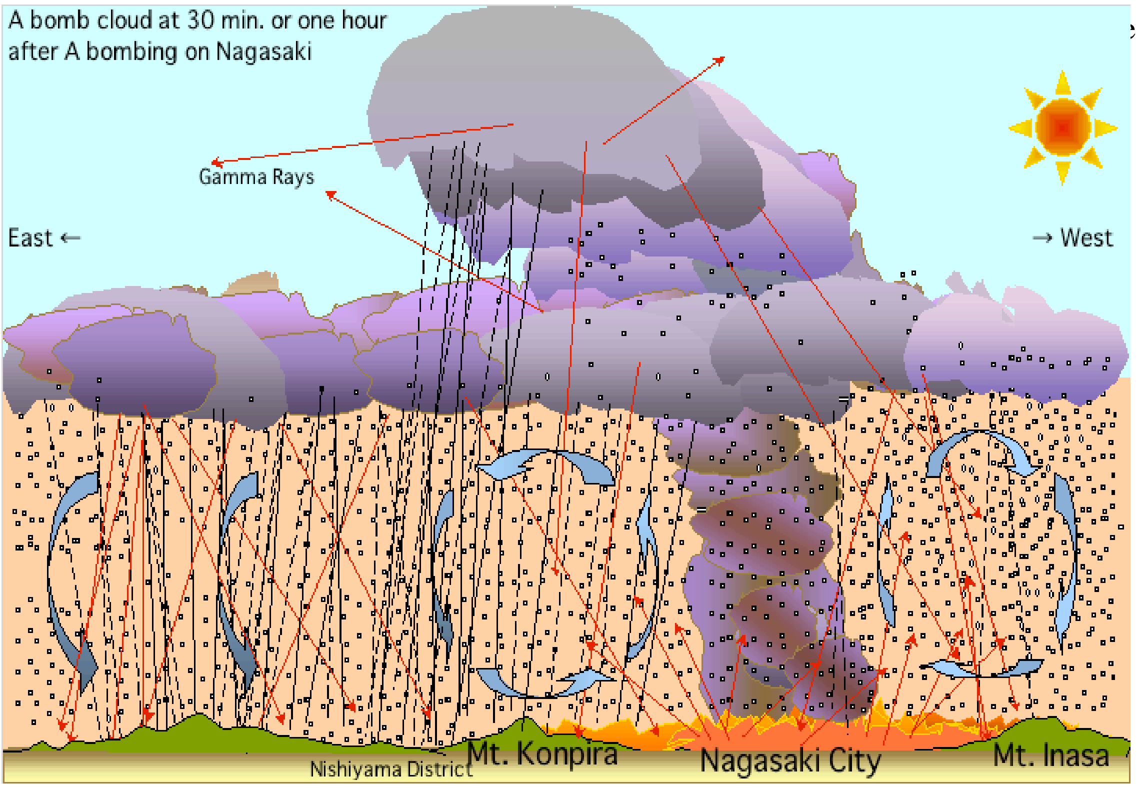

Figure 8 Fallout Rain Fell in the Special Regions under Central Part of the Cloud and Atmosphere under Cloud were Filled with Radioactive Fine Particles.

According to the estimation of DS86, survivors included in the control cohort were bombed in the region more than 2.7 km from the hypocenter, and these survivors received effects by fallout radiation equivalent to external acute exposure to gamma rays of about 1.5 Gy on average as shown in Figs. 5 and 7. These effects are 300 times the initial radiation estimated by the DS86 system. This will explain why the government criteria for atomic bomb diseases differs so much from actual states of survivors who have suffered after effects of atomic radiation for 64 years.

Radiation Effects for Entrants after the Bombing

The incidence rates of acute radiation disease were examined by G. O-ho (ibid) among the people who entered from the day after the bomb exploded to after 34 days in the region within 1km from the hypocenter of Hiroshima. From analysis of the incident rates exposure effects for entrant people are estimated. For the entrant on the day of the explosion (6 August) the accumulated exposed effective dose for onset of acute radiation disease is equivalent to external acute exposure to gamma rays of 1.05 ± 0.53 Gy. The accumulated exposed effective dose exponentially decreases to almost half for those who entered the central region 9 to 10 days after the day of the bombing. Accumulated exposure dose received from external radiation induced by neutrons can be calculated for staying at the hypocenter, and at 0.5 km and 1 km from the hypocenter. Even at the hypocenter the accumulated exposed dose from external radiation is 0.8 Gy, those at 0.5 km is 0.09 Gy and 0.0017 Gy at 1 km. The large discrepancies between exposure effects estimated from acute radiation disease among the entrants after bombing and measured external accumulated dose suggest that effects of residual radiation from chronic internal exposure due to inhalation of radioactive matter were very large compared to those of external exposure.

As is shown by analysis of the incident rate of the acute radiation diseases, however, for the survivors bombed in the region beyond 1.5 km the effects of internal exposure of radioactive fallout are more severe than the effects of external exposure by the initial radiation. Therefore application of DS86 or DS02 for the estimation of exposure of distant survivors and the entrant survivors is a complete mistake.

Estimation of Residual Radiation from Chromosomal Aberrations

When one is irradiated, abnormalities appear among chromosomes in the irradiated nuclei of a cell. Since this frequency of chromosomal aberration is closely related to the exposed dose, the frequency of chromosomal aberration in circulating lymphocytes provides an estimation of averaged absorbed dose in survivors. M. Sasaki and H. Miyata (Nature **220**,1189-93,(1968)) investigated the frequency of chromosomal aberration in circulating lymphocytes of survivors of the Hiroshima atomic bomb and eleven non-irradiated healthy people as a control who were visiting the Japan Red Cross Central Hospital in Tokyo between April 1967 and March 1968 and found that the aberrations occurred even when the initial radiation was scarcely reached.

Fig. 9 shows internal dose estimated from chromosomal aberration among survivors by Sasaki and Miyata. The obtained dose beyond 2.5 km from the hypocenter of Hiroshima cannot be explained by the initial radiation. In Fig. 9, the open markers correspond to the dose obtained from frequency of stable chromosomal aberrations and the closed ones to those obtained from unstable aberrations. The broken curves are

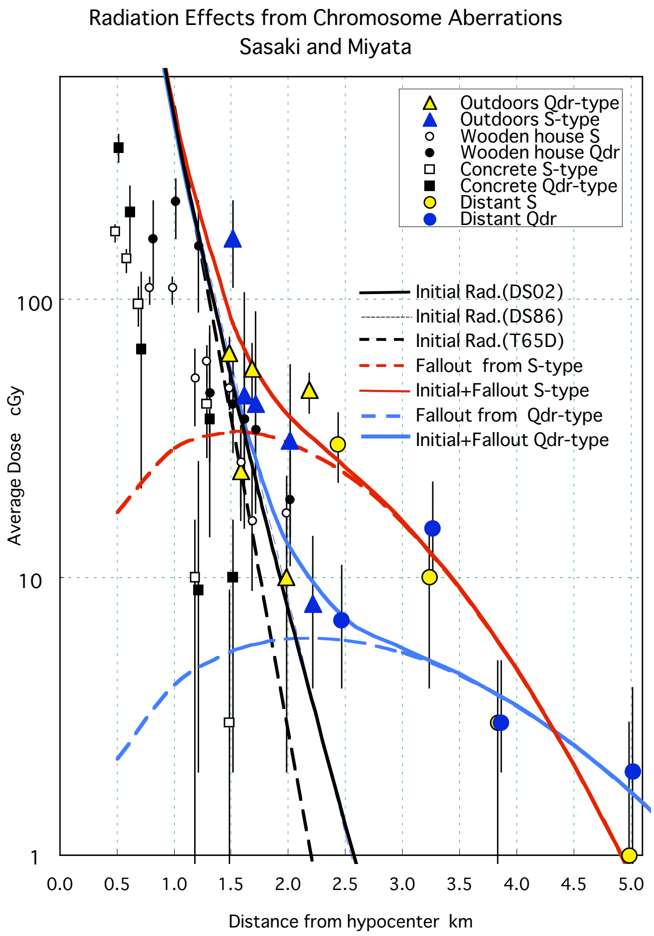

Figure 9 Radiation Effects from Chromosome Aberrations by Sasaki and Miyata

obtained by chi-square fitting to the estimated exposed dose of survivors who had been exposed outdoors at distances of less than 2.2 km from the hypocenter (denoted by triangles) and at 2.4 km or more away (denoted by circles). The initial radiation dose given by the T65D and DS86 are denoted by almost straight lines, dashed and solid ones, respectively. The broken curves are obtained by subtraction of the contribution of the initial radiation given by DS86 from the solid curves and can be attributed to the effects of fallout contribution. The peak values 0.06 Gy and 0.3 Gy obtained from unstable and stable chromosomal aberrations exceed the initial radiation dose at 2.0 km and 1.6 km, respectively from the hypocenter. In the regions beyond these distances the effects of exposure by fallout exceed those from the initial radiation. It should be noted that the estimated dose based on the frequency of chromosomal aberration in circulating lymphocytes represents the effects averaged over the whole body and do not include local effects from the insoluble radioactive fine particles which are considered in the case of the analysis of the incidence rates of acute diseases.

The chromosomal aberration of a larger sample of survivors had also been investigated by the RERF study group 23 years after the bombing and the RERF have denied the existence of chromosomal aberration in the distant region. In the RERF investigation, however, the distant survivors with dose estimation <0.01 Gy and the entrant survivors who were not in the city at the explosion time (NIC) were used as the control group. The frequency of chromosomal aberration of this control group is more than four times the control figure used world-wide and about ten times that used by Sasaki and Miyata.

Problems in RERF Epidemiological Studies

There are serious problems in the epidemiological studies of the RERF when the results of the studies are applied to survivors. One is neglect of the contribution from the residual radiation for the estimation of exposed dose of survivors. This originated in the initial investigation of survivors done by the ABCC. The other serious problem is selection of a non-irradiated control group. The epidemiological studies by the ABCC-RERF have been adopted by survivors themselves as the non-exposed control cohort for the studies. In the recent RERF investigations the survivors who had been exposed to less than 0.005 Sv of the DS86, and the NIC group in which the early entered survivors are included, are used as the control group. As is shown in the preceding sections these distant and entrant survivors were affected by the residual radiations estimated at more than 0.5～1.5 Gy on average which is several hundred times 0.005 Sv. Then it is evident that the ABCC-RERF studies cannot be applied to the estimation of exposure for distant and entrant survivors.

The analysis of chronic diseases among the RERF control cohort by use of all Japanese as the control was made by Inge Schmitz-Feuerhake, a physics professor of Bremen University, Germany and deduced the effects of exposure from fallout and the induced radioactive matter. Her result of the analysis is given in Fig. 10 (Health Phys. 44,693-695 (1983)). The high relative risk of both mortality and incidence of leukemia, thyroid, female breast cancer and respiratory system cancers among the control cohorts

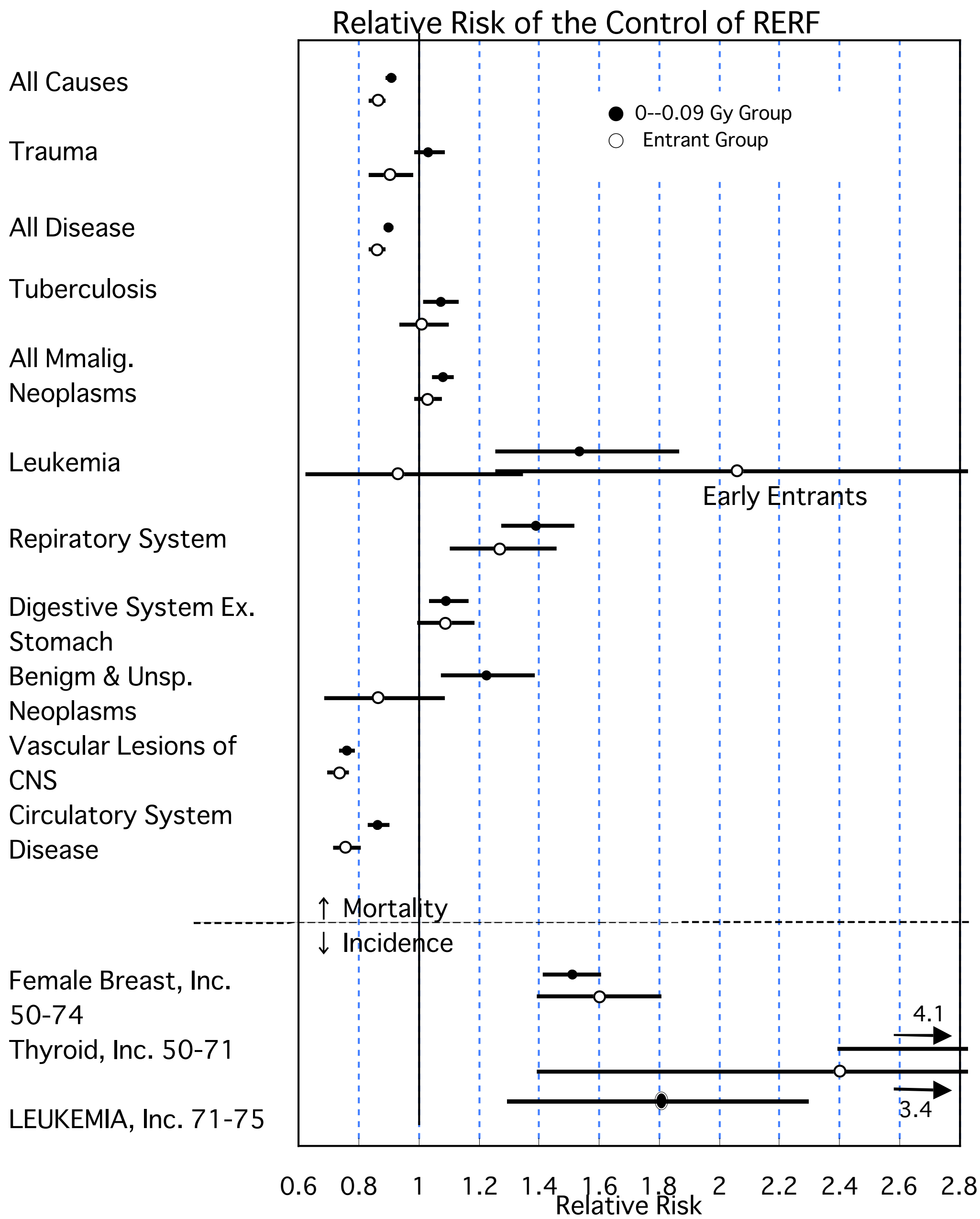

Figure 10 Relative Risk of Controls of RERF

of the RERF epidemiological study (both distant and after entrant survivor) had been affected by fallout and residual radiation. If the early entrants (4,500 of 26,500 people entered the cities within three days after the explosion) among the NIC group of the RERF investigation are extracted, then the relative risk of leukemia becomes about twice the normal rate as shown by point Early Entrants in Fig. 10. Hirose found 45 cases of leukemia among 25,798 early entrants of Hiroshima which corresponds to about 3.7 times the Japanese normal rate. These facts conclude that the RERF epidemiological studies have severe basic problems concerning the choice of the control cohorts.

Very recently T. Watanabe et al.(Environ Health Prev Med,13:264-270(2008)) compared the mortality rates of the LSS-Hiroshima group with those of the entire populations of Hiroshima Prefecture and neighbouring Okayama Prefecture. They divided the LSS group by colon absorbed dose into three categories: under 0.005 Sv (very low), more than 0.005 Sv and under 0.1 Sv (low), and more than 0.1 Sv (but less than 4.0 Sv) (high), respectively. They found that there are significantly increased risks of cancer among even survivors exposed to the very low dose level. One of their results of relative mortality rates from various cancers among the male group of LSS-

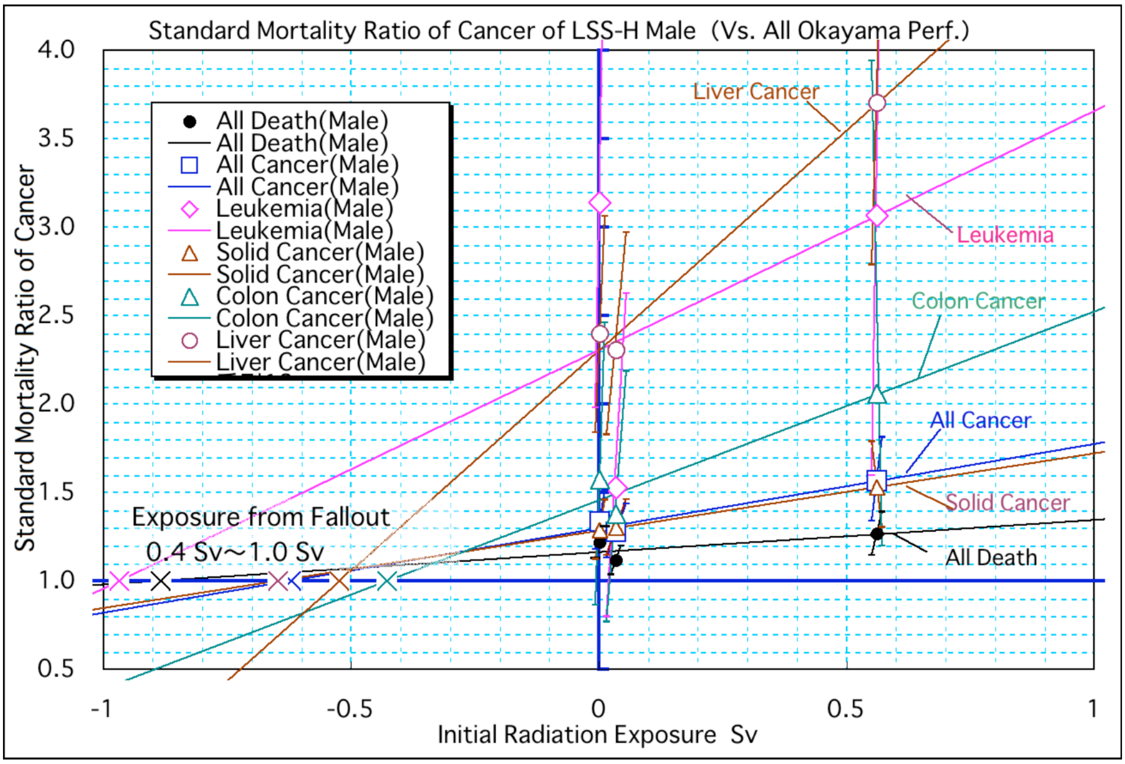

Figure 11 Relative Mortality of Cancer of LSS-Hiroshima Group vs Entire Population of Okayama Prefecture

Hiroshima Male Group vs Okayama Prefectures are shown in Fig. 11 against exposure to initial radiation. Assuming the relative mortality rates increase linearly, regression lines are drawn for each cancer. If there is no excess of relative mortality rates the regression curves will cross the line with relative mortality 1.0 at zero exposure point of the initial radiation. However, the regression lines cross at negative exposure points denoted × marks in Fig. 11. This fact means even the survivors in the very low dose initial radiation group were exposed to fallout radiation of 0.4 to 1.0 Sv.

Therefore the results of the ABCC-RERF studies should not be applied to the criteria of atomic diseases at the very least for distant and entrant survivors even though they may be used to estimate external irradiation effects of the strong initial radiation.

Danger of Usable Nuclear Weapon and Earth-Penetrating Nuclear Weapon

The Bush Administration of US had decided to research and develop earth penetrating nuclear weapons as usable. This pro-nuclear weapon policy would be largely based on ignorance of, and little concern for, the damage from atomic bombing, especially ignoring the effects of residual radiation and severe effects of internal exposure. If an earth-penetrating nuclear weapon were used, a much greater disaster from residual radiation would result than that experienced in the bombing of Hiroshima and Nagasaki, where the bombs were exploded at heights of 600 and 500 meters respectively, resulting in the radioactive fallout being somewhat weakened and the neutron beam largely decreased before reaching the ground and inducing residual radiation.

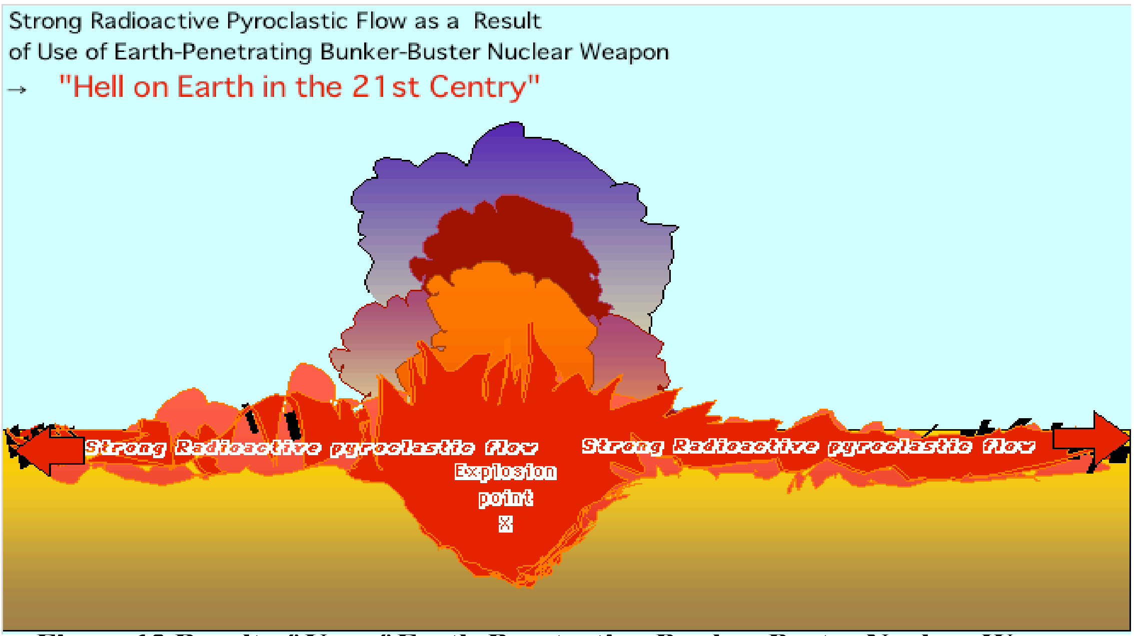

Figure 12 Result of Use of Earth-Penetrating Bunker-Buster Nuclear Weapon

On the other hand, an earth-penetrating nuclear weapon can penetrate only an earth-penetrating nuclear weapon can penetrate only at most 20 meters underground and the fireball produced by nuclear explosion will cause a pyroclastic flow, a stream of heated rocks and ash, which contains various radioactive fission products and strong radioactive matter induced by neutrons as illustrated in Fig. 12. This may cause another the '21st century hell on Earth' instead of the 20th century hell on Earth, Hiroshima and Nagasaki.

The 1993 UNSCEAR report estimated total deaths from cancer caused by fallout or downwind of nuclear tests and accidents in power stations and nuclear factories between 1945 and 1989 as 1,116,000 on the basis of the ICRP model, which had been constructed mainly by use of the results of the RERF studies and where the effects of internal exposure are paid little attention. If the effects from internal exposure to residual radiation causing cancer death are more than fifty times as severe as those in the ICRP model, then total cancer deaths caused by fallout become more than 60 million, which is about 1% of the total world population.

Thinking of my responsibility as a scientist and survivor of the Hiroshima atomic bombing, if the US cover-up policy had not been enforced and scientists had clarified the severe effects of internal exposure to the residual radiation of the atomic bombings before frequent large scale nuclear tests, then the nuclear weapon tests would have been forbidden avoiding great loss of human life comparable or more to that in wars.

Success for the collective lawsuit of survivors, who are dying, would contribute to promotion of the movement towards a nuclear weapon-free world by pointing out that nuclear weapons should never be used by demonstrating the severe and inhuman nature of internal exposure as well as extraordinary acute injuries and mass murder by the heat rays, shock waves, blast and initial radiation. Especially now it is very important to publicize inhuman character of the nuclear deterrence policies which assume ultimate use of nuclear weapon and are largest obstacles to begin the negotiation of nuclear weapon prohibition treaty.