**IONISING RADIATION AND THE ATOMIC BOMB.**

**By**
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I was looking through a popular junior science primer recently. It is generally a clearly written exposition of basic principles of physics, chemistry and biology. Various general remarks are made in the introductory chapter, e.g. on the sources of energy used by society. In the few paragraphs devoted to nuclear energy, my eye was caught by a description of the health effects of the ionising radiation released when the atomic bomb (A-bomb) was exploded over Nagasaki in 1945. The description echoes a widely-held exaggerated view of the effects of the radiation released in the explosion.

Specifically, the authors state that the radiation released in the bombing killed 25,000 people, and, subsequently, numerous genetic defects were noted resulting from exposure to the radiation. The truth of the matter is that the effects of the radiation alone were not as severe as this, and, so far, the Japanese A-bomb data provides no evidence of genetic damage.

Let me say right away that I have no intention of trying to minimise the consequences of the use of the first atomic weapons on Japan. I believe that science betrayed itself in developing the atomic bomb and that the first use of the bombs was a turning point, not only in warfare, but in human history. I also accept that in both cases, i.e. the development of the bomb and first use of the weapon, powerful mitigating circumstances and arguments applied. But that is a story for another day.

The medical data on the survivors of the atomic explosions in Japan is the single most important study on which estimates of the health effects of human exposure to ionising radiation are based. Scientifically, the data is very good, and results based on its analysis are used in setting standards to ensure protection of workers and the general public from ill-health effects arising from useful applications of ionising radiation, e.g. in medicine.

Two A-bombs were exploded in Japan at the end of the Second World War. The first was exploded over the city of Hiroshima on August 6 1945, and the second over the city of Nagasaki 3 days later. Although small in comparison to the nuclear weapons now available, the explosive power of the first A-bombs was immensely greater than conventional bombs. The explosive power of the Hiroshima bomb was equivalent to about 15 thousand tons of TNT, and that of the Nagasaki bomb to about 25 thousand tons of TNT.

Atomic bombs differ from conventional weapons in that their explosion releases large amounts of radioactive elements and ionising radiation in addition to the tremendous heat and blast energies.

Hiroshima had a civilian population of 250,000. 45,000 people died on the day of the explosion, and a further 19,000 died within the next 4 months. Nagasaki had a population of 174,000. 22,000 people died on the first day, and 17,000 more during the next 4 months. These are recorded civilian deaths. Unrecorded deaths of military personnel and foreign workers may have added significantly to these figures.

It is impossible to estimate the proportion of these 103,000 deaths that were caused by radiation alone, rather than by the extremely high temperatures and blast pressure caused by the

explosions. It is known that the radiation effects alone would have been sufficient to kill a majority of those exposed within a kilometre of ground zero (i.e. the point below which the bombs exploded), within days or weeks. However, most of those who died in this area would have been killed more or less instantly from the effects of blast, fire and falling buildings. In other words, they died in ways indistinguishable from the countless people who died in conventional bombing attacks on Cologne, Essen or London. Actually, the loss of life in the A-bomb explosions was considerably less than from the fire-raids on Tokyo a few months before, or on Dresden the previous year, when 130,000 people died in the fire-bombing.

A commission was established immediately after the end of the war in order to study the long-term effects of exposure to the atomic radiation on the health of the survivors. This work continues to this day and is called the Life Span Study (LSS). The two major long-term ill-health effects that may result from exposure to ionising radiation are (a) cancer, and (b) transmission of a hereditary defect to the next, and/or later generations. Excess cancers have been noted amongst the survivors of the A-bomb explosions. However, it is too early yet to get significant results on genetic effects (if there are any).

A total of 86,572 people who survived the atomic explosions have been followed up in the LSS study. 52,200 of these received significant doses of radiation - average dose 260 mSv (we each receive an annual dose of about 3 mSv in Ireland, mostly from natural radiation). The first type of cancer to emerge after exposure to radiation is cancer of the blood - leukaemia. Amongst the 52,200 significantly exposed survivors, 176 died from leukaemia between 1950 and 1990, and 86 (49%) of these are attributable to radiation exposure. Solid cancers show up after the leukaemias. In the significantly exposed group, there were 4,687 deaths from solid cancers between 1950 and 1990. Of these, 341 are attributable to radiation, i.e. 7%. Of the 4,863 total cancer deaths in this significantly exposed group, 427 (9%) are attributable to radiation exposure. In other words, the other 91% of cancer deaths would have occurred anyway, if no atomic bomb explosions had occurred.

Essentially everything we know about radiation induced hereditary defects comes from laboratory experiments with animals. The largest group of humans available for such a study are the Japanese survivors of the A-bomb explosions. However, in order to get statistically meaningful data in the study of transmission of hereditary defects, very large numbers of subjects are necessary, and the Japanese cohort is rather small by these standards. Also, insufficient time has passed since exposure to the radiation. Several generations must elapse before the full extent of any effects would be expected to show up. At the present time there is no evidence of any genetic changes in the children born to the Japanese survivors.

The twentieth century has produced many powerful symbols by which it will be remembered. An example of a good symbol is the image of Neil Armstrong standing on the moon. Two examples of bad symbols are the swastika and the huge mushroom cloud rising into the sky. I believe the latter is the worst of all.

The mushroom symbol has deeply scarred the human psyche for over 50 years. It signifies our monstrous creation - the ability to destroy civilisation. Throughout the long Cold War, we all suffered in blank despair under this horrible spectre. And then, suddenly, it faded to a pale shadow of its former horror, with the collapse of the Soviet empire. What I can't understand now is why the West is apparently content to sit back and watch Russia wallow in economic chaos. Why are we not pumping in massive assistance in order to help them to achieve stable

political conditions and an efficient free-market economy? The last thing we want to risk is for history to repeat itself and for another mushroom cloud to rear up its horrible head again.

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