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Workshop on the Genetic Effects of Ionizing Radiation
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Presented by

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Since the discovery of X-rays and radioactivity, considerable effort has been expended to attempt to identify and quantify various health effects of ionizing radiation in exposed populations. Initially, this effort was largely directed towards the prevention of deterministic effects of ionizing radiation, such as burns and lesions, because these were the ones that were first observed in humans (among radiologists who worked with X-rays). It was only later that stochastic effects of radiation, such as cancer, were observed in humans and much effort has since been devoted to the quantification of these stochastic risks. However, unlike cancer and deterministic effects, statistically significant genetic effects of ionizing radiation have not been observed in human populations, including the bomb survivors of Hiroshima and Nagasaki.

It is generally not possible to obtain radiobiological information from human subjects under laboratory conditions. Therefore, in the absence of human data, it is necessary to conduct animal studies, in the laboratory, to obtain pertinent information regarding the genetic effects of ionizing radiation, and then to extrapolate these findings to human populations. One should recognize that there is always a problem in extrapolating the results of animal studies to human populations. Of course, when opportunities exist, we should invest in studies of the genetic effects in human populations.

Although a recent study carried out by Gardner et al. of children near the Sellafield nuclear fuel reprocessing facility has suggested a possible association between paternal exposure to low doses of gamma radiation and a high incidence of leukemia in children, more work is needed to identify the cause of the observed excess of leukemia among the children in the Sellafield area.

With regard to the AECB study of childhood leukemia around five Canadian nuclear facilities, the results of Phase I indicate that there is no statistically significant excess of leukemia around these facilities. Of particular interest is the apparent "excess" in the ratio of observed-to-expected cases of childhood leukemia around the Bruce Nuclear Power Development; in contrast to this is the apparent "deficit" in the ratio, around the Chalk River Nuclear Facility. In both cases, the "excess" and the "deficit" are not statistically different from unity. We anticipate that the results from Phase II of this study will confirm the Phase I results with improved accuracy. Despite these findings, but in the light of the study of Gardner et al., the AECB is likely to proceed with an investigation of the relation between paternal exposure to ionizing radiation (both internal and external) and the incidence of childhood leukemia among the offspring of these fathers, who were employed at the nuclear facilities.

It is important to recognize that excess childhood leukemia has also been observed in places far removed from nuclear facilities, which points to the fact that other, possibly non-radiogenic, causes of childhood leukemia may exist. These causes have not been fully investigated. In the same way, observations of birth defects and non-leukemia cancers in children have been made and attributed, solely and without scientific justification, to ionizing radiation.

Canada has been a leading member of the international scientific community in supporting research in the area of genetic effects of ionizing radiation. For example, the baseline study of genetic disorders in the British Columbia population (both adults and children), undertaken by Canadian scientists Dr. B.K. Trimble and Mr. J.H. Doughty, has been used by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and by other scientific committees to derive risk estimates for radiation-induced genetic disorders. I am proud to note that the work of Dr. Trimble and Mr. Doughty, at the instigation of Dr. H.B. Newcombe, was further updated by Drs. T.W. Anderson and P. Baird of the University of British Columbia (assisted by Drs. R.B. Lowry and H.B. Newcombe and the B.C. Ministry of Health) as an AECB-funded project. The AECB is planning to continue the support of further genetic studies in the coming years, since it is very important for us, as a regulator, to understand better these phenomena.

Conducting research alone is not adequate to enhance our knowledge of the genetic effects of ionizing radiation. It is important to convene meetings of scientists, who are active in the field, to share their experiences and knowledge. Such meetings or workshops might also provide ideas and suggestions for conducting new research and for improving the design of on-going studies. It is hoped that today's Workshop will fulfill some of these objectives.

The idea for hosting this Workshop was originally suggested by our Advisory Committee on Radiological Protection, which is one of the two scientific committees which provide independent advice to me as President of the AECB. This idea was further developed by Dr. D.K. Myers of AECL's Chalk River Nuclear Laboratories and by the AECB's Directorate of Research and Safeguards, where it was transformed into reality. The involvement of these three groups in co-sponsoring this Workshop is not surprising, since these groups and others, such as the AECB's Radiation Protection Division, have expended considerable effort in the past in various projects associated with the assessment of the risks and effects of ionizing radiation.

Two leading scientific committees dealing with the genetic effects of ionizing radiation are the BEIR Committee of the U.S. National Academy of Sciences and UNSCEAR. As you are aware, these two committees periodically review the progress made in the field and produce reports containing their recommendations. These reports are subsequently used by the International Commission on Radiological Protection and by other international organizations as the base for recommending occupational and public dose limits. It is gratifying to note that two of the invited speakers at this Workshop are geneticists from the UNSCEAR and BEIR committees (Dr. Sankaranarayanan and Dr. Grahn, respectively).

As an aside, I take this opportunity to pay tribute to Dr. David Myers on his forthcoming retirement from active service with AECL. Dr. Myers has been helpful to the AECB, and to its staff, in a number of ways: as a member of ACRP sub-committees; as a review panelist for a number of research projects; and, more recently as a member of the ACRP. Besides these activities, he has been a "national" resource for AECB staff, who freely consult him on matters of scientific and regulatory importance.

In conclusion, I hope that this Workshop, which has brought together representatives from the UNSCEAR and BEIR committees, along with U.S. and Canadian scientists, will help identify the current problems associated with the assessment of genetic effects and suggest possible areas of research which can be undertaken in the future to contribute to a better understanding of the genetic effects of ionizing radiation.