

# RESEARCH IN RADIOBIOLOGY

Safety in the production and use of radioactive substances and protection against ionizing radiation are matters of direct concern to the International Atomic Energy Agency. On the one hand, the Agency has been trying to establish standards of safe practice, and on the other, it has been trying to promote research on the biological effects of radiation. Radiobiological research is of basic importance in the context of the growing use of radiation sources all over the world, because measures of radiation protection or the treatment of radiation sickness can be adequate and effective only when there is a clear and thorough understanding of the effects of ionizing radiation on living organisms.

A considerable volume of work has already been done in this field. That ionizing radiation causes damage to organic life is now generally known; indeed, the biologically harmful effects of radiation have been observed since the early days of radiology. The awareness of potential hazards has spread in recent years, and attempts are being made to devise methods of protection and treatment.

While a great deal is now known about the symptoms of the injury caused by radiation, the nature and mechanism of damage are not yet fully understood. It is not surprising that an extremely high dose of radiation should instantly kill the cells exposed; what is surprising is that death of cells should occur even from doses involving very minute amounts of energy. Not much is known about the subtle process by which intricate changes are initiated in the cells by even small doses of radiation. The main task is to discover the process by which radiation initiates these changes and to examine the nature of the changes. In other words, the question is why and how radiation produces the effects that it does. Effective measures of protection and treatment can be based only on a correct answer to this question.

## Research Contracts

IAEA has placed several contracts with scientific institutions in different countries for research on problems that may throw some light on various aspects of this problem. One line of research is to study the effects of small doses of radiation, a study that is essential in establishing the maximum permissible doses for radiation workers and others. A contract has been given to the Pharmacological Institute of Vienna University for the investigation of the response of cells, particularly of the nervous system, to low-level exposures. It has been observed that even doses which are small enough not to produce symptoms of radiation sickness may cause

certain instantaneous reactions which should not be neglected, and it is believed that the nervous system plays an important role in such reactions. It is, however, not clear how these reactions are produced and whether they can be diminished or suppressed by certain protective substances. The research being carried out at the Vienna Pharmacological Institute may provide an answer to some of these and other allied questions.

The immediate and low-level effects of ionizing radiation were recently discussed at an international symposium organized by the Italian National Committee for Nuclear Research, with the help of IAEA and UNESCO. Experts on radiobiology from 15 countries took part in the symposium, which met in Venice for five days, 22 - 26 June 1959.

Another important field of research is the protective action of certain substances against the effects of radiation. Certain chemicals, if present in a biological system during irradiation, increase the resistance of the system to radiation, and investigations in this field are not only of great practical value but would also contribute to a better understanding of cell behaviour. Under a research contract given by IAEA, the mode of protective action of certain chemical compounds is being studied at the Physiological Institute of Vienna University.

Of the possible effects of radiation, those of a genetic nature have caused widespread concern. It is now widely known that ionizing radiation can cause genetic mutations and that in complex organisms like humans these mutations are almost always harmful. The problem is to examine how the genes mutate as a result of irradiation and to determine the relationship between different types and doses of radiation and the rate of mutations. Such investigations have necessarily to be carried out by indirect methods; direct experiments on living human beings are obviously too hazardous to undertake. Under an IAEA contract, cytogenetical investigations are being carried out at the Institute of Medical Genetics of Uppsala University on the effects of radiation on human cells grown in vitro.

## Effects on Micro-organisms

While certain conclusions about the effects of radiation on human cells can be deduced from test tube experiments, some valuable inferences can also be drawn from studies of the radiation response of simpler organisms. In fact, such studies may help in unravelling one of the most complex problems of radiobiology. It has been observed that there are tremendous variations in the radiosensitivity of different organisms; the doses that are expected to be

lethal vary from about 200 roentgen units for mammals to 200 000 r or more for unicellular organisms. Variations in sensitivity have also been noticed between different micro-organisms as well as between different mammals. While these variations have been known for a long time, no convincing reason has yet been put forward to explain them. In fact, scientists have found it difficult to offer even a tentative explanation. The matter, however, is of basic importance, because an understanding of the reasons for these variations may provide a clue to some of the fundamental problems of radiobiology. Only when the reasons for the variations are clearly known will it be possible to base methods of radiation protection on a reliable foundation.

A contract has been placed with the Chester Beatty Research Institute in London for research on the reasons for the variations in the radiosensitivity

of different micro-organisms. Apart from its value in fundamental radiobiology and radiation protection, this research may also have a bearing on the possibility of preserving food and drugs by irradiation. One of the chief problems in the sterilization of food and drugs has been that many bacteria possess a high level of resistance to ionizing radiation. In some cases, the dosage required for their destruction may prove harmful for the food or drug itself. Experience so far has shown that sterilization may require between 200 000 r to 600 000 r. One possible solution, therefore, is to find a method of increasing the radiosensitivity of bacteria by some artificial means before they are subjected to radiation, so that a low and safe radiation dose may prove completely effective. One of the objects of the research being carried out at the Chester Beatty Institute is to examine how micro-organisms can be made more sensitive to radiation than they normally are.

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## EDUCATION FOR THE ATOMIC AGE

The rapid development of the peaceful uses of atomic energy has necessarily led to an increasing demand for manpower trained in the various branches of nuclear science and technology. The expansion of education and training in these fields has not always been able to keep pace with the steady rise in demand, and many countries have been faced with the problem of an acute shortage of trained personnel.

Even among those who receive a general scientific education or technical training, there are not many who can undertake the highly specialized work that has to be performed in the field of atomic energy. Again, atomic science and technology itself consists of a number of specialized disciplines. The greater the specialization, the more acute is the shortage of personnel with adequate knowledge and training.

Training in nuclear science and technology is one of the major problems that are being tackled by the International Atomic Energy Agency. But obviously a problem of this magnitude cannot be solved solely by the direct effort of international organizations; its solution would call for the concerted effort of every nation interested in the development of atomic energy. Besides, there must be a suitable educational base for the success of any kind of advanced training. In other words, general educational institutions will have to complete the groundwork that must precede any kind of specialization in nuclear science and technology.

The problem is thus enormously complex and ramifies into diverse aspects of educational policy. For example, it may have some bearing on the relative emphasis to be given on science in the early stages of general education. Further, it may necessitate

some re-orientation of the content and methods of traditional science education at various levels.

### Saclay Seminar

The need has long been felt for an exchange of expert views on the subject, for a detailed discussion of the problem as a whole. This was recently done at an international seminar organized jointly by IAEA and UNESCO, the two international bodies which have major responsibilities in this field. Distinguished scientists from 31 countries attended the seminar which was held at the French Nuclear Research Centre

A general view of the Nuclear Research Centre, Saclay  
France

