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SERIES: RESEARCH AND DEVELOPMENT

RADIATION PROTECTION RESEARCH IN THE EUROPEAN COMMUNITIES

Introduction

As early as 1957, when the European Atomic Energy Community was established the Member States unanimously agreed that, in view of the development of nuclear energy and peaceful applications of ionizing radiations, radiation protection was a problem that would have to be tackled jointly. Accordingly under the Euratom Treaty, and beside its regulatory function in the field of radiation protection, the Commission was charged with the implementation of a research programme on the biological effects of ionizing radiation.

The Euratom Treaty itself mentioned a sum of 3.1 million units of account (MUC) as allocated to this area of research for a period extending to December 31, 1962. The first "Radiation Protection" contract was in fact signed in 1959.

A second programme was adopted by the council for the period 1963-67, with a budget allocation of 17.5 MUC. For the 3 following years, only temporary arrangements were made, allowing "the extension of previous programmes". The system of multiannual programmes was resumed in 1971 with a 71-75 programme of 18,9 MUC, and the presently ongoing 1976-80 programme of 39 MUC.

Why radiation protection research ?

Historically radiation protection problems first drew the attention of a few experts when, three-quarters of a century ago, the pioneers in the field of radiation applications, medical doctors and scientists, were themselves submitted to radiation accidents and injuries because they simply had no sufficient knowledge of hazards involved in their work. Owing to a steady build-up of radiobiological research results, the first procedures for radiation protection could be adopted half a century ago, and those who benefited most, at that period, from the newly acquired knowledge were the patients who had to undergo medical radiation for diagnosis and treatment.

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During the last twenty-five years, practical radiation protection could be continuously adapted to new knowledges on the effects of ionizing radiation and radioisotopes. Protective measures and legislation have contributed to the high level of safety of nuclear industries observed up to now.

The successive Community programmes have contributed to the steady build-up of knowledge which is essential to dissipate uncertainties and to improve the very foundations of protective measures. These programmes have also resulted in an integrated scientific community which has genuinely worked on a cooperative basis.

Still today, protection against radiation is of immediate interest: throughout all our countries, it remains of importance to governments, parliaments, courts, responsible citizens, and the public at large. During the last years, one has witnessed an increase in emotional reaction against the use of nuclear energy, all too frequently based on a superficial knowledge of the real or potential hazards of ionizing radiations, and on uncertainty with regard to its consequences.

FOCAL POINTS IN THE COMMUNITIES' RESEARCH PROGRAMME, PROBLEMS AND RESULTS

The problems confronting the Commission in its research programme on Radiation Protection are an evident consequence of this situation. As in the past, the Commission has acted in accordance with the progress of knowledge and experience and with the current situation regarding radiation protection to adapt the research work to society's requirements while considering equally future aspects. The most recent instance of this was when the present 1976-1980 five-year programme, adopted by the Council on March 1976, was beeing drawn up, and during the last two years, when the research work based on the Councils decision, was put in action. Some focal points and achievements of this research with an evident practical importance are hereafter outlined as examples.

- Among the most pressing problems is certainly that of low radiation doses to major population groups and the resulting late somatic effects in the individual, such as cancer, and the genetic consequences for future generations. A particular problem is caused by the fact that experiments on humans are out of question and, in addition, the reliability of results regarding low doses depends solely on whether statistically relevant and reliable experiments can be successfully carried out. As only few direct human data are available, the Commission's programme is studying the risk of late effects of ionizing radiations on a wide variety of biological materials with new approaches and methods. The feasibility and reliabilty of extrapolation from high to low radiation doses and from cell cultures and experimental animals to man must be tested in this manner. The geneticist with results on chromosomal alterations and damage to DNA(*) after irradiation, the pathologist with studies on organ damage after incorporation of radionuclides and the epidemiologist with data on the frequency of radiation-induced cancers in irradiated population groups must contribute to this research, as must the physicist with considerations on microdosimetry and on the radiation-effect models.

  (*) DNA: Deoxyribonucleic acid, the constituent molecule of heritable material.

Thus, a large part of the Commission's programme has been conducted on experimental species and on mammalian tissues and cell lines cultured in vitro. To give but one example of the achievements in this area, one must note the major contributions made to our understanding of the molecular basis of sensitivity and repair in lower forms of life and human cell lines. In microorganisms, and particularly bacteriophage, bacteria and yeast, the mass of different genes and enzymes which participate to the evolution of induced damages has been disentangled and the diversity of repair systems classified on the basis of their specificity, functions and requirements. Precisely the same approach is now being followed, through the isolation and characterization of several human cell mutants and through the enzymology of normal and irradiated tissues, for understanding the ways through which the human cell deals with radio-induced heritable damage. New types of repair systems operating in humans have been dicovered and techniques have been devised which allow the detection of the first human mutants sensitive to ionizing radiations. Such achievements do not only lead to the detailed knowledgs of repair and sensitivity in man, they also contribute to the determination of quantitative differences in radio-sensitivity between individuals, groups and populations. In the long run, they should enable us to predict and to avoid particularly hazardous combinations between radiations and certain chemicals; they will open the way to a rational approach to the therapy of radio-induced damages.

-Co-operative research in radiation protection depends largely on the success of standardization of experimental methods and materials. Therefore dosimetric intercomparisons have been carried out in various ways e.g. on personnel dosimeters as well on X-ray dosimeters and recently with neutrons. All of these inter-comparisons have revealed quite a number of imperfection in experimental arrangements and their execution has induced a considerable improvement in research procedures, and increased the relability of the measurements.

-A similar effort but adapted specially to late effects research has been promoted within EULEP (European Late Effects Projects Group) first for dosimetry, then for the handling of laboratory animals, and finally for the interpretation of pathological observations. For different observers, the microscopic examination of the same tissue may, in certain cases,yield different conclusions. However, when the question is raised to know, for example, if a given dose of radiation produces in animals a certain percentage of mammary tumours, it is essential that in Munich, in London, in Paris or in Brussels, one is dealing with the same dose of radiation, given to similar animals, treated in the same way and observed according to the same criteria.

-After total body irradiation at relatively high dose, due for instancce, to a serious accident, the stem cells of the hemapoïetic system are the first to show severe damage. These cells are the precursors of the red blood cells, the platelets and the white blood cells which are responsible respectively for the transport of oxygen, the coagulation of the blood and the defence against infection. In man, the stem cells

are present in the bone marrow. In principle, the transplantation of a certain amount of marrow from a healthy donor should cure the heavily irradiated individual. In practice however, this procedure presents many difficulties which are progressively being overcome by a continuous research effort. For example, the donor and the acceptor need to be genetically as close as possible; otherwise, the transplanted marrow reacts against the recipient and might even kill him. Noticeable progress has now been achieved in selecting the donor and the mitigating the "graft versus host" reaction.

-To counter the threat of environmental contamination, the pathways of individual radionuclides in the food chain are being followed. In this respect, the importance of plutonium behaviour and radiotoxicity is well known and has been given much attention. The "resuspension" and "inhalation" pathways still require further study. If released into the environment, plutonium does not seem to pass up easily through the various stages of food chains, and it is not readily taken up from them by humans. Americium, curium and other transuranic elements could well behave differently in this respect however and be important as far as ingestion is concerned.

RADIATION DOSES IN MEDECINE

So far, only one side of the research programme actually of predominent interest to the public has been mentioned, namely the one dealing with the consequences of the development of nuclear industries. But one should not forget that medical uses of ionizing radiations for diagnostics and therapy is presently on an average a much greater source of radiation doses to the individuals than nuclear industries. It can be observed nowadays- not without a certain amount of concern- that the public is also becoming increasingly occupied with this complex subject. Nevertheless, the authorities concerned agree that ionizing radiations in diagnostics and therapy are of greatest medical importance and value and that it would be an unexcusable error not to use them where they are needed. But this should not prevent research on how radiation dose in medecine can and must be reduced with the technical means at hand to as low a level as would be acceptable from a medical standpoint. The development of nuclear medical methods with a more favourable diagnostic efficiency/radiation dose ratio and the optimization of X-ray diagnostic techniques are in the foreground of the most obvious measures to achieve dose reduction. Moreover, the results of irradiation risk assessments in the field of nuclear energy are also applicable in diagnostics. They could help in determining the conditions under which a specific diagnostic procedure, e.g. in mass examinations, is justifiable.

In this important area, the Commission's research programme is now starting a cooperative effort to develop methods which will lead to a better control and a decrease of the risk involved in medical uses of radiation.

UTILISATION AND DISSEMINATION OF RESULTS

The scientific research results of the European Communities' Radiation Protection programme are available to all participants, member states and scientists. They are used by the Commission in establishing "basic safety standards for the health protection of the general public and workers against dangers of ionizing radiation" for the Community (*), on which are based the corresponding laws of the member states. On the international level, the play their role in the formulation of recommendations by ICRP (**), or they are used in the compilation and evaluation of the latest data, which provide a world-wide information basis for radiation protection UNSCEAR(***).

The results themselves are presented in articles published in scientific journals, in Euratom reports, in monographs issued by the Commission, and in the proceedings of symposia and seminars. More than 400 such publications have been produced in 1976. Such a high number of publications in itself stimulates a continuous coordinative effect.

Moreover, it should be pointed out that the Radiation Protection Research Programme also has an appreciable influence in other areas, so that a real "spin-off" can be said to exist. Methods and techniques developed for bone-marrow transplants after radiation accidents can thus also be applied in cases of lymphatic leukaemia. Radioimmunology, in particular, is making an important contribution towards solving the problems associated with organ transplants. Studies on late radiation effects yield valuable information on carcinogenesis, while, in genetics, the work on assessing relative radiation effects is closely linked with the more general work on repair mechanism and chromosomal alterations, to give but a few examples.

IMPLEMENTATION

The Council of Ministers allocated 39 million units of account to the Radiation Protection Programme for the 1976-80 period.
More than 500 scientists(****) are currently participating in the work on over 230 projects, achieving a coherent general account of problems in radiation protection. The appropriate means for the execution of the programme are the cost-shared contracts which the Commission has concluded with universities (55 contracts), national research institutions and radiobiological institutes of nuclear centres (57 contracts) and with other scientific organizations, including also group contracts with several institutes (16 contracts). Furthermore a Biology Group of the Commission, located at Ispra, is directly participating in the programme.

(*) O.J. no L 187, 12/7/1976, p. 1-44
(**) International Commission on Radiological Protection
(***) United Nations Scientific Committee on the Effects of Atomic Radiations
(****)500 full-time and part-time scientists, corresponding to 270 scientists/year

The overall cost of this work in 1977 was 16 million u.a. in which the Commission participated with a share of about 35%. When compared with the total expenditures of the Member States in radiation protection research estimated for 1977 at 60 to 70 million u.a., these 16 millions u.a. spent on research covered by the Commission's programme represent a significant and important part.

Coherence and coordination of research activities are pursued through several means : - the Advisory Committee on Programme Management "Radiation Protection " (ACPM),- regular meetings of study groups and experts on all major subjects, - the organization of seminars and the activity of the Commission's services. About 40 study groups, steering committees and other meetings, with more than 1000 participants, take place every year. As well on the research policy level as for actual research projects, the continuous exchange of ideas and progress reviewing carried out to such an extent undoubtedly take into account national and Commission's programmes altogether, and lead to their overall coordination.

RESEARCH AND COORDINATION IN RADIATION PROTECTION - A COMMUNITY RESPONSIBILITY

Apart from its already-mentioned assignment to promulgate basic safety standards and to implement a research programme on means of solving the associated problems, quite a series of other important conditions and typical criteria are fulfilled, which require this programme to be carried out on a Community level.

Radiation hazards do not stop at national boundaries and the problems to which they give rise are basically similar in every Member State. Limited scientific manpower and financial resources contrast harshly with the complexity and the extent of the problems to be solved in an objective and neutral way. Right from the start, the Commission accordingly made efforts to initiate cooperation with the appropriate national institutes on work concerning the focal points of the programme. The success of these efforts is evidenced today by the fact that about all the national institutions active in this field and many of the university institutes are to be found among the Commission's contract partners. Thus not only has cooperation and coordination been achieved in respect of topics under the programme itself but also, in conformity with the present views on what should be a true R and D policy of the Community, de facto coordination of research on radiation protection throughout the Community now exists. Duplication of work could be avoided and the best possible utilization of the available capacity is beeing achieved through dovetailing of the projects and joint planning arrangements. It is no exaggeration to say that the potential of all Member States in the field of radiation protection has thus been appreciably expanded.
