INTERNATIONAL CONFERENCE ON THE BIOLOGICAL EFFECTS OF IONISING RADIATION

HAMMERSMITH HOSPITAL
LONDON
NOVEMBER 24-25, 1986

ABSTRACTS

Sponsored by:- Friends of the Earth, U.K. Greenpeace International

Environmental Radioactivity

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Radionuclides are widespread in our environment. Most occur naturally and are either of primordial origin or are continually produced by natural processes. Radionuclides produced by anthropogenic sources make a small additional contribution to environmental levels but are subject to intensive monitoring programmes and, perhaps inevitably, attract a disproportionate share of public interest.

The aim of this paper is to discuss the sources of radioactivity in the environment and the routes by which the population is exposed. The scope of measurement programmes within the United Kingdom will be briefly described. Finally, doses from the various sources will be evaluated and compared.

"THE ROLE OF PREDICTIVE MODELLING: SOCIAL AND SCIENTIFIC PROBLEMS OF RADIATION RISK ASSESSMENT"

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This paper starts from the premise that predictive modelling of radiation hazards, as it is currently practised, fails to reflect accurately the problematic status of radiation toxicology [1]. In the first place, the paper surveys the scientific problems facing the construction of robust models, arguing that uncertainties are such as to confine "prediction" to order-of-magnitude analysis that can provide little more than a range of plausible risk estimates [2]. Secondly, it proceeds to examine the origins of controversy over these issues and attempts to analyse the former in terms of their cognitive, institutional, and political dimensions. These problems are discussed in relation to recent concern over the raised incidence of child cancer around the Sellafield nuclear fuel reprocessing plant in the north of England [3].

If predictive modelling is to play a constructive role in debates over nuclear technology, this paper argues that policy-makers and risk analysts should have - and must be seen to have - greater regard for the extent of social and scientific dissensus surrounding the issue of radiation hazards. It concludes that this might best be achieved within the context of a less technocratic approach to risk assessment, and the establishment of formal mechanisms for public and worker involvement in the regulation of nuclear power.

References

1. R.Johnston, The Characteristics of Risk Assessment Research, in J.Conrad (Ed.), Society, Technology and Risk Assessment, Academic Press, New York, 1980, p.105-122.
2. D.Crouch, Science and Trans-Science in Radiation Risk Assessment, Sci. Total Environ. 53/3, 1986, 201-216.
3. Investigation of the Possible Increased Incidence of Cancer in West Cumbria, Report of the Independent Advisory Group (Chairman: Sir Douglas Black), HMSO, London, 1984.

Assessing Risks of Childhood Leukaemia in Seascale

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In the village of Seascale (population ~3,000) which is situated about 3 km to the south of the Sellafield nuclear fuel reprocessing plant in west Cumbria 4 fatal leukaemias have been observed in children under 20 years of age between 1950 and 1980[1]. Based on UK statistics only 0.5 leukaemias would have been expected. Because of public concern that these leukaemias could have resulted from discharges of radioactive materials from the Sellafield site, radiation doses and risks of radiation-induced leukaemia have been calculated for children born and living in Seascale over the period of operation of the plant.

The study[2] has shown that for the Seascale study population of 1225 children and young persons, followed to age 20 years, or 1980 for those born after 1960, 0.016 radiation-induced leukaemias would be expected from the Sellafield discharges. For the 4 fatal leukaemias observed in the study population to be attributed to the operations at Sellafield, the average risk would have to be increased by a factor of about 250, to 1 in 300. Although there is some uncertainty about the releases from the plant and concentrations of radionuclides in foodstuffs in the Sellafield area for the early years of its operation, the possibility that the doses calculated and the risk coefficients used for radiation-induced leukaemia could be so substantially wrong is very unlikely.

The number of radiation-induced leukaemias in the study population, from all radiation sources, is calculated to be 0.1, which corresponds to a risk of about 1 in 12,250 for the average child. About two thirds of the risk is from natural background, 16% from the Sellafield discharges, and nuclear weapons fallout and medical exposure each contribute about 9%.

References

1) Black, D. Investigation of the possible increased incidence of cancer in west Cumbria, Report of the Independent Advisory Group. Chairman, Sir Douglas Black. London, HMSO (1984).

2) Stather, J.W., Dionian, J., Brown, J., Fell, T.P. and Muirhead, C.R. The risks of leukaemia and other cancers in Seascale from radiation exposure. Addendum to NRPB Report R171 (April 1986).

EPIDEMIOLOGICAL STUDIES OF WORKERS IN THE NUCLEAR INDUSTRY.

By

Valerie Beral.

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London School of Hygiene and Tropical Medicine.

The Findings from follow-up studies of workers chronically exposed to low doses of ionising radiation will be presented. Special emphasis will be given to those findings from two recent British studies- one describing the mortality of employees in the United Kingdom Atomic Energy Authority, and the other the mortality of employees of British Nuclear Fuels plc. The relationship between radiation exposure and cancer mortality in the populations will be discussed.

OCCUPATIONAL EXPOSURES.

A UNION VIEW OF DOSE LIMITS AND ACCEPTABLE RISK.

By

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There are about 350,000 workers in the U.K. exposed to radiation at work, but only about 135,000 are routinely monitored for exposure. Their average annual exposure is comparatively low, with those in the nuclear fuel cycle averaging 4 mSv (400 mrem), though significantly higher doses are experienced by some groups, particularly in reprocessing.

The GMB has developed an approach to all harmful agents in the workplace which gives the benefit of any scientific doubt about dose/effect to the worker, rather than to the harmful agent.

Since 1981, the GMB has considered that the ICRP dose limits for radiation workers are too high. Acceptable risk should be determined by those who face the risks, and should not be based on comparative risks in other industries.

Society should give speedy and just compensation to those workers who are exspected to pay the ultimate price for the benefits of radiation which society enjoys. The BNFL/Union scheme provides a unique model for compensating radiation induced cancers.

Abstract

Recent Evidence of Radiation-Induced Cancer in the Japanese Atomic-Bomb Survivors

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The prospective study of survivors of the atomic bombing of Hiroshima and Nagasaki utilizes as a control population those persons who were far enough from the detonation to receive no exposure, but who were in the cities at the time of the bombing (ATB). Radiation exposure data are still being revised; the new evaluation indicates that the results from the two cities can be combined, since fast neutron exposures were low and were similar in both cities. New tissue doses are about half those presented previously. Many confounding factors affecting cancer rates have also been evaluated, such as medical radiation, smoking, childbearing, diet and indoor radon. The most recent follow-up data support the following conclusions : a) the dose-response relationship is consistent with a straight line through the origin, including the lowest dose group ($\sim$3 rad); b) sensitivity to induction of cancer varies considerably by tissue irradiated; c) most cancers show a radiation effect still increasing 40 years after exposure; d) a small leukemia excess among those irradiated is still present in Hiroshima; e) the thyroid cancer excess is declining at this time; f) smoking adds to the effect of radiation on lung cancer incidence; g) certain benign tumors show a radiation-related effect; h) children under the age of 10 ATB are presently showing the highest relative risk for cancer compared to all other ages ATB at equal attained age. If this last effect continues to persist, then age-specific lifetime cancer risk coefficients will be necessary, and for those irradiated as young children may be quite high.

THE ICRP HISTORICAL PERSPECTIVE

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The International Commission on Radiological Protection (ICRP) was established in 1928, under the name of the "International X-Ray and Radium Protection Committee" by the Second International Congress of Radiology. It assumed its present name and organisational form in 1950 in order to cover more effectively the rapidly expanding field of radiation protection. As one of the Commissions established by the International Congress of Radiology, ICRP has maintained its close relationship with medical radiology and the medical profession generally, but it also recognises its responsibility to other professional groups and its obligations to provide guidance within the field of radiation protection as a whole. The policy adopted by the Commission in preparing its recommendations is to consider the fundamental principles and quantitative bases upon which appropriate radiation protection measures can be based, while leaving to the various national protection bodies the responsibility of formulating the specific advice, codes of practice, or regulations that are best suited to the needs of their individual countries.

In this presentation, the historical bases of evolution of the present ICRP system of dose limitation will be reviewed, and a cautious attempt made, by reviewing the current biological bases for dose limitation, to predict future policy trends.

Above all, it will be stressed that the ICRP is composed of independent members, chosen on the basis of their recognised activity in the field of medical radiology, radiation protection, physics, health physics, biology, genetics, biochemistry and biophysics, with regard to an appropriate balance of expertise rather than to nationality. The Commission and its Committees are fully independent of both national governments and the nuclear industry; their relationship with the parent body, the International Congress of Radiology, is that of the grown child who has left the family home and is pursuing his own fortune in the wider world.

ICRP Risk Estimates -- An Alternative View

by

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For almost 60 years ICRP has served as the international source of information on risks of exposure to ionizing radiation and has provided recommendations for radiation protection. In general its publications have served a very useful purpose of reducing unnecessary radiation exposure but in some respects ICRP has delayed action to reduce excessive exposure, has underestimated radiation risks and has recommended radiation exposure levels that are much too high. For decades it showed concern to reduce exposure of doctors and nurses but ignored the principal source of population exposure, namely, patient exposure. Beginning in 1960 we became aware of two serious radiation exposure problems (occupational exposure in uranium mines and population exposure from testing of nuclear weapons). One might have expected ICRP to be the first to try to reduce these exposures but it was conspicuous for its silence. In 1958 ICRP set limits of exposure for radiation workers and members of the public. Nineteen years later (1977) when it was realized that the risk of radiation induced cancer was 10 to 30 times what it was perceived to be in 1958, ICRP might have been expected to recommend a major reduction in permissible exposure levels but to the dismay of some of us, it increased them. It was a great disappointment to some of us in 1977 when levels of MPC of radionuclides in air, water and food were increased for a large fraction of the more dangerous radionuclides. The reactor accident at Chernobyl calls for a number of new ICRP recommendations. When can we expect them?

VARIATION IN INDIVIDUAL SENSITIVITY TO IONISING RADIATION

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In the general population marked differences in sensitivity to radiation have been shown to exist. Laboratory studies on fibroblasts from disease-free individuals show significant and nearly two-fold differences in D_0 value (or X-ray dose which reduces cell number to about 37%) between the least and the most sensitive, implying a tenfold or greater difference in cell survival at lethal levels of radiation. Some members of the general population without specific disease, are more sensitive than the most sensitive shown in these studies. Radiotherapists recognise that cancer patients vary considerably in their susceptability to skin damage in the course of radiation treatment, a minority suffering severe damage to normal tissues as a result of routine therapy. Occasionally such hypersensitivity is so marked as to interfere with a planned programme of treatment, and cell studies on individuals so affected may show very low D_0 values. A small number of patients with extremely rare inherited diseases, notably ataxia telangiectasia, are even more sensitive to radiation, and amongst these death may occur from radiation burns after a single "therapeutic" dose of X-rays.

Cytogenetic studies: threshold effects and sensitivities

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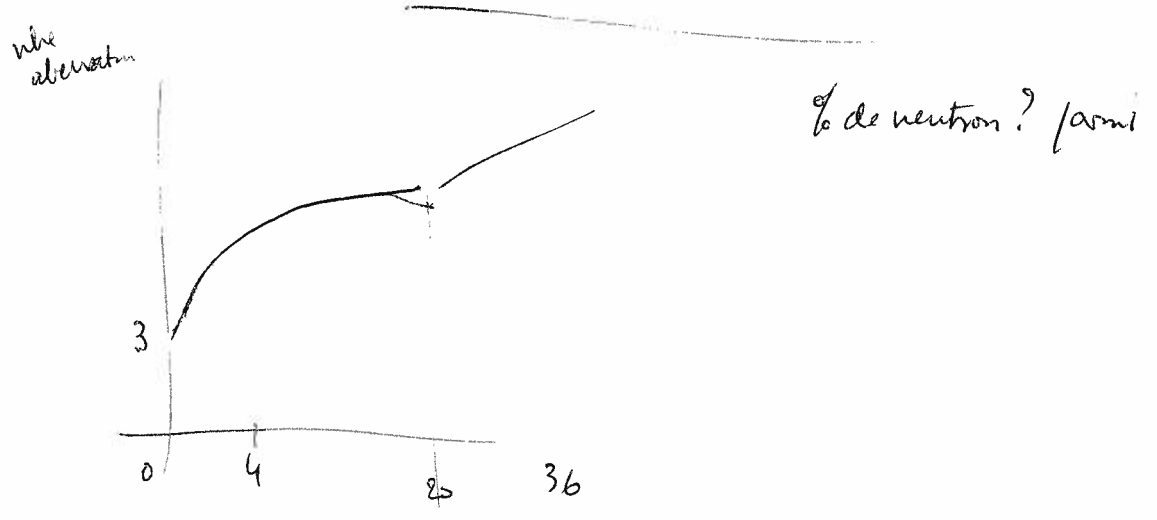
Chromosome structural changes (aberrations) comprise an important class of genetic damage induced in human cells exposed to mutagens. Such aberrations continue to arise spontaneously and in germ cells some forms contribute to inherited human disease, and in somatic cells others are associated with the development of neoplasia. The incidence of chromosome aberrations may be markedly increased in cells exposed in culture to physical, chemical or biological mutagens and such increases are also to be observed in cells of people exposed to these mutagens. Studies on populations exposed to high or intermediate levels of radiation, e.g. the Atom bomb survivors and various groups of patients exposed for therapeutic purposes, and to workers exposed occupationally at low levels, will be considered and the findings compared with those from people exposed at varying levels to chemical mutagens and with general background rates.



fumeurs : ↗ de 50% d'aberrations vs cigarettes par jour

N ~ 2-3 rads

In vitro experiments
in vivo ; RuEN

Cancer incidence and background levels of radiation

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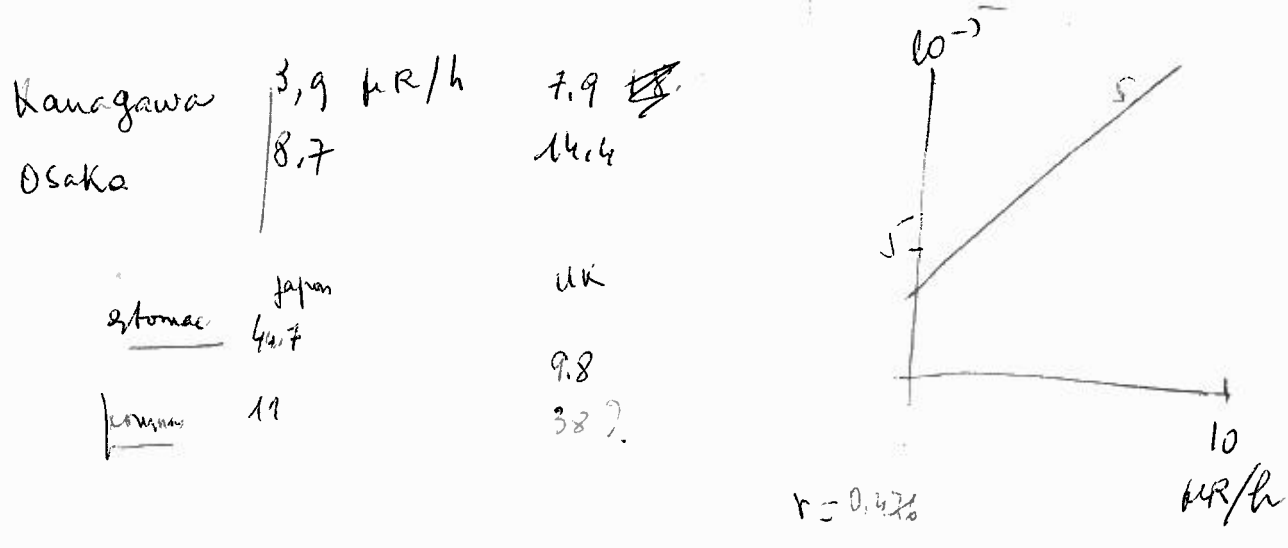
The cancer incidence of populations living in areas with various levels of background radiation provides the mean to study the radiation carcinogeneses at very low-dose rates. We compared the results of epidemiological analyses on cancer incidence in two prefectures in Japan with high population densities at two periods. The data on the background levels of radiation were refered from the exposure rate (μR/h) in each cities and towns in the prefectures that were described in the official report of National Institute of Radiological Sciences and cancer incidence were done from the epidemiological data published by each prefectural goverments. The analyses were carried out using Kendall's rank correlation method. In prefecture A, the incidence of male intestinal cancer (ICD 152 - 153), of male rectal cancer (ICD 154) and male pancreatic cancer (ICD 157) investigated not only for the period 1970 - 1974 but also 1975 - 1979, was significantly correlated with the background level of radiation dose. In prefecture B, the incidence of male colon cancer (ICD 153) for the period 1975 - 1979 significantly correlated with the background radiation dose. These results suggest that the cancer incidence of the colon, rectum and bancreas in male is related to the natural background radiation. On the malignant choriogenic diseases, the significant relation was observed between background levels of radiation and the incidence of hydatidiform and malignant hydatidiform mole in eleven prefectures.



Childhood Cancer in the UK and its Relationship to Background Radiation

by Dr. Alice Stewart, Regional Cancer Registry, Queen Elizabeth Medical Centre. Birmingham.

This paper shows the results of including two data sets in controlled analyses of factors with cancer associations. One set came from the Oxford Survey of Childhood Cancers (OSCC) and the other from the National Radiological Protection Board (NRPB), and the findings suggest that background radiation is a numerically important cause of childhood cancers. There was also a strongly clustered distribution of births followed by early cancer deaths. No obvious cause of these clusters was found but they were far too numerous and widespread to be the result of leakages of radioactivity from nuclear power stations. Therefore, attention is drawn to earlier findings of the Oxford survey and the possibility that the clustering is merely the result of local epidemics of indigenous infections.

TRENDS IN CHILDHOOD LEUKEMIA AND EXPOSURE TO RADIOACTIVITY IN BRITAIN.

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An increased incidence of childhood leukaemia has recently been noted in the vicinity of two nuclear establishments in Britain. These establishments are known to release radioactivity into the environment, but calculations of the likely doses received from these releases and the risk thought to be associated with them make it difficult to see how they could be responsible for the observed increases in childhood leukaemia, assuming the available data on the magnitude of the releases are correct. The conventional assumptions on which such calculations are based are necessarily numerous and complex. The data on which they depend are often sparse, or based on studies of populations exposed at high doses when extrapolation is needed to estimate the effect of low doses, such as are thought to be received by the general public. It is hard to verify such assumptions directly. One test of their validity, however, can be made by examining temporal trends in childhood leukaemia in Britain as a whole in relation to temporal trends in other sources of environmental radioactivity, including fallout from atmospheric nuclear weapon testing in the 1950s and early 1960s. Data on trends in childhood leukaemia in Britain since the 1950s have been compiled. These will be presented at the conference, and their implication discussed.

. LEUKEMIA RATES AROUND NUCLEAR INSTALLATIONS IN BRITAIN.

By

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Ever since the Yorkshire Television programme,'Windscale, the Nuclear Laundry' identified a tenfold excess of childhood leukemia next to the Sellafield reprocessing plant, there has been considerable public and scientific controversy about a possible connection between childhood leukemia and nuclear discharges. This paper summarises the information in the public domain, and goes on to look at leukemia death rates around 15 installations in England and Wales which discharge radioactivity. The period of study was 1963 to 1980 and local rates are compared with rates in control areas and the country as a whole. The results suggest certain areas where research could be intensified.

DOSE DISTRIBUTIONS IN WESTERN EUROPE FOLLOWING CHERNOBYL

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The accident at Chernobyl at the end of April 1986 released large quantities of fission products which, over a period of about 8 days, deposited radionuclides over Western and Eastern Europe from Scandinavia to Turkey. This paper will attempt to describe what is currently known about the levels of activity in air and levels deposited on the ground over Western Europe and Scandinavia. The deposition was extremely non-uniform, depending principally on the intensity of rainfall during the time when activity was present in the air. The made it difficult to identify quickly areas of high deposition.

The paper will present the internationally recommended basis for actions to introduce countermeasures to protect members of the public in the event of an accident at a nuclear installation and will describe the sequence of decision making criteria which were used by countries. This will illustrate the difficulties of establishing common 'action levels' which are universally applicable.

Finally, the paper will summarise the dose estimates made by Western European countries of the consequencies of Chernobyl and will attempt to assess the total health impact of Western Europe and Scandinavia.

FALLOUT FROM THE TSCHERNOBYL-ACCIDENT

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The release of fission products during the Tschernobyl-accident has led to a rather strong fallout in the southern parts of Bavaria. At the GSF (northern area of Munich), the following deposited activities (in kBq/m^2) have been measured: 92 (J-131); 120 (Te-132); 27 (Ru-103); 7 (Ru-106); 19 (Cs-137); 10 (Cs-134); 0,2 (Sr-90); 2,2 (Sr-89); 4 10^{-5} (Pu-239). Extensive measurements of the fission product activity in relevant foodstuffs and of the external γ-dose rate have been carried out in the following weeks. With these input data an analysis of the expected, long-term exposure was made, applying a time-dependent radioecological model (ECOSYS).

For the population in the region of Munich it results a total effective lifetime dose of 150 - 600 mrem, depending on the age at begin of the fallout exposure. Ingestion and external γ-radiation contribute each about one half to this dose.

Applying linear or linear-quadratic dose-risk relationships, a total excess cancer risk from this fallout in the order of 1:10000 can be calculated. This excess risk is small compared with the observed temporal and regional variation of the cancer frequency in the population.

	T	retombés de 1954-65
Sr 90	210	2500
Cs 137	19000	4000
Pu 239	0,01	10

5 M.
2 M à Munich 5 M de vaches

migration de l'activité des Cs des feuilles aux fruits

à Munich 2000 Bq/l (allant jusqu'à 5000 Bq)

International Conference on the Biological Effects of Ionising Radiation
Hammersmith Hospital, 24-25 November 1986

Abstract

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"Effects of Chernobyl"

The health consequences in the UK as a result of the Chernobyl disaster will be an increase in the risk of cancer both fatal and non-fatal. These cancers will develop over the next 40-50 years and will probably be undetectable in the normal variations in the incidence of malignancies. In this context arguments over the exact magnitude of the possible increase in incidence of disease are irrelevant as are calls for retribution. However, the controversy over the consequences of this incident heightens the public's awareness of the strength, or otherwise, of the risk basis for dose limitation. The realisation that some risk must be accepted from an international nuclear energy programme is important as is the comparison of that risk with that from other forms of power production. The fact that we need the data from disasters such as this to learn about risk cannot increase public peace of mind.

However, some of the effects have been more profound. Models of transport of radionuclides through food chains will need revision as will plans for dealing with emergencies. There is an obvious need for some primary independent monitoring and better organisation of communications with the public with a clear chain of responsibility.

The clearest lesson to be learnt is the need for international agreements over reactor safety procedures without which the "it couldn't happen here" assertions are hollow promises.