THE eBulletin
Radiological Protection Bulletin

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Editorial

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Cosmic exposures

The universe is awash with radiation, from microwaves to gamma rays plus a vast array of particles. Our atmosphere provides an effective radiation shield but at aircraft cruising heights the ambient dose rate from cosmic sources is between fifty and a hundred times what it is at ground level. Is there a risk to the health of cabin and cockpit crew?

The recent and sudden occurrence of very large solar storms with associated flares and coronal holes, has stimulated a lot of interest in radiation from our local star. It has also led to some anxieties in air crew who, with the exception of astronauts, receive the highest individual exposures to cosmic radiation. Newspapers have reported that some pilots have reduced cruising altitude from 35,000 to 30,000 feet in a bid to reduce their exposures (Gadher, 2003). Unfortunately, unless there is real-time cosmic radiation monitoring equipment on board, such actions will not necessarily reduce exposures. Indeed, it is possible that such action may even increase exposure because aircraft cruising speed decreases with altitude and the flight therefore takes longer. For example, Concorde flew at heights between 60,000 and 70,000 feet and measurements over many years showed that Concorde air crew received approximately the same dose on a transatlantic flight as those on aircraft flying at 35,000 feet. The cosmic ray dose rate at Concorde cruising altitudes is roughly twice that at 35,000 feet (10 microsieverts per hour (µSv h^{-1}) compared to 5 µSv h^{-1} on average), but the journeys took about half the time, so the dose is approximately the same. Also, Concorde aircraft were fitted with in-flight real time radiation detectors and, in over 30 years of flight time, there were no confirmed occasions when aircraft had to decrease altitude to avoid elevated exposures.

In its issue of November 2003, the journal *Occupational and Environmental Medicine* published three papers and an editorial (Whelan, 2003) on cancer incidence in air crew from Iceland and Sweden. There have been various epidemiological studies of pilots and cabin crew published recently, and these suggest that pilots are at an increased risk of malignant melanoma and non-melanoma skin cancers. There are also indications of raised risks of breast cancer among female cabin crew. However, it is not clear whether these observed excesses are due to occupational cosmic radiation exposures or to lifestyle, reproductive or other non-occupational factors. Studies can use detailed occupational data on flight hours for example, and national records systems for cancer information, but they are less able to take account of well-established non-occupational risk factors that can influence cancer risks. For example, skin cancers are linked to sunburn episodes and there are hypotheses that the increase in melanomas in air crew is due to the sun-associated lifestyle that they experience more than the average person.

There is a general need to obtain as much information as possible about exposures and potential confounding factors before coming to firm conclusions. Current research in Europe and the USA on cancer risks in air crew should help in this regard. The European study involves nine countries and is a cohort mortality study of over 28,000 cockpit and 44,000 cabin crew. Recently published findings for this study (Blettner et al, 2003; Zeeb et al, 2003) indicate that occupational factors have a limited influence on mortality among air crew, apart from aircraft accidents. The US study involves 9,000 flight attendants and pays special attention to non-occupational factors. There is also a US study on biological dosimetry, examining whether persistent chromosome aberrations can be linked to cosmic radiation exposures.

At present, there are some indications of a possible increased cancer risk in air crew, and the current European and US studies should provide a better understanding of these risks.

References

Blettner M, Zeeb H, Auvinen A, Ballard TJ et al (2003). Mortality from cancer and other causes among male airline cockpit crew in Europe. *Int. J. Cancer*, **106**(6), 946–52.

Gadher D (2003). Pilots fly low to curb radiation. *The Sunday Times*, 9 November.

Whelan EA (2003). Cancer incidence in airline cabin crew. *Occupational Environ. Med.*, **60**(11), 805 and 806.

Zeeb H, Blettner M, Langner I et al (2003). Mortality from cancer and other causes among airline cabin attendants in Europe: a collaborative cohort study in eight countries. *Am. J. Epidemiol*, **158**(1), 35–46.

Michael Clark

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Health Protection Agency Bill

The Health Protection Agency Bill was presented to the House of Lords on Thursday 27 November 2003 by Lord Davies of Oldham, on behalf of Lord Warner. It was read for the first time and ordered to be published. The full text of the Bill can be found on the United Kingdom Parliament website (see below); there are links to explanatory notes for the Bill. The purpose of the Bill is to establish the Health Protection Agency (HPA) as a UK-wide non-departmental public body. The Agency will be able to undertake both health functions and radiological protection functions (including functions currently carried out by NRPB). These, more integrated, arrangements are intended to improve the ability of the UK to tackle the problems posed by infectious disease and other hazards, including the UK response to chemical, biological, radiological and nuclear (CBRN) terrorism.

When the Bill is passed through Parliament, NRPB will be absorbed into HPA, presently constituted as a special health authority (SHA). The SHA will be wound up along with NRPB. The Chairman of HPA will be appointed by the Secretary of State for Health in England, after consultation with each of the devolved authorities in the UK.

Michael Clark

External links

- Health Protection Agency Bill
  www.publications.parliament.uk/pa/ld200304/ldbills/003/2004003.htm
  Explanatory notes to the Health Protection Agency Bill
  www.publications.parliament.uk/pa/ld200304/ldbills/003/en/04003x--.htm

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UK adult brain tumour study

NRPB has recently published a report on behalf of the investigators of the United Kingdom Adult Brain Tumour Study (UKABTS), in collaboration with the Centre for Occupational and Environmental Health, University of Manchester, the Institute of Occupational Health, University of Birmingham, the Department of Epidemiology and Public Health Medicine, University of Nottingham, the Information and Statistics Division of the Common Services Agency, National Health Service, Scotland, and the Unit of Epidemiology and Health Services, University of Leeds.

UKABTS is a case-control study that started in 2001 to investigate a number of possible causes of brain tumours including the use of mobile phones, occupational exposure to RF and extremely low frequency (ELF) electromagnetic fields (EMF), solvents and pesticides. The study is part of the international INTERPHONE case-control study on mobile phones and adult brain tumours, being co-ordinated by the International Agency for Research on Cancer (IARC). Interview data is being collected from over a thousand case subjects diagnosed with brain tumours, and a similar number of population-based control subjects. A Computer Assisted Personal Interview (CAPI) questionnaire is used to obtain information about exposures, and expert systems will be constructed to interpret the CAPI responses.

The report describes a complementary study to examine the feasibility of collecting direct measures of ELF magnetic field exposure for UKABTS case control subjects. A large number of studies have been published on the possible link between occupational exposure to EMF and cancer. Personal monitoring provides the opportunity to obtain valuable quantitative exposure data and thus examine the relationship with surrogate exposure. The main objective of the feasibility study was to acquire personal dosimetry measurements for a sample of case-control subjects, for all the jobs held for twelve months or more in the last five years, and comparable data when away from the working environment. For jobs in which cases and controls were not currently employed, employers were asked to select appropriate proxy workers. Six broad areas of investigation were addressed: employer co-operation; proxy selection methods; the appropriateness of proxy exposure; measurement validity; appropriateness of CAPI exposure assessment; and the costs of a measurement programme. The study demonstrated that convincing measures of adult exposure to ELF MF were accessible at a relatively moderate cost, and the results form the basis for an extension of the UKABTS measurement programme.

The work was funded by the Health and Safety Executive.

Reference

van Tongeren M, Mee TJ, Whatmough P, et al (2003). UK case control study of the aetiology of adult brain tumours and neuromas: exposure to extremely low frequency magnetic fields - report of a feasibility study. NRPB-W50. NRPB, Chilton.
www.hpa.org.uk/radiation/publications/w_series_reports/2003/nrpb_w50.htm

Myron Maslanyj

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ICRP recommendations in 2005

The International Commission on Radiological Protection (ICRP) plans to publish some new recommendations in 2005. In a recent paper, ICRP has laid out its current thinking which is '... to produce a simplified and more coherent statement of protection philosophy, for the start of the 21st century'. (ICRP (2003). The evolution of the system of radiological protection: justification for new ICRP recommendations, *J Radiol Prot* **23**, 129–42).

Recommendations from ICRP are very influential worldwide, especially Publication 26 (1977) and Publication 60 (1991). However there is some concern that the application of the basic principles of radiological protection has become too complicated. Justification, optimisation and limitation of radiological exposures have been supplemented since 1991 by numerous 'constraints' on optimisation to control exposures from radiation sources. Thirty constraints contained in nine publications have been recommended since Publication 60, based on a variety of arguments including annual individual risk, multiples or fractions of natural background radiation exposures, cost-benefit analysis, qualitative judgements and the avoidance of acute, deterministic effects. Such a large number of different values for dose constraints based on very diverse arguments, is regarded by ICRP as unduly complex. Instead, ICRP suggests that the starting point for selecting dose levels for setting constraints should be natural background radiation levels. The existence of natural background radiation cannot justify additional exposures, but it can set a benchmark for levels of concern and importance.

ICRP proposes various levels of concern for individual effective doses received in a year, based on comparisons with the global average annual natural background effective dose from all sources of 2.4 millisieverts (mSv) (UNSCEAR, 2000).

The level of concern for exposures between 1 and 10 mSv should be low because this is the normal range of exposures to natural background measured over the world. Exposures above 100 mSv cannot be justified except in extraordinary circumstances (for example, life-saving measures) and acute exposures of 500 mSv or more lead to deterministic effects (radiation sickness).

The levels of concern for exposures below 1 mSv are, in a sense, more complicated. In terms of risk, the level of concern from a dose of a few microsieverts should be low, but actual public concern can depend on a variety of other factors, including perceived risks and political judgements. Routine discharges from nuclear installations are good examples of this. Average radiation exposures from discharges are normally well below 1 mSv, and typically they are below 0.01 mSv. Nevertheless, such discharges can still be the subject of much public concern.

ICRP held a meeting in Buenos Aires this month and reports from the Main Commission and its committees will be published in a subsequent issue of the *eBulletin*.

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External link

- International Commission on Radiological Protection (ICRP)
  www.icrp.org/

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Dr Dan Beninson (1931–2003)

Dr Daniel Jacobo Beninson died on 21 August 2003. Known globally as ‘Dan’, he had a substantial international reputation in radiological protection. He was a member of the Main Commission of the International Commission on Radiological Protection (ICRP) for thirty-two years until 2001, including eight years as Chairman of ICRP (1985–93).

Dan Beninson was born in 1931 in Buenos Aires, Argentina, and graduated in medical sciences from Buenos Aires University in 1954. He went to the USA in 1956 to do research at the Lawrence Radiation Laboratory and obtained his doctorate in applied physics there. In 1956 he was appointed General Secretary of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), a position he held for two years; later (1974–79) he became Director of the Scientific Secretariat for UNSCEAR.

Dan Beninson had many honours bestowed upon him, almost too many to mention here. Notable among them was his appointment as an advisor to the Pontifical Academy of Science and receiving the Rolf Sievert award from the International Radiological Protection Association. Professionally, Dan Beninson will probably be remembered most for his significant contributions to the two major recommendations from ICRP, Publication 26 (1977) and Publication 60 (1991).

Anyone who met Dan Beninson could not fail to be impressed by his formidable intellect. He also had a tremendous sense of humour, and these qualities made Dan Beninson a wonderful colleague to many scientists throughout the world.

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- International Commission on Radiological Protection (ICRP)
  www.icrp.org/

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COMARE refutes Green Audit claims

A report from the pressure group Green Audit has claimed that there are excesses of cancers (breast, kidney, leukaemia and cervix) in the vicinity of the nuclear power stations at Hinkley Point in Somerset. However a subsequent study by the South West Cancer Intelligence Service (SWCIS), carried out at the request of the Burnham Primary Care Trust, has shown that the Green Audit study only covered a small sample of all cases occurring in the area. Using the complete cancer registration data set for the Burnhamward, SWCIS found no cancer excess except for leukaemia. When the leukaemia cases were investigated, the excess proved to be chronic lymphocytic leukaemia (CLL), a cancer not associated with exposure to radiation.

Understandably, the Green Audit Report has caused some alarm in the local community near Hinkley Point. The Committee on Medical Aspects of Radiation in the Environment (COMARE) states that the Green Audit Report '… is so deeply flawed that it cannot provide any reliable information or conclusions about rates of cancer…' and recommends that it be withdrawn. Unfortunately Green Audit champions its 'citizen's epidemiology', obtained by carrying out doorstep surveys of illness. COMARE notes that the local NHS ethics committee was not consulted by Green Audit and the study protocol was not peer reviewed. So, in essence, a seriously flawed study about public health has been published without any proper scientific review.

In the field of public health, particularly when dealing with serious diseases, there is a basic responsibility for scientists and the medical profession to ensure that statements about health effects are correct. COMARE recommends that Green Audit '… should follow normal scientific practice and submit their reports for peer review. All other scientific investigators have to follow these rules.'

Michael Clark

External links

- Committee on Medical Aspects of Radiation in the Environment (COMARE)
  www.comare.org.uk
  COMARE statement on Green Audit Occasional Paper 2002/5
  www.comare.org.uk/statements/comare_statement_burnham.htm
- Green Audit
  www.greenaudit.org
- Low Level Radiation Campaign
  www.llrc.org

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Anti-radiation pills

Hollis Eden Pharmaceuticals is co-developing with the US military a pill for use in protection from radiation injury. The drug (NEUMUNE or HE 2100) is aimed at arresting the short-term effects of radiation by reducing the occurrence of neutropenia, the loss of particular white blood cells which fight infection. So far the drug has been successfully tested on non-human primates following exposure to radiation. Hollis Eden are developing the drug under a new US Food and Drug Administration (FDA) rule which allows a demonstration of safety in humans following clear efficacy testing on animals. FDA rule that it is unethical to expose humans to life threatening pathogens or radiation in order to test the efficacy of protective medicines.

There is often confusion about the label, 'anti-radiation'. For example, potassium iodide (or iodate) pills are frequently referred to as anti-radiation pills when they are not strictly so. They block the thyroid uptake of iodine and therefore reduce the uptake of iodine-131. They significantly reduce dose but this is only for one radionuclide. The drug being developed by Hollis Eden is not strictly an anti-radiation pill either. It is a post-irradiation anti-infection pill. Nevertheless, if successful in its basic drug safety testing, it will be a welcome addition to the armoury of treatments for radiation injury, and arguments about precise labels would be rather churlish.

Michael Clark

External links

- Hollis Eden Pharmaceuticals
  www.holliseden.com
- *New Scientist* news service - Radiation sickness drug could save thousands
  www.newscientist.com/news/news.jsp?id=ns99993745

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UVR and life

Before life existed on Earth three or four billion years ago, the intensity of ultraviolet radiation (UVR) at ground level is estimated to be a hundred times what it is today. This would have been highly sterilising to primitive life forms, so there has been a large question mark over how the primordial soup could have produced complex molecules like RNA. Long-chain molecules should have been broken up by UVR, so the traditional hypothesis is that life evolved in shielded environments, such as shallow seas and tidal lakes. A different hypothesis has recently been proposed by scientists at Osnabrück University in Germany using Monte Carlo simulations of the formation of oligonucleotides (DNA fragments) under continuous UVR (Mulkidjanian AY, Cherepanov DA, Galperin MY (2003). Survival of the fittest before the beginning of life: selection of the first oligonucleotide-like polymers by UV light, *BMC Evol Biol.,* **3** (1), 12). They postulate that molecules like RNA had a selective advantage over other large molecules, because of RNA's ability to absorb and disperse UVR without breakage. Nitrogenous bases are particularly efficient absorbers for UVR and can protect the pentose phosphate backbone of molecules like RNA. So these molecules appeared as biopolymers in the primordial soup, and were subject to abiogenic selection (ie, not due to interactions with living organisms) as the most UVR resistant.

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Thyroid doses in Poland after Chernobyl

Parts of Poland were affected by the first plumes from the Chernobyl accident in 1986, and countermeasures were taken at the time to minimise thyroid doses from iodine-131. In a recent paper, scientists from the Central Laboratory for Radiological Protection in Warsaw have carried out a retrospective evaluation of iodine-131 deposition and thyroid dose (Pietrzak-Flis Z, Krajewski P, Radwan I and Muramatsu Y (2003). *Health Physics*, **84** (6), 698–708). Concentrations of iodine-129 and iodine-127 were determined by neutron activation analyses of uncultivated soils from sixteen locations in Poland. The iodine-131 deposition was estimated using the estimated iodine-129/iodine-131 ratio of 32.8 at the time of the accident. The calculated iodine-131 deposition ranged from 63.2 to 729 kBq m^{-2} and the highest thyroid doses from inhalation and ingestion without countermeasures were 178 mSv, 120 mSv and 45 mSv for five-year-old children, ten-year-old children and adults, respectively. The authors estimate that countermeasures such as iodine prophylaxis, would have reduced these doses by about 30%.

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First MTHR paper published

The LINK Mobile Telecommunciations Health Research Programme (MTHR) was initiated in 2001 and the first scientific paper has been published in the open literature. It gives the results of calculations of the specific energy absorption rate (SAR) in the head due to TETRA (terrestrial trunked radio) handsets. TETRA is the mobile telephone system adopted by the Home Office for the police and emergency services in the UK. (Dimbylow P, Khalid M and Mann S (2003). Assessment of specific energy absorption rate (SAR) in the head from a TETRA handset. *Phys. Med. Biol.*, **48**, 3911–26). A comprehensive set of calculations of SAR in the head was performed for positions of the handset in front of the face and at both sides of the head. The representative TETRA handset considered, operating at 1 watt (W) in normal use, is in compliance with international guidelines for occupational and public exposure.

Calculations were also performed for 3 W handsets using monopole and helical antenna. The 3 W handset with a monopole antenna in normal use also shows compliance with international guidelines for occupational and public exposure. However the 3 W handset with a helical antenna in normal use shows compliance with the occupational exposure guidelines but not for public exposures.

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External link

- Mobile Telecommunciations Health Research Programme (MTHR)
  www.mthr.org.uk

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New European environment and health strategy

In June, the European Union (EU) announced a new environment and health strategy. It is a joint initiative from the Directorates-General for environment, health and consumer protection, and research. Although many environmental and health problems have improved in Europe, there are some health problems that are becoming more prevalent, especially amongst children. Asthma is an example and this is thought to have an environmental cause.

The strategy will first enable groups of experts to gather relevant facts on the relationship between the environment and health. Together with the World Health Organization and member states, indicators and bio-monitoring systems will be identified to assess the environmental impact on health of various substances. Specific pilot actions will be launched concerning priority pollutants such as dioxins, heavy metals and endocrine disrupters, and common goals for research will be identified. Actions to reduce exposures to dangerous substances, '… with special emphasis on indoor and outdoor air quality, heavy metals, electromagnetic fields and urban environments.'

The first action plan will be for the period 2004–2010 and there is, of course, an acronym for the strategy, SCALE. S stands for science, C for children, A for awareness and LE for legislation. Not exactly an acronym in the strict dictionary sense, but memorable as these things go.

Michael Clark

External link

- European Union - environment and health strategy

  europa.eu.int/comm/press_room/presspacks/pdf/com_en.pdf

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Marie Curie in the Great War

In *Physics Today*, Professor Lawrence Badash describes the contribution Marie Curie made in establishing effective x-ray examinations of wounds during the Great War (1914–18). Prior to the war Marie Curie had been awarded the 1911 Nobel Prize for chemistry to add to her joint Nobel Prize (with her husband Pierre) for physics, awarded in 1903. Despite this, she had been refused admission to the Académie Français, most probably because she was a woman and not French-born. She also had a close relationship with Paul Langevin, following the death of her husband in 1906 after a traffic accident. Her affair with Langevin, who was married, became public knowledge and Marie Curie was the subject of many unflattering press articles. This engendered public and professional hostility towards Marie Curie which only abated after the Great War when her contribution to help wounded French soldiers was recognised.

Marie Curie pioneered the extensive use by the French Army of x-rays to examine wounds before operations. In 1914 the utility of x-rays for such purposes were well known, but the facilities and equipment available were inadequate for the scale of casualties. She led a successful campaign to get the funds, equipment and vehicles to bring x-ray techniques to battlefield hospitals. She was in charge of training radiographers and spent much of her time at field hospitals. She learnt to drive and hauled equipment to remote and dangerous stations. These were the 'voiture radiologique' also known as 'petit Curie'. The benefits of mobile x-ray units enabled the fast, accurate determination of the extent of wounds, and led to wiser triage choices. This led to speedier recovery and better morale.

X-ray examinations had been used in previous conflicts, including the Boer War, but only on a small scale. By the end of 1918 France had more than 500 fixed x-ray units and 300 mobile units. No surgeon would think of removing bullets or shrapnel without x-ray examination first. This revolution in medicine was in no small part due to the energy and talent of Marie Curie.

Michael Clark

External links

- *Physics Today*
  www.physicstoday.org

  Article - Marie Curie: In the Laboratory and on the Battlefield
  www.physicstoday.org/vol-56/iss-7/p37.html

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Radon and lung cancer

A recent publication (Lubin JH (2003). Studies of radon and lung cancer in North America and China, *Radiat Prot Dosim*, **104**, 315-19) gives a brief description of results from the pooling of North American and Chinese case-control studies of domestic exposure to radon and lung cancer. Attention was concentrated on those studies which

- included more than 200 cases
- involved long-term radon measurements
- collected data on smoking.

The seven North American studies included in the pooling had a total of over 4000 cases and 5000 controls and the two Chinese studies included over 1000 cases and 2000 controls. Results were expressed in terms of odds ratios at 100 bequerels per cubic metre. For the pooled North American studies the odds ratio was calculated to be 1.106 (95% confidence interval 1.00-1.28). For the Chinese studies the odds ratio was 1.136 (1.01-1.36).

Many individuals included in these studies had gaps in their exposure records because of the difficulties in going back to dwellings occupied decades ago. When analyses were limited to those with complete exposure records, rather higher odds ratios were obtained: 1.176 (1.02-1.43) from the North American studies and 1.319 (1.08-1.88) from the Chinese pooling.

These results are broadly in agreement with previous risk estimates and help to confirm the reality of the risk from domestic exposures to radon. As with some previous studies, there is a suggestion that taking account of uncertainties in the exposure estimates will increase the risk factors.

We look forward to more detailed descriptions of the North American pooling and to the publication in 2004 of results from the pooling of European case-control studies.

Gerald Kendall

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Uranium bugs

Geobacter metallireducens microbes (geobacter) can convert soluble uranium compounds into insoluble uranium oxide (uraninite), according to Anderson and colleagues at the University of Massachusetts at Amherst. This recently published finding (Anderson RT, Vrioni HA, Ortiz-Bernadet I,et al (2003). Stimulating the in situ activity of geobacter species to remove uranium from the groundwater of a uranium-contaminated aquifer, *Applied and Environmental Microbiology*, **69**(10), 5884–91), could have applications in the treatment of uranium wastes and for decontaminating sites. Environmental problems are often caused by soluble uranium compounds leaking into groundwater and spreading contamination. Geobacter's potential ability to render uranium wastes insoluble *in situ* could alleviate these problems without the need for traditional pump and treatment schemes.

Geobacter usually occurs in small quantities in soil, but growth can be accelerated by adding nutrients. Anderson's team stimulated the bugs to multiply in an aquifer contaminated by uranium in Colorado by adding acetate compounds, a favourite nutrient for geobacter. Within a few days the geobacter population boomed and levels of soluble uranium started to drop. After forty days, Anderson estimated that 70% of the uranium had been converted to insoluble uraninite.

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External link

- Geobacter Project of the Environmental Biotechnology Center, Department of Microbiology, University of Massachusetts Amherst
  www.geobacter.org/

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Chips and CDs with everything

Some types of telephone chip cards can be used as passive dosemeters for exposures to external gamma radiation. A scientist at the GSF National Research Centre, Neuherberg, Germany has measured the radiation dose responses of more than 200 chip cards produced by various companies since 1990, using infrared stimulated luminescence (IRSL). The dose responses of some chip cards were found to be compatible with the synthetic phosphors used for routine occupational dosimetry. The response was reported to be linear over the dose range from 25 milligrays (mGy) to 5 Gy and stable at ambient temperatures. In the event of an accidental or other unplanned exposure, such chip cards could be used to reconstruct individual doses (Goksu HY (2003). Telephone chipcards as individual dosemeters. *Radiation Measurements*, **37**, 617–20).

Similarly, it is possible to use compact disks (CDs) to assess radon levels in homes. The radon absorption ability and track-etch properties of the polycarbonate material used to manufacture CDs make them potentially sensitive retrospective radon detectors (Presyanov D et al (2003). The compact disk as a radon dectector - a laboratory study of the method, *Health Physics*, **84**(5), 642–51). The results suggest that CDs stored in the home can be used to assess radon levels with an uncertainty of less than 10%. They can measure levels down to 3 bequerels per cubic metre (for a ten-year exposure time) and appear to cover practically the whole observed range of indoor radon concentrations. More work is required to verify the temperature corrections needed to calculate levels. Also, the technique is destructive to the CD itself, which will need to be made clear to the homeowners involved. It will affect the choice of CD donated to assess radon levels.

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Gamma rays and the Hulk

The fictional theme of the recent film *The Hulk* is how an exposure to gamma rays changes a mild-mannered boffin from Berkeley into a very mean and green strong man, capable of causing havoc in America. The gamma sphere shown in the film is based on a real piece of equipment at the Lawrence Berkeley National Laboratory (LBNL) in California. Fiction being fiction, the capabilities of the real gamma sphere have been changed fundamentally. It is actually a very sensitive gamma ray detector, designed to probe atomic and sub-atomic physics by examining the decay of atomic nuclei at its centre. The detector is therefore not able to irradiate anyone but, taking a cinematic view, it's all good publicity for the low energy nuclear physics programme at LBNL.

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External link

- *Nature* science update - Real experiment stars in Hulk movie
  www.nature.com/nsu/030616/030616-3.html

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Is there an epidemic of cancer deaths?

Campaigners against a number of types of environmental pollution use an explicit assumption that there is a 'cancer epidemic'. This short paper uses information in the public domain, presented in a simple way, to examine the evidence for a cancer epidemic in England and Wales.

'… the committee has been impressed by the lack of evidence as to the origin of the global cancer epidemic which began in the period 1975-85.' (*2003 recommendations of the ECRR: the health effects of ionising radiation exposure at low doses and low dose rates for radiation protection purposes*, edited by Chris Busby et al).

If there were an epidemic of cancer then you would expect that death rates from cancer would rise year on year. Death rates, expressed as age-standardised rates and broken down by cause, are freely available from the Office for National Statistics (ONS) via its website. Age standardisation is vital when comparing trends over time because it eliminates the effects of secular changes in population structure (population ageing in this case) and allows direct comparison between the sexes. Rates covering all cancer deaths in the whole of England and Wales provide a precise estimate of trends. There have been advances in cancer cure rates over the period of this study, but not of sufficient size for a steady death rate to mask a real rise in incidence.

The method

The years 1971, 1981, 1991 and 2001 were chosen for analysis because they cover four decades and age-standardised cancer death rates are available, standardised to the same population, at the click of a mouse. 1971 was taken as a baseline and, for each cancer and for each other year, the change in cancer rate from the 1971 baseline was calculated in two ways:

- the difference between rates
- the percentage change (rise or fall in rate) since 1971.

The data are presented as line graphs, all starting with 1971 as baseline with each cancer being shown as a different line. There are separate graphs for males and females.

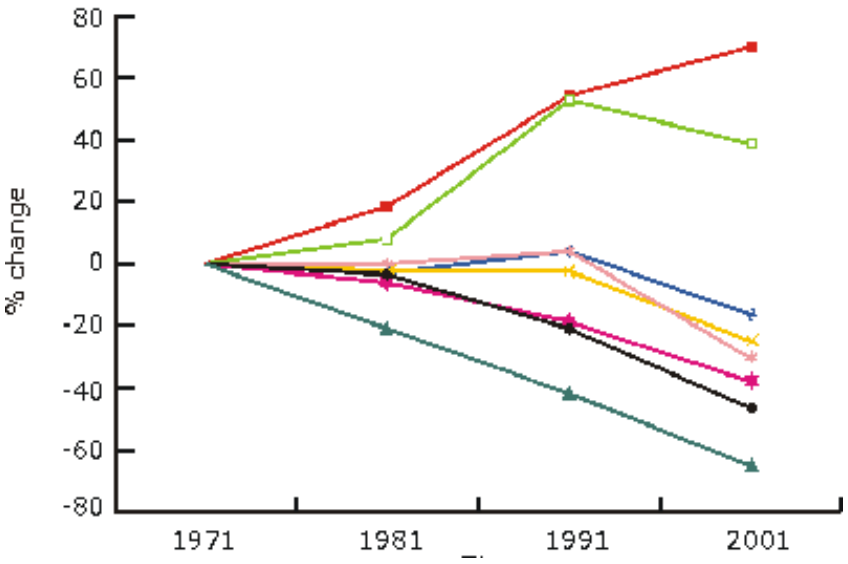

FIGURE 1 Percentage change in age standardised cancer death rate (underlying cause) in males over four decades

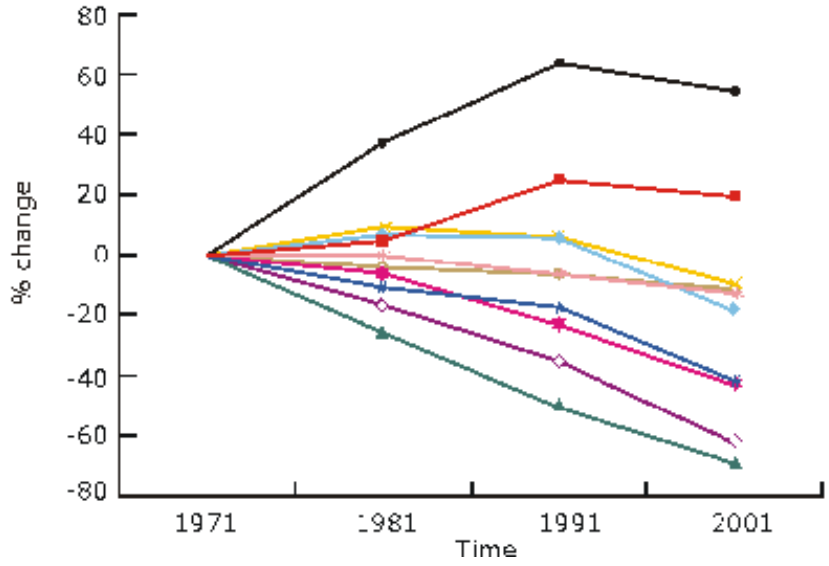

FIGURE 2 Percentage change in age standardised cancer death rate (underlying cause) in females over four decades

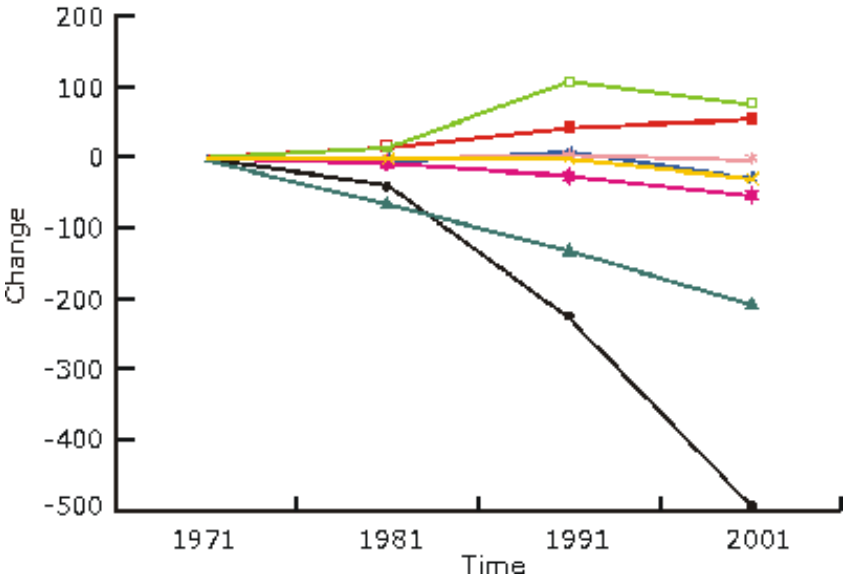

FIGURE 3 Age standardised cancer death rate (underlying cause) in males over four decades

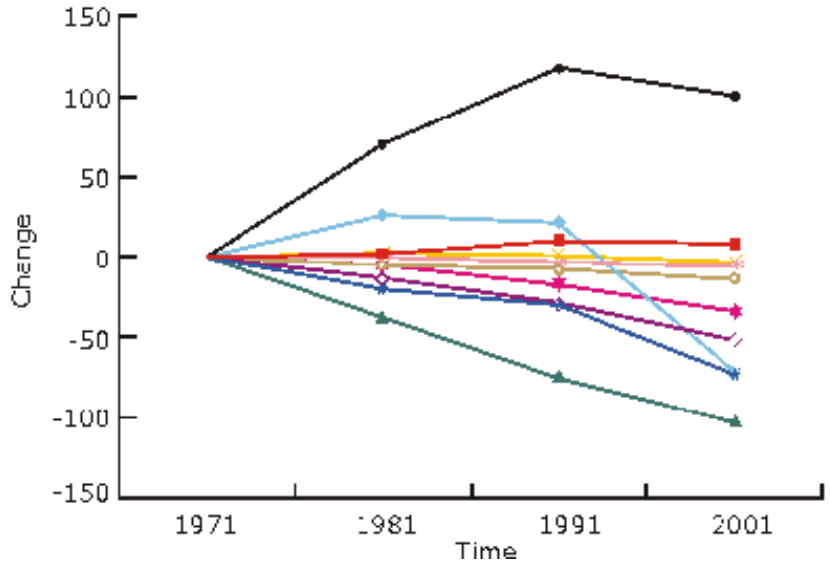

FIGURE 4 Age standardised cancer death rate (underlying cause) in females over four decades

Key for figures

What would a 'cancer epidemic' look like?

If a 'cancer epidemic' were evident from the data, you would expect the trend of most of the lines would be to rise above the 1971 rate as the years go by. However, you would not expect rates of all cancers to rise by the same amount because of the numerous influences on both incidence and mortality.

Results

Is there an epidemic of cancer deaths ?

The data show that there has been no general trend for cancer death rates to rise between 1971 and 2001. Death rates for some individual cancers have risen, a good example being the rise in female death rates from lung cancer following the increased proportion of older women who have smoked. The trends for individual cancers look different depending whether the absolute difference in rate or the percentage change since 1971 is used. In general, cancers with low death rates will have more fluctuation over time and thus higher percentage changes. However, the direction of change (rise or fall in cancer rate) is not altered by the way the change since 1971 is expressed.

Changes in the International Classification of Diseases (ICD) coding published by the World Health Organization (WHO), especially the shift to ICD-10 (tenth revision) in 2001 may have marginally increased the proportion of all deaths that are coded to cancer. A sensitivity analysis achieved by including the 2000 data revealed that it makes no significant difference to the graphs (data available on request or you could do your own).

The data provide no evidence for a generalised rise in age-standardised cancer death rates in England and Wales between 1971 and 2001. They do not support the hypothesis that there is a 'cancer epidemic'.

Jill Meara

Internal link

- Reponse statement on the 2003 recommendations of the European Committee on Radiation Risk
  http://www.hpa.org.uk/hpa/news/nrpb_archive/response_statements/2003/response_statement_3_03.htm

External links

- Office for National Statistics (ONS)
  www.statistics.gov.uk/
- World Health Organization (WHO)
  www.who.int
  ICD-10 The International Statistical Classification of Diseases
  and Related Health Problems, tenth revision
  www.who.int/whosis/icd10/

Article

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Generalised habit data for radiological assessments

The habit data used for assessment purposes at NRPB are kept under review and updated as necessary. The most recent review was completed this year and a report produced (Smith and Jones, 2003). This report provides a summary of generalised habit data that are suitable for most assessment purposes. Generalised food intake rate data, habit data for people in coastal areas, inhalation and water intake rates, and indoor/outdoor occupancy data are presented.

The data presented are intended to replace those in the previous review (Robinson, 1996). The main changes introduced in the report include minor revisions to the previously recommended inhalation rates, and updated recommendations on riverbank and lakeside occupancy data, which are based on recent relevant surveys.

Members of the public are exposed to radiation, or have the potential for such exposure, because their location or habits bring them into contact with a source of radiation. They may be exposed directly from the source, by direct irradiation or inhalation of released activity, or indirectly due to exposure to contaminated environmental materials, for example, foods. Consequently, habit data are an essential part of dose and risk assessments for members of the public. The habit data used for assessment purposes at NRPB are kept under review and updated as necessary. The most recent review was completed this year and a report produced (Smith and Jones, 2003).

The report provides a summary of the default habit data which are currently used at NRPB for general radiological assessment purposes for members of the public. The data presented in this new report supersede those in the earlier report (Robinson, 1996).

The following types of data are included in the report:

- generalised food intake rates;
- generalised water and air intake rates;
- indicative habits of coastal communities;
- shoreline occupancy, of both coastal communities and the general population;
- occupancy data for the time spent indoors and outdoors.

Two types of habit data are commonly used in assessments; those relating to specific sites or those for general use. This report provides generalised data. These data are not intended to preclude the use of site-specific information where these are available and where they are more appropriate. Generalised data are likely to be adequate in circumstances where doses are not expected to approach limits or constraints, and where regional variations in habits are likely to be small. Generalised data may also be more appropriate than site-specific information when assessments extend over

long time periods and relate to future rather than past exposures.

Habit data are presented which represent (i) the behaviour of 'average individuals' and (ii) the habits of those individuals who have higher than average intakes or occupancies.

Data are provided for a number of representative age groups. The purpose of the particular assessment will determine which type of data and which age groups are appropriate to consider. For many assessments, the dose or risk to those members of the public who are most exposed from a radiation source is required. This group of people is known as the 'critical group'. The higher intakes and occupancies presented in the report are valuable for representing critical group habits. The application of critical group data and average habit data are discussed in detail in the report.

Generalised intake rates

Generalised intake rates are required for a number of different purposes. The type of data applied will clearly depend upon the scope of the calculation. Generalised average and critical group intake data are given in the report for the following: terrestrial foods; marine foods (for both the general population and for coastal communities); soil and sand; seawater and house dust. As indicated above, generalised habit data are particularly valuable in assessing future doses or risks which will be assumed to apply for a number of years, for example, in conducting assessments for authorisation purposes. Site-specific factors may result in actual critical groups having habits different from those presented in this report but these differences are likely to be significant only where doses approach dose criteria, or where habits are inadequately described by national data.

The generalised UK food intake rates used at NRPB have been published previously (Byrom et al, 1995; Robinson, 1996). They are based on an analysis carried out by the former Ministry of Agriculture, Fisheries and Food (MAFF) (Byrom et al, 1995) of three national dietary surveys. The surveys of adult (OPCS, 1990), child (DH, 1989) and infant (Mills and Tyler, 1992) diets were specifically designed to reflect individual consumption habits. The child and adult surveys were designed to provide a nationally representative sample of individual diet for the age groups 10-15 years and 16-64 years, respectively. The child survey allows two groups, 10-11 year olds and 14-15 year olds, to be differentiated. Two main categories of intake rate data were determined for each age group, those which represent the habits of the average individual and those which represent individuals with higher than average consumption rates, or a generalised critical group.

Since the derivation of the generalised intake rates presented in the earlier report (Robinson, 1996), new national surveys have been undertaken of child (Gregory at al, 2000) and adult (ONS, 2002) diets. The results from these surveys have not yet been analysed in the same manner as the previous surveys and thus it has not been possible to generate generalised intake rates appropriate for radiological assessments from them at this stage. A preliminary analysis of the results of these surveys indicates that differences from the earlier surveys are unlikely to have a significant impact on the generalised data. Thus those presented in the earlier report are considered to be still valid and are included in the new report for completeness. Advice on the appropriate use of the data is provided in the new report.

The recommended average inhalation rates for members of the public, both children and adults, differ slightly from those in the previous NRPB habit data report. The new recommendations are presented in Table 1. These were taken from the International Commission on Radiological Protection (ICRP)Task Group report on the model of the respiratory tract (ICRP, 1994). The new report also gives recommended inhalation rates for workers

and guidance on their use.

TABLE 1 Generalised inhalation rates

Age group	Inhalation rate*	
	$m^3\ y^{-1}$	$m^3\ h^{-1}$
1-year-old infant	$1.9\ 10^3$	0.22
5-year-old child	$3.2\ 10^3$	0.37
10-year-old child	$5.6\ 10^3$	0.64
15-year-child	$7.3\ 10^3$	0.84
Adult	$8.1\ 10^3$	0.84

* These data are based on the ICRP model of the respiratory tract (ICRP, 1994) and are thought to be appropriate for most assessment purposes.

No significant data on water intake rates and inadvertent ingestion rates of soil, sand, household dust and seawater have been published since the previous review. The little additional information available supports the values currently used. Recommended intakes rates for these have therefore remained the same, but are included in the new report for completeness.

Since the previous review of habit data, more information from habit surveys of UK coastal communities, and other high aquatic food intake groups, conducted by MAFF and the Scottish Environment Protection Agency (SEPA) have been published (MAFF and SEPA, 1996, 1997, 1998 and 1999). Since 1999, such surveys have been undertaken by the Food Standards Agency (FSA) and SEPA (FSA and SEPA, 2000). These site-specific ingestion data are the most reasonable basis for deriving generalised aquatic food intake rates for radiological protection purposes in the UK. They are the only surveys which specifically target the coastal, or angling, communities. The generic intake rates recommended in the report see Table 2, are the result of a review of these data and additional data considered in the preceding review. The recommended values have not changed.

TABLE 2 Representative critical group intake rates for aquatic foods

	Adult	Child*, **	Infant**
Marine fish	100	20	5
Freshwater fish	20	5	1
Crustacea	20	5	0***
Mollusca	20	5	0***

* The data for the child age group are appropriate for both the 10-year-old and 15-year-old child.

** The data for children and infants have been obtained by scaling the adult information using information from the national surveys of child and infant diet.

*** There were no infant consumers of shellfish in the national survey of infant diet. Non-zero numbers may be appropriate for some assessments (Smith and Jones, 2003).

Generalised occupancies

There is the potential for reduction in dose, from external exposure and inhalation, from radioactivity in the environment during periods spent inside buildings. As a result, information on the amount of time spend indoors, indoor occupancy, is required for many dose assessment purposes. Default indoor occupancy data are presented in the report. Information on beach, riverbank and lakeside occupancies are also frequently required for assessment purposes. There are two general forms of beach, riverbank or lakeside occupancy data considered; those relating to the general population and those for critical groups. The occupancy habits of the general population can be divided into two further sub-groups: those who occasionally visit the beach or bank due to its vicinity to their home or holiday locations, and those who use the beach as part of a leisure activity such as fishing or diving. Appropriate occupancies for these groups are recommended in the report. Critical group occupancies tend to result from occupational use of beach or bank areas, for example, bait digging. However, a few individuals occupying houseboats on intertidal areas may also represent the critical group in some cases. Recommended generic critical group occupancies have been derived by considering the results of extensive site specific habit surveys (MAFF DFR, 1992-94; Doddington et al, 1990; MAFF and SEPA, 1996, 1997, 1998, 1999; FSA and SEPA, 2000). A summary of the data is presented in Table 3.

TABLE 3 Maximum occupancies (h y^{-1}) for various activity categories and substrate types taken from a selection of surveys

Substrate/Activity	Review maximum	Comment
Mud and sand	1900	Data from Rosyth
Mud	3300	Boat dwelling on Ribble estuary
Saltmarsh	1900	Farmers at Rockcliffe, Cumbria
Sand and rock	1100	Fishermen in Sellafield area
Sand/coal	3000	Coal gatherers near Hartlepool
Bait diggers	950	Bait diggers in the Sellafield area
Angling	1000	Anglers in the Sellafield area

On the basis of this review, recommended generic occupancies were derived and these are presented in Table 4. The available data for occupancies on beaches and in intertidal areas supported the previously recommended values, and so these have not changed from the previous report. The data on

riverbank occupancy, however, supported an increase in the recommended generic riverbank and lakeside occupancy for an adult, from 500 hours per year (h y^{-1}) to 1000 h y^{-1}.

TABLE 4 Representative critical group beach/intertidal area and riverbank/lakeside occupancy data

Age group	Beach/Intertidal area occupancy (h y^{-1})	Riverbank/Lake occupancy (h y^{-1})
Adult	2000*	1000
Child	300	500
Infant	30	30

*For houseboat dwellers this occupancy would also be appropriate for children and infants if present.

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Rachel Smith and Alison Jones

External link

- Office for National Statistics (ONS)
  www.statistics.gov.uk/

THE eBulletin

Radiological Protection Bulletin

Report

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Radon Statusgespräch, Berlin, 2003

A tradition of the radon research programme funded by Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU, the German Environment Ministry) is the annual radon seminar, the Radon Statusgespräch. Twenty or so short presentations are given in a day and a half, and space for talks, and indeed whole topics, is keenly contested. A few foreign speakers are invited to contribute to this busy and informative meeting. The sixteenth meeting in the series was held on October 21 and 22 2003. As usual, the great variety of presentations makes it impossible to summarise the whole event and all that can be given are a few personal highlights.

One of the problems in controlling occupational exposures to radon is that measurements need to run for weeks or months in order to average out temporal fluctuations. Employees are at risk only for the working day, while most simple, cheap detectors measure 24 hours a day and thus average over periods when nobody is being exposed. An ingenious Austrian device has overcome this problem by using an electrical timing device to open and close an electret.

Radon practitioners sometimes worry that the public are indifferent to this natural radioactive gas. They will have taken some comfort from a survey which reported that 60% of the population regarded radon as a moderate or high risk, very similar to the response given for stored nuclear waste. We can skate over the fact that radiation doses from radon are vastly greater than those from stored waste, but it was disconcerting to learn that only 20% of respondents regarded natural background radiation as a risk. Radon is certainly part of the natural background, so the rest of it is presumably beneficial.

Another presentation pointed out the pitfalls of presenting the most accurate scientific predictions to a lay audience. It is thought that radon and smoking interact as causes of lung cancer. The interaction is more than additive, if not quite multiplicative, but it means that, say, a 10% increase in the large number of 'natural' lung cancers in smokers implies many more deaths than a 30% increase in the small number of deaths in non-smokers. But a lay audience which hears that there is a 10% increase in smokers and a 30% increase in non-smokers is very likely to conclude that the latter are worse off.

Radon has been recognised as a problem in some water treatment plants, where groundwater, rich in radon, can lead to high air concentrations in areas where people work. A new milestone was reached when two presenters reported that measurements of over 1M bequerels per cubic metre (Bq m^{-3}) had been found and ascribed to this cause.

One of the high spots of the meeting for many participants was the session on epidemiology. One presentation gave the first results of the study of miners from the 'Wismut' uranium mines. A cohort of about 50,000 individuals had been followed up to the end of 1998, at which time about 28% had died. There was a healthy worker effect overall, with the all-causes standardised mortality ratio (SMR) at 93. This was significantly lower than rates in the old East Germany as a whole (confidence interval (CI) 91-94). However rates for all cancers were elevated (SMR 115, CI 112-118) and that for lung cancer very markedly increased (SMR 183, CI 176-191). As an aside, there was no hint of increased mortality from leukaemia (SMR 75, CI 61-92). There appeared to be evidence of a trend in lung cancer rates with increasing radon exposure category, but the investigators are still working to refine the analysis.

Germany has also been home to two large case-control studies of lung cancer and domestic exposure to radon. In the

published analyses, the study in the old East Germany has clearly shown an effect. That in the West, where radon exposures were lower, has been less clear, with an association being significant only when attention has been concentrated on the higher radon areas.

A new analysis had combined both datasets and replaced a number of missing exposure estimates. This yielded results very much in line with other large case/control studies. The excess relative risk was estimated at about 10% at 100 Bq m^{-3}, though this result did not quite reach statistical significance. A full account of this interesting analysis is awaited, but the data will also be included in the pooling of European case-control studies. This will be based on about 7000 cases of lung cancer and about twice as many controls and should provide the most powerful evidence yet on the effects of domestic exposure to radon.

As in previous years, participants were grateful to the organisers for compiling such an interesting, if hectic, programme.

Gerald Kendall