COVER SHEET
FOR TRIP REPORTS SUBMITTED TO THE OFFICE OF ENERGY RESEARCH

Destination(s) and Dates for Which Trip Report Being Submitted: EDINBURGH, SCOTLAND 7/17-25/87

Name of Traveler: C. R. RICHMOND

Joint Trip Report ☐ Yes
☒ No

If so, Name of Other Traveler(s): ______________________

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ORNL
FOREIGN TRIP REPORT

ORNL/FTR-2641

DATE: August 20, 1987

SUBJECT: Report of Foreign Travel of C. R. Richmond, Associate Laboratory Director for Biomedical and Environmental Sciences

TO: Herman Postma

FROM: C. R. Richmond

PURPOSE: To participate in the 8th International Conference of Radiation Research, Edinburgh, Scotland, July 19-24, 1987.

SITES VISITED: 7/19-24/1987 8th International Conference of Radiation Research, Edinburgh, Scotland

ABSTRACT: The traveler participated in the 8th International Conference of Radiation Research which was held at the University of Edinburgh, Edinburgh, Scotland, July 19-24, 1987. A paper entitled "Plutonium Contamination Twenty Years After The Nuclear Weapons Accident in Spain," coauthored with E. Iranzo was presented. The congress was attended by about 1500 people from 37 countries including Iran and Iraq. Both Japan and The Peoples Republic of China sent large delegations.

About 95 percent of the attendees actively participated by presenting papers or participating in poster sessions. The subject areas included Radiation chemistry and photodymanic therapy; Physics, models, environment, and dosimetry; In vitro radiobiology including DNA breaks; Transformation, mutation, cytogenetics, risks; Animal and clinical radiobiology; and Hyperthermia.

Many of the U.S. contributions were from universities rather than national laboratories. Despite this situation, the U.S. may be losing its traditional lead in radiation biology.

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EIGHTH INTERNATIONAL CONGRESS OF RADIATION RESEARCH
Edinburgh, Scotland
July 19-24, 1987

The first International Congress of Radiation Research (ICRR) meeting was held in Burlington, Vermont, in 1958 almost 30 years ago. I was just beginning my research career at the time and was thrilled to be able to attend the first meeting of the ICRR. I can recall meeting with and listening to some of the well-known senior people in the field of radiation biology at that congress. Three decades have not dulled that impression. Meeting the well-known senior people in the field of radiation biology at the Edinburg meeting was probably a similar thrill for the younger investigators present. I had the opportunity to meet and to listen to their presentations. Unfortunately, many of the presentations were limited to two-minute poster sessions.

However, many things have changed in the intervening years since Burlington. It is not the United States, but other nations that appear to be pushing rapidly to the forefront of the field of radiation research. Dr. J. W. Boag, the first major lecturer, presented a lecture entitled "A Glance at the Last 25 Years of Radiation Research." He purposely did not mention individuals by name for fear of committing sins of omission as he had but 30 minutes to cover 30 years of radiation research activities. I was distracted from his talk as I noted both the preponderance of senior investigators and the relative lack of young investigators from the United States. The major representation of other countries, especially Japan, was very obvious. There was also a major contingent of attendees from the People's Republic of China. I suddenly realized that the United States may be about to lose its preeminent position in the field of radiation research. If this presumption is correct, it is indeed a sad situation.

As I listened to Jack Boag, I noted some of the inscriptions under the artworks flanking the center lectern. The words intelligence, imagination, perseverance, and experience appear under some great figures. I thought that we (U.S.) have all these important qualities except one, and that is perseverance. Perhaps we need to rethink our past and future commitments to radiation research. Much remains to be done in this important endeavor that contributes not only to the field of radiation research but also to our knowledge of normal and abnormal cells and tissues. After all, radiation is but one tool used to study biological processes.

Research and development in nuclear fuel reprocessing has been drastically reduced in the U.S. but it is proceeding in Japan, France, and other countries. Some of these countries are providing support to U.S. laboratories for assistance. Perhaps we are heading in the same direction as regards radiation research. What a sad commentary on our future prospects.

The meeting organizers mentioned that almost fifteen hundred people were in attendance. There were twenty-five scheduled thirty-minute lectures spread over the five days of the meeting which were designed to inform nonspecialists as well as specialists. Four to six of these took place simultaneously at the start of each morning and afternoon session. Each was followed by nine parallel sessions of symposia and general sessions, with the general sessions being divided into six subject areas.

- Radiation chemistry and photodynamic therapy
- Physics, models, environment, and dosimetry
- In vitro radiobiology including DNA breaks
- Transformation, mutation, cytogenetics, risks
- Animal and clinical radiobiology
- Hyperthermia

There were approximately 400 oral and 600 poster presentations with the vast majority of all the attendees actively participating in the meeting.

Our paper, coauthored with Dr. Iranzo of the Centro de Investigaciones Energeticas Medioambientales y Technologicas (CIEMAT), (formerly the Junta de Energia Nuclear) in Madrid, was in the session on Physics, Models, Environment and Dosimetry. Most of the papers in this session were on the Chernobyl accident. The paper, "Plutonium Contamination Twenty Years After the Nuclear Weapons Accident in Spain," represented the first presentation at a major international conference of data related to the accident. A more general presentation, made at the annual meeting of the Health Physics Society in the United States several years ago, was published in the journal of the Health Physics Society earlier this year.

Dr. Iranzo and I spent as much time as possible discussing the Palomares accident. Although this arrangement kept us from attending some of the sessions, it was planned in advance and saved the traveler a trip to Spain. Most of our discussions centered on the funding situation and related problems. After considerable delay, the funding for the year beginning in February 1986 was finally received in two installments.

We need to find a source of ^{242}Pu for the bioassay work at CEIMAT in Madrid. The material we had planned to make available to Dr. Iranzo was contaminated during production and cannot be used for low-level alpha spectrometry. We are now investigating the possibility of obtaining some ^{242}Pu from the National Bureau of Standards. However, they may be dependent upon the same production run we were hoping to use as a supply.

Most of our discussions were on a review of the overall progress of their activities both at the CIEMAT and at Palomeres. We now have enough information to make a first rough approximation of the residual inventory of ^{239}Pu at Palomares. This data will be discussed with the appropriate DOE personnel in Washington.

Dr. Iranzo wants to send a member of his staff to ORNL for several months to work on a model for ^{241}Am excretion. We have no objections and will begin to make arrangements with DOE and CIEMAT.

One paper, by Malcolm Cooper of Australia, was a report on the plutonium contamination at former nuclear weapons test sites in Australia. Cooper, currently on assignment in Canada, is from the Australian Radiation Laboratory at Yallambie in Victoria. We do not understand the differences observed between the particle size distributions found by Cooper and those reported for Palomares, Spain. Cooper reported an association between fine particles (less than 10 μm diameter) and clay fractions of the soil. Some Pu and U is found in high specific-activity microspheres ranging in size from tens to hundreds of μm in diameter. We agreed to send data on Palomares to Cooper who, in turn, will share data from Australia with us.

V. Wolf et al. from Karlsruhe, FRG, reported on the use of Prussian Blue (PB) to reduce the body burden of cesium in people. This material, ferric ferrocyanide, which can be obtained in pure form as Radiogardase in the FRG, blocks the enteral absorption of Cs in the gastrointestinal tract. Years ago I showed (using myself as a subject) the efficacy of PB in accelerating the turnover of Cs from the body. Some countries have PB available as a means of reducing body burdens of Cs that might arise from reactor accidents. I enjoyed talking to Wolf after the session.

W. Burkart, Wurenlingen, Switzerland, reported on "hot particles" resulting from the Chernobyl accident. Some particles collected on air filters contained up to 10 kBq ^{103}Ru each. Some individual particles contained activities up to 0.3 Bq for ^{242}Cm. Local lung doses calculated for such hot particles can be as high as tens of MSv. This represents the classic "hot particles" problem that was widely studied years ago both in the U.S. and Europe, partly as the result of the Gofman-Tamplin controversy. Burkart believes that particulate activity is less effective biologically than are smaller particles or monomeric activities. Both theory and experiments tend to support this conclusion. Limited data from workers (the Manhattan Project workers from Los Alamos) still support this argument. This report is in stark contrast to others in which estimates of dose commitment were made for ^{137}Cs. Researchers from the National Institute of Radiological Sciences in Chiba, Japan, report dose commitments on the order of 10 μSv from ^{137}Cs.

A. A. Cinga, ENEA, Italy, gave a symposium lecture entitled "Radiation in the Global Environment". He called for the use of more realistic models for use in environmental studies to reduce conservatism. I agree. Our (ORNL) studies on model validation as applied to the

Chernobyl accident strongly support this argument. He also recommends the use of radionuclides to study natural ecosystems. We are actively exploring this possibility at ORNL. One of Cinga's slides contained the following quotation. "Every falling raindrop and snowflake carries some radioactive material to the earth, while every leaf and blade of grass is covered with an invisible film of radioactive material." This was from Lord Rutherford in February 1905.

Dr. R. J. Berry (U.K.), chairman of the Late Effects Session, made an interesting summary statement. He reminded the audience to think about days of life lost as an end point for late effects because that is what is important for man and man is the reason we study the late effects of radiation. Perhaps more people should heed this advice. Berry's statement is useful to the practitioners of risk analysis as well. After all, we can rather simply measure, at least in the actuarial sense, life span and deduct days lost from a given radiation event. Perhaps we have been too preoccupied with the number of tumors produced from a given exposure, in a given species that often differs from man in many ways.

One of the most interesting and provocative talks was Robin Mole's (U.K.) entitled "Some Aspects of Extrapolation of Late Effects Studies to Man." Sir Robin argues that there is no such thing as a "low dose" -- at least from the cells standpoint. He points out, correctly, the large local energy deposition associated with a given radiation interaction within a cell. Event frequencies per cell may be about 4.5 for 1 MeV gamma-rays and 0.02 for 1 MeV neutrons. As dose is increased, more interactions (of the same kind) take place.

Mole also argues that perhaps we should get rid of the dose rate concept. Energy absorption takes place in tissue on time scales below a picosecond. He argues that what we all call dose-rate effects are really the results of repair phenomena. H. Paretzke (FRG), in the discussion period, argued that cells should not see a dose rate effect below about 1 rad, because below some dose rate a given cell is either irradiated or not irradiated.

E. Barendsen (Netherlands) pointed out that reverse dose rate effects, at low doses, for high LET radiations, are not consistent among researchers reporting data from various laboratories. For fission neutrons the effect is sometimes a factor of 1.5, and at other times as high as eight. Barendsen happens to use his own cell line and exposes the cells during the plateau phase. This area of cell biology is still far from being understood. Barendsen uses flow cytometry in his chromosome studies. He was a frequent visitor to Los Alamos where the flow systems were originally developed.

H. J. Dunster (U.K.) gave an excellent introductory review on "Radiation and the Environment." He used an interesting comparative scale to relate the effects of radiation from measurable physical effects to tissue destruction and death on a log scale ranging from 10^{-1} to 10^{4} mSv.

Dunster also listed the annual dose equivalents from artificial sources to people in England. The "average individual" doses were as shown in the table below.

Coal	4 μSv
Medical	250 μSv
Air	6 μSv
Fallout	10 μSv
Occupational	9 μSv
Nuclear waste	2 μSv
Rounded total	280 μSv

He mentioned that some people, such as those eating fish at Sellafield, may receive doses up to 10^3 μSv per year.

Dunster gave some estimates of the biological effects resulting from the Chernobyl nuclear power station accident. The highly exposed people, of the total of about 135,000 evacuees, probably received doses of about 10^3 μSv. The risk of cancer for the highest exposed individuals is about 1 in 100.

Dr. E. A. Martell, National Center for Atmospheric Research (NCAR), Boulder, gave me a copy of his paper entitled "Spontaneous Mutations Attributable to Inhaled and Ingested Radioisotopes." Martell concludes that primordial and cosmogenic radionuclides, on biological surfaces and internally, may be adequate to account for most spontaneous mutations in living organisms, consistent with the somatic mutation theory of aging.

An interesting abstract, "Accumulation and Recovery of Uranium from Liquid Waste by B. Subtilis and Mucor Cells," was contributed by M. A. S. Al-Shaickly et al. from Bagdad, Iraq. I could not attend that particular presentation. A copy of the abstract is included with this report.

SUMMARY

The congress was a valuable experience for me and for others. However, future ICRR congresses could be improved by decreasing the number of concurrent sessions. Also, when competing sessions are in different buildings, it is often hard to move selectively among them even when the schedules are rigorously followed.

LITERATURE ACQUIRED

Martell, E. A.
Spontaneous Mutations Attributable to Inhaled and Ingested Radioisotopes

Radiation Research
Proceedings of the Eighth International Congress of Radiation Research, Edinburgh, July 1987. Edited by E. M. Fielden et al.

ITINERARY

7/17-18/87	Travel from Oak Ridge, Tennessee, to Edinburgh, Scotland
7/19-24/87	Eighth International Conference on Radiation Research
7/25/87	Travel from Edinburgh, Scotland, to Oak Ridge, Tennessee

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B31-17P ACCUMULATION AND RECOVERY OF URANIUM FROM NUCLEAR LIQUID WASTE BY B. SUBTILIS & MUCOR CELLS

M.A.S. AL-SHAICKLY, A.H. MAHMOOD and A.J. AL-MAATHEDI
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Two microbial isolates, namely *Bacillus subtilis* 15-B & *Mucor* sp. 16F, obtained from nuclear liquid waste were tested for their special ability to accumulate uranium (1). *B. subtilis* 15.D & *Mucor* sp. 16F were able to accumulate 200 ± 2 & 100 ± 4 mg uranium/g dry weight of cells, respectively, when incubated at 37°C in aqueous solutions (pH 4) for 6 hours. These values amounted to 98% & 95% of total uranium present at concentration less than 100 ppm as measured by the flourometric technique. Accumulation, however, reduced to 80.61% and 60.84% of the total uranium in the nuclear liquid waste tank for *B. subtilis* 15.D and *Mucor* cells respectively. In either case, the accumulated uranium was easily and almost completely recovered by washing cells with EDTA or sodium carbonate solution. Effects of temperature, pH, duration of contact, concentration of cells & uranium and pretreatment with varying chemical and physical agents will be discussed.

(1) The study abstracted from M.Sc. thesis carried out in this University by Mr. A.H. MAHMOOD.

DISTRIBUTION

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