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BNWL-1307
Part 2
UC-48

MASTER

PACIFIC NORTHWEST LABORATORY
ANNUAL REPORT FOR 1969
TO THE USAEC
DIVISION OF BIOLOGY AND MEDICINE
VOLUME II: PHYSICAL SCIENCES
PART 2. RADIOLOGICAL SCIENCES
February 1970

AEC RESEARCH & DEVELOPMENT REPORT

BNWL-1307
Part 2

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RICHLAND, WASHINGTON

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UNITED STATES ATOMIC ENERGY COMMISSION UNDER CONTRACT AT(45-1)-1830

RADIOLOGICAL PHYSICSINTERNAL DEPOSITIONS OF RADIONUCLIDES IN MAN

These studies are concerned with the continued development and improvement of diagnostic techniques for the assessment of internal depositions of radiotoxic materials in man. The studies are restricted primarily to investigation of radionuclides of interest to the nuclear industry which are difficult or impossible to reliably assess in vivo through the use of external radiation detectors such as whole body counters. Because of this restriction, analysis of body excretion is the usual method of diagnosis, quantification of which is accomplished through excretion studies on human test subjects. Since the radionuclides of interest are usually highly radiotoxic, substitute isotopes which have good measurement sensitivity but which are much less radiotoxic are developed for use in human testing studies. Animal studies performed to give basis for human studies also permit correlation of metabolic parameters between man and animals which in turn can give basis to other animal studies.

Plutonium

I. C. Nelson and D. McConnon

Our current interest in plutonium is the development of a diagnostic method to be used in the presence of chelating agents used for therapeutic removal of plutonium. In addition, human testing performed for the above would add basis to the early work of Langham, et al. The process of preparing test quantities of ^{237}Pu , the substitute isotope for several highly toxic plutonium isotopes, involves cyclotron irradiation and, as it turns out, has involved long turn-around times. Two full irradiation sequences were completed this year. The first was an irradiation

of 99+% enriched $^{235}\text{U}_3\text{O}_8$ which resulted in a yield one tenth that of the previously used 93% enriched uranium-235 metal foil experiments but the product was still contaminated with an excessive amount of the long-lived alpha-emitting radionuclides ^{236}Pu and ^{238}Pu . This poorer yield was attributed to non uniformity of irradiation and it was decided to discontinue use of U_3O_8 targets in favor of the more easily prepared metal foil targets. The second experiment consisted of three separate foils irradiated for shorter times at three different energies. This test will provide information relative to the trade

off of ^{237}Pu yield in favor of reduced amounts of contaminating ^{236}Pu and ^{238}Pu . Separation within 24 hr after irradiation was also performed to reduce the ingrowth of these plutonium contaminants from neptunium decay. Analysis of these samples is still in progress.

A plutonium tissue monitor was designed and prototype built which was tested in the morgue of the local hospital. Fabrication of the permanent device is in progress. This device is for use by the pathologist in screening autopsy cases for gross findings of plutonium in liver tissue. Indication of plutonium would alert the pathologist to a need for a more comprehensive tissue sampling program. This work is in support of the National Plutonium Registry.

Promethium 147

D. McConnon and I. C. Nelson

Current efforts are oriented toward a diagnostic method for inhaled promethium 147 oxide. The earlier inhalation experiment utilizing human volunteers and promethium 143 chloride was abandoned on the advice of the BNW Human Testing Committee in favor of inhalation studies performed with the oxide. This advice was based on the fact that the pressing need is for information on the oxide and, although a chloride experiment would be simpler to perform, the justification for human testing was not so clear in the case of the chloride

since it has a much smaller hazard potential. At an acceptable dose level the mass of promethium 143 oxide is inadequate to permit production of the test aerosol. Samarium was the first choice as a carrier for promethium. It is not known if samarium behaves the same as promethium in a biological system. Experiments have been designed to determine this. Initially samarium chloride and promethium chloride will be administered intravenously to a group of rats with subsequent tissue analysis to determine if gross differences exist in the metabolism of samarium and promethium. If no gross differences exist, groups of rats will be exposed to Sm_2O_3 , $^{147}\text{Pm}_2\text{O}_3$, and $(^{143}\text{Pm}, \text{Sm})_2\text{O}_3$ via inhalation to assess the appropriateness of the carrier in the rat. Again, if the results are favorable, similar tests will be conducted on beagle dogs, an animal large enough for whole body examination, to confirm the basis for human testing.

An aerosol generator was designed, fabricated and tested. Some special apparatus was necessary since the equipment is intended for use in human inhalation testing. Particle size studies were also performed to determine particle size distributions as a function of aerosol concentrations and other operating parameters. For the above mentioned samarium carrier and promethium aerosol, experiments will be performed to ensure that the promethium is distributed uniformly throughout the samarium

PUBLICATIONS

I. C. Nelson. "Urinary Excretion of Plutonium Deposited in the Lung," Health Physics, vol. 17, 514, 1969.

PRESENTATIONS

D. McConnon. "The Use of Electron Capture Decay Isotopes for Human Metabolism Studies," 14th Annual Health Physics Society Meeting, Pittsburgh, Pennsylvania. June 1969.