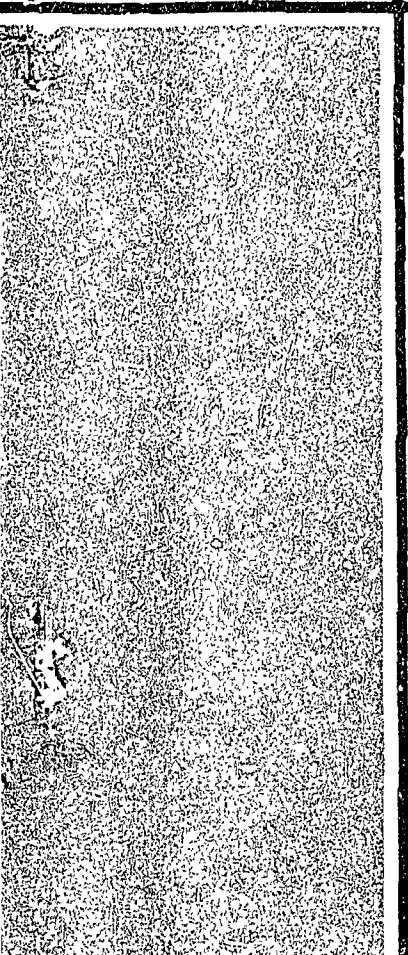
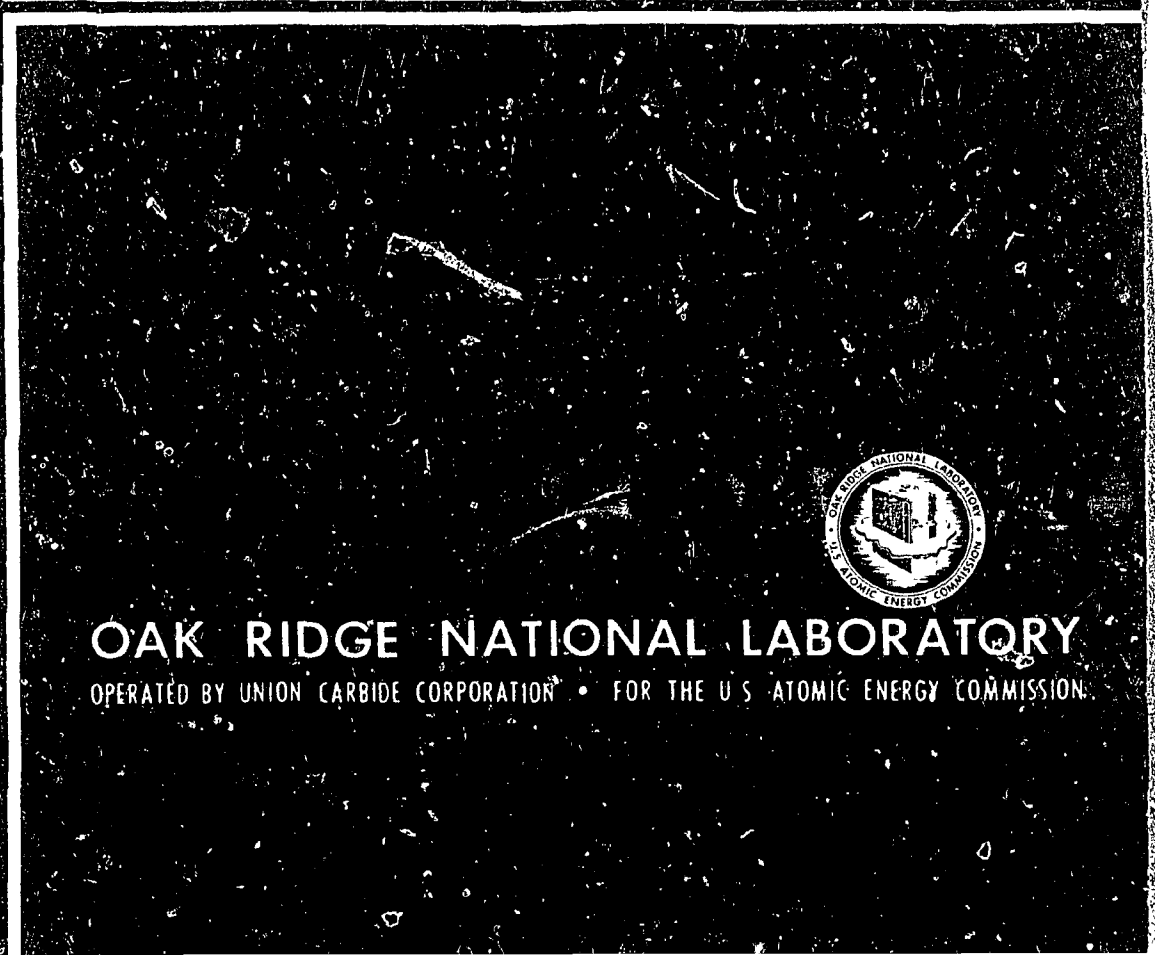
ORNL-EIS-74-21
(Suppl. 3)

ENVIRONMENTAL ASPECTS of the TRANSURANICS

A Selected, Annotated Bibliography





OAK RIDGE NATIONAL LABORATORY
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ORNL-EIS-74-21 (Suppl. 3)

ENVIRONMENTAL ASPECTS OF THE TRANSURANICS
A SELECTED, ANNOTATED BIBLIOGRAPHY

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Work Supported by Nevada Applied Ecology Group
Nevada Operations Office
of the
U. S. ATOMIC ENERGY COMMISSION

at

OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
operated by
UNION CARBIDE CORPORATION
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U. S. ATOMIC ENERGY COMMISSION

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ABSTRACT

This fourth published bibliography of 528 references is from the computer information file built to provide support to the Nevada Applied Ecology Group (NAEG) of the AEC Nevada Operations Office. The general scope is environmental aspects of uranium and the transuranic elements, with a preponderance of material on plutonium. In addition, there are supporting materials involving basic ecology or general reviews on other nuclides that are entered at the request of the NAEG. References provide findings-oriented abstracts. Numerical data is referred to in the comment field. Indexes are given for author, subject category, keywords, geographic location, permuted title, taxons, and publication description.

PREFACE

Five hundred and twenty-eight references are presented in this, the fourth bibliography, published from the information activity supported and guided by the Nevada Applied Ecology Group of the AEC's Nevada Operations Office.

The first three published bibliographies[1,2,3] have presented 2,107 references previously. The scope is centered on the environmental aspects of plutonium, with later extensions into uranium and all transuranic elements. All published material is contained in a dynamic computerized information file that is used to answer specific requests related to its scope. Users may contact the Ecological Sciences Information Center for assistance at any time. Guests making arrangements to visit the Oak Ridge National Laboratory are invited to use the collection of documents retained by the center.

Citation Form

The bibliographic data were arranged according to the Environmental Information System standard format for computer entry of information.[4]

As a result of computer limitations in indicating superscripts and subscripts in the standard manner, certain conventions have been established in the bibliography:

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[1] Environmental Aspects of Plutonium, A Selected Annotated Bibliography, ORNL-EIS-72-21 (December 1972), 387 p.

[2] Environmental Aspects of Plutonium and Other Elements, A Selected, Annotated Bibliography, ORNL-EIS-73-21 (Suppl. 1) (August 1973), 482 p.

[3] Environmental Aspects of Plutonium and Other Elements, A Selected, Annotated Bibliography, ORNL-EIS-74-21 (Suppl. 2) (February 1974), 272 p.

[4] Oen, C. J., N. F. Sollins, and D. K. Trubey, Guide to the Generalized Bibliographic Format for the Environmental Information System, ORNL-EIS-71-3 (February 1972), 36 p.

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1) X sub t (X being a variable) means X_t or X subscript t.

2) In chemical compounds and elements, NaIO3 (for example) means $NaIO_3$.

3) 10(E+3) or X(E-3) (E denoting exponent) means 10^3 or X^{-3}, respectively.

4) For units of measurement, such as centimeters, meters, feet, etc., X3 means X^3.

Indexes

Indexes are provided for: 1) author, 2) subject category, 3) keyword, 4) geographic location, 5) permuted title, 6) taxon, and 7) publication description.

CREDITS

Lorie Weinberg assisted in preparing the material for this publication, and Beth McMullin was responsible for literature scanning and selection.

ACKNOWLEDGEMENTS

P. B. Dunaway, Director of the Nevada Applied Ecology Information Center, Nevada Operations Office, has closely guided the group in the selection of material for this project.

Dr. G. R. Eisele of the Comparative Animal Research Laboratory has contributed documents on the biomedical aspects of plutonium, and Dorothy Hamel of the Nevada Applied Ecology Group Technical Library and her staff have been helpful in alerting us to relevant materials.

Ruth Slusher of the Computer Sciences Division, ORNL, and Faye Fletcher of the Information Center Complex have managed the computer production of this document.

The computer programs supporting the composition and indexing for publications constitute a part of the Oak Ridge Computerized Hierarchical Information System (ORCHIS).[5]

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[5]Brooks, A. A., ORCHIS Progress Report, TM-3688 (February 1972), 22 p.

SAMPLE REFERENCE

This is an example of the format of the descriptive fields used in this bibliography:

1 - *Record Number (Sequential Number of Reference)*
2 - *Author*
3 - *Corporate Author*
4 - *Publication Date*
5 - *Document Title*
6 - *Publication Description*
7 - *Language of Document*
8 - *Restriction*
9 - *Abstract*
10 - *Abstractor's Initials*
11 - *Comments (Pertinent Numerical Data)*

2<266>
Langham, W., and E.R. Russell,[3] University of Chicago, Chicago, IL.[4] 1945, July 23

[5] Excretion Studies.[6] CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 27-45), 62 p.[7] (Russian, English Summary)(Declassified December 22, 1952)[8]

[9] Attempts to establish a method of sampling and analyzing urine for small amounts of plutonium and establish a relationship between the amount of plutonium in urine and the total body burden are summarized. A method for collecting and analyzing samples is given. Results of personnel monitoring and human excretion following injection of 4.7 ug of plutonium citrate (+4) are given in tabular form. Results of rat studies showed that the percent of the total injected dose excreted in urine was independent of the size of the dose administered. The excretion of plutonium by humans, dogs, rats, rabbits, and mice is shown in tabular form. The minimum amount of plutonium excreted daily was 0.01% of the retained amount. No comparisons between concentration in the blood and urinary excretion could be made. (ST)[10]

[11] Tables 18-25 contain plutonium excretion data for man and several animals.

<1>
Dunaway, P.B. (Ed.), and M.G. White (Ed.), Nevada Operations Office, Las Vegas, NV. 1974, July

The Dynamics of Plutonium in Desert Environments, Nevada Applied Ecology Group Progress Report as of January 1974. CONF-731048; NVO-142; Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, 369 p.

A status report of the Nevada Applied Ecology Group research activities is given. The twenty-six articles included have been abstracted separately for the data base. Investigations on the soils of Pu contaminated areas at the Nevada Test Site were reported with statistical analyses included. Other papers dealt with the Pu content of vegetation of contaminated areas; Pu metabolism in dairy cattle; grazing studies on Pu-contaminated areas, giving the radionuclide levels in Area 18 cattle; ecological studies of vertebrates; digestion of ingested Pu in chickens and subsequent transfer to eggs; the role of soil microorganisms in the movement of Pu; resuspension studies, including the use of NTS data to predict air concentrations of Pu due to resuspension on the Eniwetok Atoll; distribution and inventory element activities on NTS and off-NTS; the Pu transport and dose estimation model; a description of the information support for the NAEG by the Oak Ridge Data Base and the Library Services at AEC Nevada Operations Office. (PMM)

<2>
Fowler, E.B., and E.H. Essington, Los Alamos Scientific Laboratory, Los Alamos, NM. 1974, July

Soils Element Activities, October, 1972-September, 1973. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 7-16), 369 p.

The report presents a general review of the Soils Element Activities for the year October, 1972-September, 1973. Areas declassified, areas sampled, and analytical results for plutonium 239, 240, and americium 241 are briefly discussed. Changes found in the ratio of plutonium 239, 240, and americium 241, as well as the implications of the changing ratio, are presented. It is suggested that the observed increasing ratio with depth of soil profile may be related to "differential solubility" of the two radionuclides, and that with passing time, americium 241 may become the radionuclide of prime concern. A modified analytical method for plutonium in soils, the LASL-HASL leach method, is discussed. (Auth)

<3>
Kayha, H.J., I. Aoki, and D.L. Wireman, Reynolds Electrical and Engineering Company, Inc., Las Vegas, NV. 1974, July

REECo Field Activities and Sample Logistics in Support of the Nevada Applied Ecology Group. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 17-19), 369 p.

The field activities and sample logistics of Reynolds Electrical and Engineering Co., Inc. (REECo), in support of the Nevada Applied Ecology Group (NAEG) plutonium studies in the Test Range complex, are discussed in the report. Field instrument measurements, determination of sampling sites, and procedures used in preparation of samples are included. The field activity status of the present NAEG intensive study areas is as follows: fences enclosing the contaminated areas have been erected; single transect soil samples have been collected from all study areas and prepared for analysis; grid systems have been completed in all study areas; FIDLER surveys are complete in Areas 5 and 13, and are 75 percent complete at Tonopah Test Range and Area 11; soil and vegetation sampling are complete from Areas 5 and 13. (Auth)

<4>
Leavitt, V.D., National Environmental Research Center, Las Vegas, NV. 1974, July; 1974, March

Soil Surveys of Five Plutonium-Contaminated Areas on the Test Range Complex in Nevada. CONF-731048; NVO-142; NERC-LV-539-28; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 21-27), 369 p.

The report discusses soils in five areas located on the Test Range Complex, Nye County, Nevada. The survey was undertaken as part of the Nevada Applied Ecology Group (NAEG) plutonium studies. Most of the surface soils in the areas have a gravelly texture and are typically classified as gravelly sandy loam. The majority of the surveyed land is either floodplain or alluvial fan with deep soils having well-developed profiles and platy structure. All of the soils are alkaline, ranging in pH from 7.0 to 9.0. Two general categories of vegetation are found in the study areas, low and high desert shrub. The low desert shrubs are predominantly creosote bush (LARREA DIVARICATA) and white bursage (FRANSERIA DUMOSA). The high desert shrubs are mostly fourwing saltbush (ATRIPLEX CANESCENS), winterfat (EUROTIA LANATA), and bud sagebrush (ARTEMISIA SPINESCENS). (Auth)

See also complete report, NERC-LV-539-28.

<5>

<5>
Tamura, T., Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN. 1974, July

Distribution and Characterization of Plutonium in Soils from Nevada Test Site. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 29-42), 369 p.

The distribution and characterization of plutonium in soil fractions of the Nevada Applied Ecology Group (NAEG) intensive site study area samples were studied. The report discusses analytical results obtained on three selected surface soil samples from two areas at Nevada Test Site. Analytical methods are described for determination of total plutonium content, plutonium distribution in different particle size fractions, and short-time digestion leachability by HNO3. Leaching with HNO3 revealed that 65 to 91% of the plutonium could be leached. The leaching results suggest the possibility of using the acid extraction as a means of predicting the "availability" of plutonium in soils. Preliminary data suggest that plutonium in the coarser size fractions is PuO2, whereas plutonium associated with the finer size particles possibly is a hydrous PuO2. (Auth)

<6>
Eberhardt, L.L., and R.O. Gilbert, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1974, July

General Statistical Considerations in Environmental Plutonium Studies. CONF-731048; NVO-142; BNWL-SA-4810; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 43-49), 369p.

The high sampling variability encountered in environmental plutonium studies along with high analytical costs makes it very important that efficient sampling plans be used. However, efficient sampling depends on explicit and simple statements of the objectives of the study. When there are multiple objectives, as in the Nevada Applied Ecology Group (NAEG) study, it may be difficult to devise a wholly suitable sampling scheme. Sampling for long-term changes in plutonium concentration may also be complex and expensive. Some possibilities to be considered are: later transport by water, penetration into the soil, gradual dispersion along soil surfaces as the result of wind movement, and local accumulation areas (as in soil mounds under bushes at Nevada Test Site). Further attention to problems associated with compositing samples is recommended, as is the consistent use of random sampling as a basic technique. (Auth) (FMM)

Portions of this report were published as BNWL-SA-4810.

<7>
Gilbert, R.O., and L.L. Eberhardt, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1974, July

Statistical Analysis of Plutonium in Soil at the Nevada Test Site--Some Results. CONF-731048; NVO-142; BNWL-SA-4815; Part of Dunaway, P.B. and White, M.G. (Eds.), The dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 51-89), 369 p.

The statistical field sampling design being used to estimate surface soil inventory in Areas 13 and 5 of the Nevada Test Site (NTS) is described and discussed. It is estimated that the total amount of Pu 239-240 in the upper 5 cm of soil inside the outer fence region of Area 13 is 39 Ci with a standard error of 5 Ci. This estimate is obtained from soil samples collected at randomly chosen locations according to a stratified random sampling plan. Correlation and regression analyses are computed, which indicates that lab gamma scans on soil samples for Am 241 can, in general, predict quite well the concentrations of Pu 239-240 present in the soil in Area 13. This suggests the determination of Pu 239-240 may not be required on all soil samples in this area. Average Pu/Am ratios are obtained for Areas 13, 5, and the Tonopah Test Range (TTR). The average ratio for TTR appears to be considerably greater than those for Area 13 or 5. There is also some evidence to suggest that the Pu/Am ratio may not be constant over all levels of Am 241 for the lower count per minute (cpm) regions of Areas 13 and 5. Correlation analyses indicate the FIDLER field instrument as used in the current sampling program (cpm readings taken 1 ft off the ground over the soil sampling location) is not accurate in predicting Pu 239-240 concentrations in surface soils. However, three-dimensional maps of FIDLER readings taken at grid points in Area 13 and Pu 239-240 determinations in soils taken at random soil sampling locations indicate the usefulness of the FIDLER for mapping the general surface distribution of Pu 239-240. Data are presented which suggest the Pu/Am ratio may decrease with depth of profile. Also, the available data are examined to estimate the within-lab variability on replicate samples. The results suggest that four or five replicates may be necessary to detect even rather large differences between the three participating labs. There are no apparent consistent differences between the three participating laboratories in reported Pu 239-240 determinations for aliquots from the same soil samples from Areas 13, 5 and TTR sent to each lab. (Auth)

Portions of this report were published as Report BNWL-SA-4815 (Rev.).

<8>
Romney, E.M., A. Wallace, R.O. Gilbert, S.A. Bamberg, J.D. Childress, J.E. Kinnear, and T.L. Ackerman, University of California, Los Angeles, CA; Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1974, July; 1973, December

Some Ecological Attributes and Plutonium Contents of Perennial Vegetation in Area (Nevada Applied Ecology Group Vegetation Studies). CONF-731048; NVO-142; UCLA-12-937; Part of Dunaway, P.B. and White, M.G. (Eds.), The dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 91-106), 369 p.

The report includes data on the ecological attributes of vegetation in Area 13, Nevada Test Site (NTS), as well as data on the Pu 239-240 and Am 241 in samples of vegetation collected in conjunction with the soil sampling program in Area 13. Prominent shrub and grass species in the fallout pattern of Area 13 include ARTEMISIA SPINESCENS, ATRIPLEX CANESCENS, ATRIPLEX CONFERTIFOLIA, EUROTIA LANATA, GRAYIA SPINOSA, KOCHIA AMERICANA, LYCIUM ANDERSONII, and CRYZOPSIS HYMENOIDES. Individual or codominant species distinguished local association patterns of varied size within the fenced study area. Vegetation cover estimates in sample study plots ranged from 12.8 to 28.3%. Shrub densities ranged from 11.2 x 10(E+3) to 17.9 x 10(E+3) plants per hectare, and the standing shrub biomass ranged from 1,592 to 4,285 kg per hectare (0.7 to 1.9 tons per acre). Preliminary results showed rather uniform distributions of Pu 239-240 and Am 241 among individual samples of the same plant species collected within an intensive study plot. However, there was considerable variation in the contamination levels between different species, presumably from superficial entrapment of resuspended particulate material. Concentrations in EUROTIA LANATA were three to five times higher than in other species sampled from the same study site. The Pu 239-240 and Am 241 generally tended to decrease in samples of vegetation collected at increasing distances from Ground Zero, but there were poor correlations betweenetation and soil Pu 239-240 concentrations in isopleth strata within the fenced grazing area. Results showed inconsistencies in the Pu/Am ratios for vegetation and soil. Lower ratios found in vegetation samples indicate that preferential uptake and concentration of Am 241 through plant roots might have occurred in the Project 57 area. (Auth)

<9>
Major, W.J., K.D. Lee, R.A. Wessman, and R. Melgard, LFE Environmental Analysis Laboratories Division, Richmond, CA. 1974, July

Determination of Plutonium 239 and Americium 241 in Large Nevada Applied Ecology Group Vegetation Samples. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 107-118), 369 p.

A method has been developed at this laboratory for analyzing Pu 239 and Am 241 in various types of woody vegetation from Nevada Applied Ecology Group (NAEG) collection sites in amounts ranging from 300 to 500 g dry weight. Special dry ashing techniques are used initially to eliminate carbonaceous material. A one-gallon metal paint can, covered with perforated aluminum foil, is used as a disposable container to perform initial drying (110 C) and carbonization steps (250 C). Ashing is then completed in a Pyrex glass beaker (600 C), also covered with perforated foil. The sample ash is treated with HNO3-HCl plus H2O2. Any insoluble residue is filtered and treated with HF and HNO3 in a soil-type dissolution procedure, since tests show that a variable amount of undissolved plutonium and americium remains in the residue. The vegetation is thus reduced from its large, irregular bulk to a small volume of homogeneous solution. All or a portion of the dissolved sample is transferred to a counting vial for instrumental measurement of Am 241 via its 60-kev gamma emission. Uncertainties in counting such low-energy gammas in inhomogeneous samples are essentially eliminated and a standard counting geometry is achieved. Radiochemical isotope dilution analysis is performed for Pu 239 using Pu 236 tracer. Also, if Am 241 is too low for instrumental measurement or a confirmation of the instrumental measurement is required, isotope dilution analysis for Am 241 is performed using Am 243 tracer. Comparisons are made between radiochemical and instrumental analyses of Am 241. Plutonium is isolated from a sample aliquot on an anion exchange resin column. Americium is isolated from another aliquot on an HNO3-methanol anion exchange resin column. Plutonium and americium are finally electrodeposited on stainless steel and measured by alpha spectroscopy. Tracer recoveries for plutonium range from 60 to 80%, with americium slightly lower. (Auth)

Portions of this report were published as Report TLW-6122

<10>
Rhoads, W.A., EG&G, Inc., Santa Barbara Division, Goleta, CA. 1974, July

Analysis of Vegetation Cover in Certain Plutonium Contaminated Areas Using Aerial Photography. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 119-133), 369 p.

Two methods of estimating vegetation cover were developed using aerial photographs; both are less expensive and do not contribute to disturbance of the areas compared to standard methods of measuring vegetation cover on the ground. Cover values for five Pu-contaminated areas at Nevada Test Site and Tonopah Test Range are presented. A preliminary assessment of vegetation conditions in the vicinities of Clean Slate 2 and 3 (Roller Coaster Series) is given. (Auth)

Portions of this report were published as Report EGG-565-108.

<11>

<11>
Au, F.H.P., National Environmental Research Center, Las Vegas, NV. 1974, July

The Role of Soil Microorganisms in the Movement of Plutonium. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 135-141), 369 p.

Microbial studies which are completed or in progress were designed to determine the ability of microorganisms to absorb plutonium, to quantify the uptake, and to determine the microbial population of soils of the Nevada Test Site (NTS). Results of the microbial inventory of Area 13 (NTS) showed that about 2% of the ASPERGILLUS was near the surface of the hummock and increased with distance away from the plants. PENICILLIUM, on the other hand, showed an inverse pattern in that its relative abundance decreased away from the plants. A method was developed for in vitro studies in which aerial fungal spores were collected to determine soluble plutonium uptake from agar medium. The concentration of plutonium in mature spores was approximately one-fourth of that in the growth medium. (Auth)

<12>
Barth, J., and A.A. Mullen, National Environmental Research Center, Las Vegas, NV. 1974, July

In Vitro Plutonium Studies Using the Artificial Rumen and Simulated Abomasal and Intestinal Fluids. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 143-150, 369 p.

An artificial rumen, and simulated abomasal and intestinal fluids procedure was used to study the alimentary solubility and biological availability of various forms of plutonium. Plutonium was added to viable rumen juice and incubated for 24 hr. This juice was converted to simulate the digestive stages of the abomasum, duodenum, jejunum, and lower small intestine by the addition of enzymes, bile, and adjustment of the pH. Samples were collected from these digestive stages for soluble plutonium analysis by liquid scintillation. When plutonium was administered as soluble plutonium nitrate, 10.1% remained soluble following the artificial rumen incubation period, 15.3% following the abomasal period, and 30.1% and 32.7% when held at pH 4 and 5 respectively, in the duodenal phase. The solubility increased to 60.1% following the addition of bile and enzymes and the adjustment of the pH to 6. Plutonium administered as plutonium citrate was 9.0% soluble following the rumen incubation period, 13.1% following the abomasal period, and 22.5% and 24.8% when held at pH 4 and 5 respectively, in the duodenal phase. This increased to 59.6% following the addition of bile and enzymes and the adjustment of the pH to 6. Plutonium administered as 0.06 um plutonium dioxide spheres was 1.5% soluble following the rumen incubation period, 2.3% following the abomasal period, and 3.6% and 3.9% when held at pH 4 and 5 respectively, in the duodenal phase. This increased to 7.4% following the addition of bile and enzymes and the adjustment of the pH to 6. The sharp rise in soluble plutonium observed for all forms following the addition of bile and enzymes and adjustment of the pH to 6 was found to be due to the presence of bile rather than enzymes or change in pH. (Auth)

<13>
Smith, D.D., National Environmental Research Center, Las Vegas, NV. 1974, July

Grazing Studies on Selected Plutonium Contaminated Areas in Nevada. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 151-161), 369 p.

A grazing study in Area 13 of the Nevada Test Site was initiated in May of 1973 and is proceeding on schedule. This includes the monthly collection of ingesta samples from fistulated steers, the quarterly sacrifice and sampling of a goat, and the semiannual sacrifice and sampling of selected adult and young cattle. No data are yet available. Bone ash samples collected from the NTS beef herd for the years 1958-1967 have been obtained from the University of Nevada, Reno, and submitted for plutonium and americium analyses. During 1972, cattle from three different herds on and around the Nevada Test Site were sampled to determine the tissue burdens of plutonium and uranium. The herds sampled were: (1) a control herd from Searchlight, Nevada; (2) a herd from Area 18, Nevada Test Site; and (3) a herd from the Roller Coaster area. The uranium content of the tissues sampled was relatively consistent among the three herds; however, the Pu 239 was about 20 times higher in femurs from the Roller Coaster herd than in the Searchlight cattle. This ratio was lower in edible tissues. Using the maximum concentrations observed in beef tissue, the hypothetical maximum bone dose fof a man ingesting 250 g/day for 50 years was calculated to be 9.7 mrem from beef muscle or 36.4 mrem for beef liver. (Auth)

<14>
Stanley, R.E., E.W. Bretthauer, and W.W. Sutton, National Environmental Research Center, Las Vegas, NV. 1974, July

Absorption, Distribution, and Excretion of Plutonium by Dairy Cattle. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 163-185), 369 p.

In order to obtain information on the significance of the milk link in man's food chain as a source of plutonium exposure and to gain additional information on plutonium deposition patterns in ruminants, a series of metabolism studies with dairy cows was initiated. This preliminary report outlines the first two studies in the series and while some of the laboratory assays have not been completed, several comparative observations can be reported at this time. Two groups of Holstein dairy cows, four cows in each group, were studied to examine the physiological transport of ingested plutonium citrate and plutonium dioxide. Approximately 3 mCi of plutonium citrate per animal was administered in an acute treatment to the first group, while 1 mCi of plutonium dioxide was given daily to each animal for 19 consecutive days in the second group. Samples of blood, milk, urine, and feces were taken during and after oral dosing, while tissue collections were made at necropsy 6 to 13 weeks after treatment. As expected, the major portion of plutonium activity (approximately 96% in Group 1 and slightly less than 100% in Group 2) was excreted in the feces. However, recovered activity in urine and milk following both the acute dose of plutonium citrate and the multiple doses of plutonium dioxide confirmed the physiological uptake and transport of both chemical forms. Total plutonium transport to milk was not great an, on a percent of oral dose basis, was observed to be 2 x 10(E-4) and 2 x 10(E-5) following the plutonium citrate and plutonium dioxide treatments, respectively. A complete report, including a comparison of gastrointestinal uptake, tissue deposition patterns, physiological reduction factors, and placental transfer, will follow once the laboratory anlayses are finalized. (Auth)

<15>
Hoor, K.S., and W.G. Bradley, University of Nevada, Las Vegas, NV. 1972, July

Ecological Studies of Vertebrates in Plutonium Contaminated Areas of the Nevada Test Site. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 187-212), 369 p.

Various standard census methods were employed during the period March, 1972-August, 1973, to obtain a qualitative and quantitative inventory of the vertebrate biota in three plutonium-contaminated study areas of the Nevada Test Site (NTS). Data are presented on the vertebrate composition, relative abundance, and seasonal status in the study areas. More detailed data on rodent populations are included for Area 13. Five species of snakes have been observed in these study areas. Additional species, although not observed due to their nocturnal habits, are undoubtedly present. The insectivorous lizards, CNEMIDOPHORUS TIGRIS and UTA STANSBURIANA, are the most abundant lizards in all of the study areas, where as CALLISAURUS DRACONOIDES is only abundant in Area 5. The carnivorous lizard, CROTAPHYTUS WISLIZENI, is found in all three study areas. Seasonally, birds are an important group in all study areas. Species richness, seasonal status, and relative abundance varied greatly between the years 1972-1973. The Horned Lark is the only common-to-abundant resident, while common-to-abundant migrants during spring, 1973, were Black-throated Sparrows, Mourning Dove, and Western Kingbird. Rodents common to all study areas were: DIPODOMYS MICROPS, DIPODOMYS MERRIAMI, PEROGNATHUS LONGIMEMBRIS and AMMOSPERMOPHILUS LEUCURUS. In addition to the four common species, MICRODIPODOPS MEGACEPHALUS and PEROGNATHUS PARVUS, characteristic of the Great Basin Desert, were found in Area 13. Concentrations of Pu 239 and Am 241 were determined in the pelt, GI tract, and carcass of nine DIPODOMYS MICROPS, resident of Area 13 for at least six months. Maximum Pu 239 values obtained in nCi/g ash were 2.44 x 10(E+0), 4.74 x 10(E+0) and 8.58 x 10(E-3) for the pelt, GI tract and carcass, respectively. Am 241 values were 2.87 x 10(E-1), 5.49 x 10(E-1), and "not detectable" for the pelt, GI tract, and carcass, respectively. (Auth)

<16>
Mullen, A.A., National Environmental Research Center, Las Vegas, NV. 1974, July

Distribution of Ingested Plutonium in Chickens and Subsequent Transport to Eggs. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 213-219), 369 p.

Soluble plutonium 238 citrate and relatively insoluble particulate plutonium 238 oxide were administered orally to two groups of laying hens daily for two weeks. The yolks, whites, and shells from the eggs were analyzed for their plutonium content. Yolks from the eggs of chickens fed plutonium citrate appeared to be the only egg fractions in which plutonium activity was observed. This activity reached a peak of 0.0155% of the administered dose nine days after the initial ingestion. The activity decreased with a biological half-life of 1.85 plus or minus 0.48 days and an indication of a longer half-life of >25 days. Ten chickens from each group were sacrificed 12 days after the final administration of plutonium. Tissue samples were collected to determine the amount of plutonium present in the edible portions and feathers of the chickens. The remaining chickens were sacrificed 30 days after the final dose was administered. Preliminary results indicate little plutonium remained in either the tissues or feathers obtained from either group of chickens at time of sacrifice. (Auth)

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Phelps, P.L., and L.R. Anspaugh, Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA. 1974, July; 1974, February 19

Resuspension Element Status Report.
CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 221-233), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, A Progress Report, (p. 1-16), 111 p.

An intensive study on the resuspension of plutonium at the Nevada Test Site has been initiated. The main thrust of the study is to develop a mathematical model for describing the concentrations of plutonium in air as a function of the source and driving forces. Apparatus and experimental techniques for studying the dynamics of plutonium and soil particle behavior have been developed. This has included the development of ultrahigh-volume air samples (1500m3/hr) which allow collection of adequate samples of plutonium at worldwide air concentration levels in two hours of sampling time. The most intensive field program to date has been in the GMX area. Data have also been collected in Area 13 and Mercury. Analysis of air samples collected from February, 1971, to July, 1972, shows that the GMX site, which was contaminated 17 years ago, still represents a significant resuspension source. However, the average air concentration of resuspended Pu 239 outside the exclusion area is only a small fraction of the presently accepted maximum permissible concentration for occupational exposure. It was also concluded that the air concentrations of Pu 239 in Mercury may be influenced by the local NTS sources. Measurements using cascade impactor studies indicate that there is no difference in the distribution of activity with particle size for the three species Pu 238, Pu 239, 240, and Am 241. The data also showed that the fraction of the resuspended plutonium aerosol at GMX which would be expected to undergo pulmonary depositions is approximately 0.2 based upon the ICRP Task Group on Lung Dynamics model. Experimental results have shown that there is no obvious correlation of specific Pu activity with particle size. An average specific acitivty of 890 dpm/g, or about one-third of that found in the soil in close proximity to the cascade impactors, was measured. Particle data from the cascade impactors showed that the ratio of Pu 239, 240 to Am 241 activity is the same as reported for soil in the vicinity of the cascade impactors. Preliminary results from the ultrahigh-volume air sampler runs indicate a gross correlation between many of the wind speed related parameters and the concentration of resuspended plutonium. Experience and data gathered at the GMX site were used to derive simple predictive models for air concentrations of plutonium due to resuspension on the Enivetok Atoll. (Auth) (PMM)

<18>
Kennedy, N.C., and H.G. Booth, Air Resources Laboratory, Las Vegas, NV. 1974, July; 1974, February 19

Measurements of Meteorological Parameters.
CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 235-239), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, a Progress Report, (p. 17-23), 111p.

A part of the Air Resources Laboratory-Las Vegas support to the Resuspension Element has been the recording of meteorological information at air sampling locations. Measurements of wind direction, speed, and precipitation were made at Reynolds Electrical and Engineering Company and Lawrence Livermore Laboratory air sampling sites. These data are being used in the analysis of sample variation. In conjunction with the more detailed GMX area resuspension experiments, a more elaborate meteorological data gathering system has been established. A brief outline of the wind, temperature, moisture, solar radiation and other miscellaneous meteorological measurements made during sampling periods is given. The wind and temperature profiles for 4 high-volume air sampler runs are shown in a graph. One profile is for light winds, one for strong winds, and the other two for the initial two runs for which the Pu 239 activity data has been received. (PMM)

Figure 2 gives meteorological data for four particle analyzer runs at GMX site. Figure 1 gives meteorological data for four UHV air sampler runs at GMX site.

<19>
Goluba, R.W., Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA. 1974, July; 1974, February 19

Ultra High Volume Air Sampler. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 241-246), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, A Progress Report, (p. 24-32), 111 p.

An air sampler with a nominal volumetric flow rate of 1500 m3/hr was developed in order that a measurable amount of Pu 239 could be collected in as short a time span as 2 hr. The design of the unit is patterned after an air sampler built by Asikainen and Blomqvist (1970) which had a flow rate of 1000 m3/hr. The air flow through the sampler is maintained by a centrifugal blower thats inlet is attached to one side of a large plenum. The filter, which measures 0.6 x 1.7 m, is mounted horizontally on top of the plenum at a height of 1.3 m above ground level. The filter material used is Delbag 99/98 Microsorban, which is made of mats of polystyrene fibers with diameters of 1 um and less. The blower exhausts through a 0.3 m diameter of 3 m long sheet metal duct, which is inclined at an angle of 10 degrees with respect to the ground. The length of the duct precludes any interference of the exhaust flow stream with the air intake to the sampler. The duct is inclined so that the exhaust flow stream dissipates without directly striking the ground, which would artifically introduce aerosol into the air. The centrifugal blower is a 0.4 m diameter wheel with radial blades and is driven by a 7.5 hp electric motor. A schematic of the calibration setup for the ultra high volume air sampler is shown and the experimental procedure is described. (FMM)

<20>
Reichman, J.M., Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA. 1974, July; 1974, February 19

Saltation and Creep Samplers. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 247-254), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, A Progress Report, (p. 33-43), 111 p.

Motion of windblown sand close to the ground can occur by two mechanisms. The first of these mechanisms is creep, which is the rolling motion of sand along the ground. The second mechanism is saltation which occurs when wind speed increases and sand "hops" along the ground in short, arching paths. Measurement of these mechanisms of sand movement, together with the resuspended sand, is necessary for the understanding of the total flux of windborne soil. Several devices used to measure saltation and creep in previous studies were evaluated to determine the most efficient. Modifications then were made to further increase efficiency. Testing of the units was conducted under controlled conditions at Livermore in order that more reproducibility could be obtained than would be possible at the Nevada Test Site (NTS). (ST)

<21>
Koval, J.S., Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA. 1974, July; 1974, February 19

In Situ Optical Particle Size Analysis of Ambient Aerosol. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada October 2-3, 1973, (p. 255-264), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, A Progress Report, (p. 44-54), 111 p.

The Climet Particle Analyzer is a light-scattering instrument capable of sizing and counting particles in the range of 0.5 to 10 um in diameter. The design, calibration and configuration of this instrument for data collection at the Nevada Test Site is described. Between April 18 and August 2, 1973, data from 132 Climet Particle Analyzer runs were collected. Very little data reduction has been completed. The primary goal of the data analysis will be detection of correlations between particle concentration and one or several meteorological parameters. (ST)

<22>

<22>
Anspaugh, L.R., and P.L. Phelps, Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA; Lawrence Livermore Laboratory, Electronics Engineering Department, Livermore, CA. 1973, July; 1974, February 19

Results and Data Analysis: Resuspension Element Status Report. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 265-298), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, A Progress Report, (p. 55-93), 111 p.

The long-range goal of the Nevada Applied Ecology Group (NAEG) resuspension studies is to produce a set of equations which can be used to predict the time-dependent average concentration of resuspended material downwind from a source of any geometrical configuration and soil surface characteristics. Results which are currently available are limited and/or have not been fully analyzed; they are presented in the nature of a status report and as representative of the types of measurements being made. These results include resuspension measurements and analysis for Pu 239 at the fence boundaries of the GMX and Camp Mercury, NTS areas; measurements of particle size distribution for aerosols at the GMX site using cascade impactors; and the study of resuspension of plutonium in the GMX area using untrahigh-volume air samplers. (ST)

<23>
Anspaugh, L.R., Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA. 1974, July; 1974, February 19

Appendix A, Resuspension Element Status Report: The Use of Nevada Test Site Data and Experience to Predict Air Concentrations of Plutonium Due to Resuspension on the Enewetak Atoll. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 299-310), 369 p.; UCRL-75484; Part of Anspaugh, L.R., et al, Resuspension of Plutonium, A Progress Report, (p. 94-111), 111 p.

Two approximate methods, the resuspension factor approach and the mass loading approach, were used to predict resuspended air activity in the vicinity of an area contaminated with Pu. The mass loading approach is based upon measured or assumed levels of particulate matter in ambient air with the assumption that this material is derived from the contaminated soil. Representative calculations were made using Nevada Test Site data and experience to predict air concentrations of Pu due to resuspension on the Enewetak Atoll. Soil levels for both soluble and insoluble Pu 239 calculated by both methods agreed within a factor of two. (ST)

<24>
Church, B.W., D.M. Brady, I. Aoki, and W.A. Bliss, U.S. Atomic Energy Commission, Las Vegas, NV; Reynolds Electrical and Engineering Company, Inc., Las Vegas, NV; National Environmental Research Center, Las Vegas, NV. 1974, July

Distribution and Inventory Element Activities On Nevada Test Site and Off Nevada Test Site. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 311-320), 369 p.

The Nevada Applied Ecology Group Distribution and Inventory Element expanded its activities this past year to include investigation of all plutonium-contaminated areas on and near the NTS. This progress summary report describes the element activities under way, but does not include compiled data. Soil samples taken at 226 NTS event sites are being analyzed for Pu 239-Pu 240, Am 241, gross gamma, and specific gamma emitting constituents of the gross gamma spectra. Offsite activities include plutonium concentration analyses of filters and soil samples from selected stations adjacent to NTS in NERC-LV's routine Air Surveillance Network (ASN). Statistical analysis of plutonium-in-air results was performed on data from eight widely separated stations of the ASN. A separate comprehensive element progress report is in preparation, which will include details of the Distribution and Inventory Element activities to date. (Auth) (ST)

<25>
Oen, C.J., Oak Ridge National Laboratory, Environmental Plutonium Data Base Group, Oak Ridge, TN. 1974, July

Information Support for the Nevada Applied Ecology Group. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 321-328), 369 p.

A computer file of 2,500 references on the environmental aspects of plutonium, uranium, and the Nevada Test Site (NTS) has been developed . Recent emphasis on the historic (pre-1962) literature on plutonium and uranium accounts for over 400 references. These early AEC-sponsored reports are primarily on exposure, radionuclide contamination, and radioactivity resulting from nuclear testing at the NTS or on the medical and biological aspects of plutonium and uranium. Services available include published bibliographies, customized bibliographies, and assistance in locating documents. A manual file of documents rounds out this information resource. (Auth)

<26>
Hamel, D.M., U.S. Atomic Energy Commission, Las Vegas, NV. 1974, July

Nevada Applied Ecology Group Library Services at AEC Nevada Operations Office. CONF-731048; NVO-142; Part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 329), 369 p.

Current status of the Nevada Applied Ecology Group (NAEG) Library reflects staff cutback. Relocation and consolidation of materials are recommended as follows. AEC/NV has recently assumed responsibility and total operation of the library as an AEC facility. The contractual arrangements with University of Nevada, Las Vegas (UNLV) ended in August, 1973. Decision was made and is being effected to consolidate the Technical Library and NAEG collection. This move will provide a distinctly better use of space and existing staff. In addition, there will be an attendant reduction in the duplication of materials and record maintenance. As a consequence of the general cutback, the library was not permitted to refill the NAEG library technician position recently vacated. This action has necessitated a drastic reduction of direct library services to NAEG. Specifically, all supportive responsibilities, such as acquisition of books and periodicals, scanning literature, cataloging and indexing technical reports, journal articles, and reprints, charging out materials, responding to queries, and coordination with the Environmental Plutonium Base in Oak Ridge have of necessity been relegated in priority with overall NV library requirements. In conclusion, a reevaluation of the total information supportive services is suggested, to reflect current requirements of the Nevada Applied Ecology Group. A careful redefinition of needs will permit the library to function with optimum efficiency within its new capabilities. (Auth)

<27>
Martin, W.E., S.G. Bloom, and R.J. Yorde, Jr., Battelle Columbus Laboratories, Columbus, OH. 1974, July

Nevada Applied Ecology Group Plutonium Study Modeling Program: Plutonium Transport and Dose Estimation Model. CONF-731048; NVO-142; part of Dunaway, P.B. and White, M.G. (Eds.), The Dynamics of Plutonium in Desert Environments, Proceedings of the NAEG Plutonium Environmental Studies Program Symposium held in Las Vegas, Nevada, October 2-3, 1973, (p. 331-360), 369 p.

A computer program based on a matrix exponential method was used to solve a system of ordinary differential equations which simulate the behavior of Pu 239 in desert ecosystems such as those found at and near the Nevada Test Site. The model was used to estimate the rates of Pu 239 transport, via several environmental pathways, to Standard Man, who was assumed to live in a contaminated area. These estimates were then used to calculate radiation doses and dose commitments, as a function of time, to different organs. The model provides a method for evaluating the potential radiological hazard to man due to the presence of Pu 239 in a given area. However, the studies designed to implement the model, by providing accurate estimates of critical parameters, are still in progress. Therefore, the results to date are incomplete and inconclusive. On the basis of present assumptions and parameter values, the model indicates a 70-year dose commitment to the pulmonary lymph nodes of 13.6 rem per pCi (Pu 239)/g (soil). Comparable values for other organs are: bone, 0.14 rem; lung, 0.10 rem; kidney, 0.015 rem; liver, 0.014 rem; GI tract, 0.007 rem; and total body, 0.003 rem. Inhalation accounts for 100% of the dose to the lungs and pulmonary lymph nodes, a negligible fraction of the dose to the GI tract, and about 56% of the dose to bone, kidney, liver, and total body. This means that all but a negligible fraction of the dose to the GI tract and 44% of the Pu 239 entering the bloodstream is due to ingestion of soil, vegetation, milk, beef, and beef liver. It is quite possible that the relative importance of inhalation has been overestimated, while the relative importance of ingestion has been underestimated. (Auth)

<28>
Golchert, N.W., and J. Sedlet, Argonne National Laboratory, Argonne, IL. 1972, October 31

Radiochemical Determination of Plutonium in Environmental Water Samples. Radiochemical and Radioanalytical Letters, 12(4-5), 215-221

A radiochemical separation procedure for the determination of plutonium in large environmental water samples is presented. The procedure is based on the coprecipitation of plutonium with calcium fluoride from an acid-fluoride medium followed by purification on an anion-exchange resin and electrodeposition for alpha spectrometry. Chemical recoveries of added plutonium from samples up to 50 liter have averaged 94%. The detection limit of Pu 239 in 10 liter samples is 0.5 fCi/l. (Auth)

<29>

<29>
Craig, D.K., R.L. Buschbom, and J.P. Herring, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, June

Relationships Between Nebulizer Suspension Concentration, Concentration and Size Distribution of Plutonium 239 PuO2 Aerosols Generated for Animal Inhalation Experiments. Health Physics, 24, 637-644

In a study of low-level effects of inhaled Pu 239 PuO2 in beagle dogs, alveolar burdens over the 1500-fold range from 2 nCi to 3 uCi were deposited in unanesthetized dogs by aerosol inhalation. Aerosols were generated by nebulizing magnetically-stirred suspensions of Pu 239 PuO2 particles in water, the aerosol concentration (CONC) being varied, primarily, by changing the Pu concentration of the suspension (SSA). If the mass concentration of the suspension was kept below about 10 mg (~40 uCi) PuO2/ml, a good correlation (R equals 0.827 for n equals 64) was observed between CONC and SSA with constant air flow through the exposure chamber. SSA values from 1 to 600 uCi/ml gave CONC values in the range 1.5 to about 3000 nCi/l. However, the aerodynamic equivalent size distribution of Pu 239 PuO2 in the exposure chamber was found to vary significantly with CONC. The aerosols were log-normally distributed and the activity median aerodynamic diameter (AMAD) increased from about 1.5 to 3 um as CONC increased (R equals 0.777 for n equals 64), while the geometric standard deviation (GSD) decreased (R equals -0.576 vs AMAD). An explanation of this unexpected phenomenon, based on aggregate formation due to the greater likelihood of there being more than one PuO2 particle per nebulizer droplet at the higher SSA values, is advanced. The effect is believed to contribute to the large variation observed in the percentage alveolar deposition of inhaled Pu 239 PuO2 aerosols from 1.4 to 31.3% in 52 dogs for which the thorax x ray count was significantly different from zero at P < 0.05. (Auth)

<30>
Bruenger, F.W., W. Stevens, and B.J. Stover, University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1969, February

Americium 241 in the Blood: In Vivo and In Vitro Observations. Radiation Research, 37(2), 349-360

The concentration in canine blood of trivalent Am 241 that had been injected intravenously at doses of 0.9, 0.3, and 0.1 uCi/kg decreased at a rate comparable with those of divalent alkaline earths. A small fraction of the Am 241 was associated with blood cells, but the major part was in the serum. Complexes with serum proteins were demonstrated in sera obtained at 1 and 5 minutes after injection. Americium 241 complexes with both transferrin and albumin were identified and isolated in in vitro experiments with human sera. The Am(+3) complex with transferrin is less stable under physiological conditions than either the Fe(+3) or Pu(+4) transferrin complex. Evidence was obtained for a third Am(+3) protein complex. (Auth)

Figure 1 shows a comparison of the concentrations of Pu 239, Ra 226 and Am 241 in plasma during the first day after IV injection.

<31>
Fairhall, L.T., U.S. Public Health Service, Rockville, MD. 1957

Industrial Toxicology. The Williams and Wilkins Company, Baltimore, Maryland, 2nd Edition, 376 p.

The importance of evaluating the disease hazard from industrial applications of chemicals is pointed out. The possibility of relating chemical constitution and physiological activity has proved a fascinating field of speculation. Since no rational scheme is available to aid in deciding upon the toxicity of a given substance, it is necessary to carry out experiments with animals, but caution must be exercised in interpreting the results. In the book on the toxic effects of industrial poisons, the chemicals are divided into two sections, namely inorganic substances and carbon compounds. Each element, including Pu and U, or compound is then described according to characteristics, industrial uses, and toxicity and usually methods of analysis are given. In the appendix there is a conversion table for gases, a table of some end products of detoxification of certain compounds of industrial interest, values for the average maximum permissible atmospheric concentration of contaminants to which workers may be exposed in an 8 hr working day, and a table of comparative toxicities of various substances based on the LD 50 value for oral administration to rats. (PMM)

<32>
Dionne, P.J., and B.O. Stuart, Battelle Memorial Institute, Pacific Northwest Laboratories, Applied Physics and Electronics Department, Richland, WA; Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, March 1

Plutonium Inhalation Model Simulates the Long-Term Burdens of the Deep Lung and Systemic Organs. BNWL-SA-1540; CONF-680502-1; Part of Proceedings of the 6th IEEE Region Symposium held in Portland, Oregon, May 22, 1968, (23 p.), 206 p.

The dynamic simulation of plutonium buildup and elimination from the major organs of the body after plutonium dioxide inhalation was developed from tissue radioanalyses and excretion data from beagle dogs, which were sacrificed from two months to six and one-half years after inhaling plutonium 239 PuO2 aerosols. The model's description of individual tissue levels as functions of time after exposure were fitted to the analyzed plutonium burdens obtained from over fifty dogs, providing insights into several problems connected with inhaled insoluble plutonium. Thus, it was found that changing the combined initial depositions in the nasopharynx, tracheobronchial, plus fast pulmonary regions, from 70% to 90% had comparatively little effect on the long-term burdens of plutonium in the liver, bone, and kidneys. The rapid initial peak in the blood compartment suggests that much earlier blood sampling is needed. The use of a model based on the slow pulmonary compartment appears to be justified in the study of effects upon systemic organs and the lymphatic system as additional lung radioanalyses and whole body retention data become available. In addition, the model has been programmed for a UNIVAC 1108 digital computer using a digital simulation language. The model appears to give sufficiently accurate dynamic levels in all major organs to permit its use with individual animal retention and excretion data. Predictions of long-term buildup and elimination of plutonium in critical organs are used in establishing maximum permissible air concentrations of plutonium dioxide, and known excretion patterns may be used to determine initial burdens following possible accidental exposure. (Auth) (FMM)

<33>
Djuric, D., M. Kilibarda, Lj. Novak, D. Panov, and M. Vukotic, Institute of Occupational Health, Department of Radiological Health, Belgrade, Yugoslavia. 1964

Studies on Airborne Radioactive Contamination of Miners in a Yugoslav Uranium Mine. Health Physics, 10, 1059-1064

For the last 4 years the radon concentrations in the atmosphere of a Yugoslav uranium mine have been periodically measured. The concentration of Po 210 in the urine of miners was also determined. The potential sources of Pb 210 and Po 210 and the possibility of correlation between a radon exposure and polonium excretion in the urine are discussed. Certain assumptions lead to a very rough estimate of the integral exposure of miners to radon. To elucidate one of the many problems encountered in a more detailed study of this correlation, a method for determination of Po 210 in the dust of the uranium mine was developed. Radium and uranium can be determined simultaneously with polonium. (Auth)

<34>
Bernard, S.R., Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN. 1958

Maximum Permissible Amounts of Natural Uranium in the Body, Air and Drinking Water Based on Human Experimental Data. Health Physics, 1, 288-305

The distribution of uranium in the human body following intravenous injections of hexavalent and tetravalent uranium has been studied in the case of eight terminal patients. At the dosage levels used the data indicate that the kidneys and the skeleton are the principal sites of deposition with approximately equal amounts in each. On this basis the kidneys become the critical organ and the toxic effect of the uranium rather than radiation damage becomes the limiting effect in determining the maximum permissible concentrations (MPC) for occupational exposure. The influence of particle size on retention of inhaled material is considered in interpreting some of the available human data. (Auth)

<35>

<35>
MacNider, W.de B., University of North Carolina, Laboratory of Pharmacology, Chapel Hill, NC. 1936

A Study of the Acquired Resistance of Fixed Tissue Cells Morphologically Altered through Processes of Repair. 1. The Liver Injury Induced by Uranium Nitrate. A Consideration of the Type of Epithelial Repair Which Imparts to the Liver Resistance Against Subsequent Uranium Intoxications. Journal of Pharmacology and Experimental Therapeutics, 56, 359-372

A study was made on dogs of the acute injury to the liver from uranium nitrate, the various types of repair processes which may be inaugurated subsequent to the injury, the functional value of the epithelium responsible for the repair and the degree of resistance acquired by the liver to secondary intoxications by the uranium nitrate. The dogs were given subcutaneous injections of either 2 or 4 mg of uranium nitrate/kg. Prior to these intoxications as well as during the acute stages of hepatic injury, and at intervals for ten weeks during the periods allowed for processes of repair, the degree of hepatic function was ascertained by employing the phenoltetrachlorphthalein test for liver function. Biopsy material was also studied. The animals that recovered from a slight injury to the liver induced by 2 mg of uranium nitrate per kilogram showed that the process of epithelial repair was accomplished by the formation of a normal type of polyhedral cell. This repair process was associated with a return of the liver to its normal functional value as indicated by the use of phenoltetrachlorphthalein. The experiments also showed that when the animals were reintoxicated with the same amount of uranium nitrate per kilogram, no evidence developed of an acquired resistance on the part of the liver either in a functional or structural sense. The results obtained in the animals intoxicated by a larger amount of uranium nitrate, (4 mg per kilogram), showed that if the liver epithelium was sufficiently injured, the repair of this tissue was accomplished by the formation of an atypical type of hepatic cell characterized by its flatness and evenness in staining and also by its tendency to remain as a syncytial structure. The animals of this group furthermore showed that when hepatic repair had taken place by the formation of this type of atypical cell, the livers of such animals had acquired, as a result of such an epithelial metaplasia, a high degree of resistance against this poison in an amount 2 mg per kilogram in excess of the quantity which was severely hepatoxic to the normal type of polyhedral liver cell. (PHM)

<36>
Kornberg, H.A., and et al, General Electric Company, Hanford Atomic Products Operation, Richland, WA. 1957, January 4

Biology Research Annual Report, 1956. HW-47500; 237 p.

Reorganization has disbanded the Radiological Sciences Department and transferred the Biology Section to the newly named Biology Operation of the Hanford Laboratories Operation. Work performed during the past year is reported. Research programs continue to change from being primarily Hanford oriented toward being mostly concerned with radiobiological problems derived from the general needs of radiation hazard control. Metabolism and irradiation studies on rats, sheep and pigs, decontamination studies, studies utilizing radioactive particles, plant and microbiological studies, and the effects of production facility effluents on biota have been investigated. The work involves the radionuclides phosphorus 32, strontium 90, ruthenium 106, cesium 137, iodine 131 and plutonium. Five papers dealing with work on plutonium have been abstracted and entered into the data base separately. (BBM)

<37>
Ballou, J.E., General Electric Company, Hanford Atomic Products Operation, Richland, WA. 1957, January 4

Effect of Age on the Absorption of Plutonium and Ruthenium. HW-47500; Part of Kornberg, H.A., et al, Biology Research Annual Report, 1956, (p. 25-29), 237 p.

Gastrointestinal absorption of plutonium and ruthenium by immature rats exceeded adult absorption by as much as 85 times for plutonium and 5 times for ruthenium. Plutonium distribution was essentially the same in the seven-day-old rat and the adult. Ruthenium distribution varied considerably with age, but at all ages the highest concentrations were found in kidney, liver, femur and ovaries. (Auth)

<38>
Kawin, B., N.L. Dockum, and R.F. Palmer, General Electric Company, Hanford Atomic Products Operation, Richland, WA. 1957, January 4

Distribution and Excretion of Plutonium. HW-47500; Part of Kornberg, H.A., et al, Biology Research Annual Report, 1956, (p. 30-35), 237 p.

Following intravenous injection into rats, plutonium distribution in several cellular fractions and plasma components is being studied. In urine, plutonium may be associated with S 35, as suggested by paper chromatography. Tissue localization of plutonium is being studied by autoradiography. Preliminary results are reported at this time. (Auth)

Table 1 gives the relative percentage of Pu 239 in cell components (nuclear fraction, mitochondria, and microsomes) of rats one hour after intravenous injection of 50 ug of Pu 239(+4).

<39>
Bernsky, R., General Electric Company, Hanford Atomic Products Operation, Richland, WA. 1957, January 4

Collagen Reactivity with Plutonium. HW-47500; Part of Kornberg, H.A., et al, Biology Research Annual Report, 1956, (p. 36-41), 237 p.

Collagen reactivity with plutonium was determined by electronoscopic observation and hydrothermal stability measurements. The observations and results suggest that collagen combines chemically with plutonium in vitro. (Auth)

<40>
Ballou, J.E., and W.D. Oakley, General Electric Company, Hanford Atomic Products Operation, Richland, WA. 1957, January 4

Absorption and Decontamination of Plutonium on Rats. HW-47500; Part of Kornberg, H.A., et al, Biology Research Annual Report, 1956, (p. 142-145), 237 p.

Absorption of plutonium through rat skin from a solution containing Pu^{+4} in nitric acid was comparable to that previously measured for other nitric acid solutions of plutonium. The absorption of tributyl phosphate complexed plutonium in carbon tetrachloride solution was approximately four times greater. The ability to remove plutonium from pieces of excised pig skin was found to be a suitable preliminary test of the efficiency of decontaminating agents. (Auth)

<41>
Smith, V.H., and R.W. Wager, General Electric Company, Hanford Atomic Products Operation, Richland, WA. 1957, January 4

Preparation of Aqueous Suspensions of Ruthenium 106 RuO_2 and Plutonium 239 PuO_2. HW-47500; Part of Kornberg, H.A., et al, Biology Research Annual Report, 1956, (p. 157-159), 237 p.

The preparation of aqueous suspensions of radioactive ruthenium oxide and plutonium oxide particles is described. Ruthenium oxide particles usually ranged in size from 0.5-2.5 microns in diameter with 90% in the 1-2 micron range. Plutonium oxide particles ranged in size from 0.5-3 microns with about 80% between 0.5-1.5 microns. The suspensions may be used in experiments for intratracheal injections. (BBM)

<42>
Becker, K. (Comp.), Oak Ridge National Laboratory, Oak Ridge, TN. 1972, August

Bibliographies in Nuclear Science and Technology. AED-C-21-10; 54 p.

This is the last of a series of ten bibliographies (AED-C-21-01 to 10) which covers with about 12,000 references the literature mostly in photographic, chemical, and solid-state dosimetry; internal (radionuclide incorporation) dosimetry; and ionometric techniques in dosimetry. This issue contains 2,581 references of conference papers, reports, patents, dissertations, monographs, and publications in journals, which deal mostly with ionization chambers, GM and proportional counters, scintillation and semiconductor counters and similar, mostly pulse-type dose rate measuring devices, published between the mid-1960's and mid-1970's. Subject and author indices are given. (Auth)

<43>
Brewer, L.W., Sandia Laboratories, Environmental Health Department, Albuquerque, NM. 1973, March; 1973, August

Environmental Monitoring Report for Sandia Laboratories from 1964 through 1972. SLA-73-0339; WASH-1259; Part of Environmental Monitoring at Major U.S. Atomic Energy Commission Contractor Sites, Calendar Year 1972, (p. 231-283), 1217 p.

Water, soil and vegetation around Sandia Laboratories are regularly monitored and the results analyzed. The data from these tests, primarily for radiation levels, are presented for the period from 1964 through December 1972. In August 1970 plutonium soil samples were taken in the near vicinity of three plutonium work areas. All the samples were below the detectable limit of one femtocurie (fCi) of total plutonium per gram of soil. In October 1971 four new sampling sites for plutonium were established. All of the samples taken were below the detectable limit, for a 10-minute count, of 3 picocuries of total plutonium per gram of soil. Based upon the environmental sampling data, Sandia Laboratories has not released any significant amount of radioactive or nonradioactive contaminants to the environment during the period January 1, 1964, through December 31, 1972. The soil sampling data show less activity than was obtained before the start-up of the two reactor facilities and the vegetation data on the average have remained relatively constant. Water-sampling data are within the limits recommended for unidentified radionuclides. (FNM)

<84>
Taylor, B.T., United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Health Physics and Medical Division, Harwell, Berkshire, England. 1966, June

Measurement of Plutonium 239 In Vivo. AERE-PR/HPM-9; Part of Johnston, J.E. (Ed.), Health Physics and Medical Division Research Progress Report, January-December, 1965, (p. 25), 37 p.

A report is presented on continuing investigation of the performance of the large area proportional counter for determination of lung burdens of plutonium 239. The equipment was used to investigate two cases of suspected inhalation of plutonium 239. Contributions to the background due to cesium 137 and potassium 40 in the body were determined from phantom measurements, and amounted to 7 counts/min in the L x ray energy band for a subject containing 145 g of potassium and 20 nCi cesium 137. The estimated minimum detectable lung burden of plutonium 239 was 28 nCi based on a simple calibration with a point source and absorbers of Mix D. The performance of the counter has been considerably improved by the use of an additional anti-coincidence counter covering the window in the original design. With the complete anti-coincidence system, the reduction in counter background above 4 keV is nearly a factor of 50 in the lead shield (from 950 counts/min to 21 counts/min.). In the L x-ray energy band (10-24 keV) the lowest background obtained is 7.2 counts/min, the additional anti-coincidence counter producing a reduction by a factor of about 7. The improvement in discrimination against gamma ray contributions to the background due to cesium 137 and potassium 40 in the body, is also about a factor of 7. A subject containing 20 nCi cesium 137 and 145 g of potassium increases the counter background by 1 count/min in the L x ray energy band. The counter is capable of detecting less than 1 maximum permissible lung burden (16 nanocuries of plutonium 239). (FNM)

<85>
Sanders, C.L. (Ed.), R.H. Busch (Ed.), J.E. Ballou (Ed.), and D.D. Mahlum (Ed.), Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1973, June

Radionuclide Carcinogenesis. CONF-720505; AEC Symposium Series No. 29; Proceedings of the 12th Annual Hanford Biology Symposium held at Richland, Washington, May 10-12, '72, 500 p.

The broad objective of this symposium on radionuclide carcinogenesis was to update current knowledge of carcinogenesis from internally deposited radionuclides. One aspect of the symposium was the increasing emphasis being placed on the roles of hormones, viruses, nonradioactive cocarcinogens, and tumor-promoting agents acting together with radionuclides in the induction of tumors. Emphasis is also increasing on retrospective epidemiologic studies in human populations exposed accidentally, occupationally, or medically to alpha emitters and the attempts to relate observations in experimental animals to the human problem. Those papers involving Pu and Am have been entered separately into the data base. (BBM)

<86>
Sanders, C.L., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, June

Cocarcinogenesis of Plutonium 239 PuO2 with Chrysotile Asbestos or Benzpyrene in the Rat Abdominal Cavity. CONF-720505; AEC Symposium Series No. 29; Part of Sanders, C.L., et al (Eds.), Proceedings of the 12th Annual Hanford Biology Symposium on Radionuclide Carcinogenesis held at Richland, Washington, May 10-12, 1972 (p. 139-153), 500 p.

Studies were made of the carcinogenic response of intraabdominally injected plutonium 239 PuO2 at several doses and the cocarcinogenic response to combinations of plutonium 239 PuO2 with 3,4-benzpyrene (BP) or chrysotile asbestos. Groups of 18 to 36 female rats were given an intraabdominal injection of 70 to 360 or 2880 nCi of plutonium 239 PuO2 particles, 720 nCi of PuO2 with 15 mg of asbestos, 360 nCi of PuO2 with 5 mg of BP, 15 mg of asbestos or 5 mg of BP alone. Control rats received an injection of saline or were untreated. The asbestos fibers and PuO2 were concentrated within fibrous adhesions of the visceral peritoneum, mostly in the omentum. The PuO2 was also concentrated within parasternal lymph nodes, although no tumors were derived from these high-radiation dose areas. Benzpyrene increased the translocation of plutonium 239 to liver and lung; asbestos had no influence on plutonium 239 distribution. Both abdominal sarcomas and mesotheliomas were induced by plutonium 239 PuO2 or asbestos. No mesotheliomas were found in rats given BP only. About 90% of all abdominal tumors originated in the omentum. Observed tumor incidences following plutonium 239 were a 26% incidence of mesotheliomas and a 38% incidence of sarcomas at a calculated average dose of 33,500 rads to omental tissue, a 10% mesothelioma incidence and a 21% sarcoma incidence at 6300 rads, and a 6% mesothelioma incidence and a 13% sarcoma incidence at 770 rads. Asbestos acted in an additive manner with plutonium 239 in inducing mesotheliomas, the two agents combined having an effect equal to the sum of their effects when administered separately. A similar additive response was seen with BP and plutonium 239 PuO2 in the induction of abdominal sarcomas. Our results suggest that radiation protection considerations for plutonium should involve the distribution of radiation dose within the target tissue as well as evaluation of exposures to other industrial pollutants. (Auth)

<47>
Moskalev, Yu.I., and V.N. Strel'tsova, Ministry of Public Health, Institute of Biophysics, Moscow, USSR. 1973, June

Dependence of Osteosarcomogenic Activity of Radionuclides on their Physical Properties and Physiological State of the Animal. CONF-720505; AEC Symposium Series No. 29; Part of Sanders, C.L., et al (Eds.), Proceedings of the 12th Annual Hanford Biology Symposium on Radionuclide Carcinogenesis held at Richland, Washington, May 10-12, 1972, (p. 307-311), 500 p.

The induction of osteosarcomas by bone-seeking radionuclides is dependent on the radiation dose delivered to the skeleton, the energy and effective half-lives of the emitters, and the protraction of administered dose. Optimum osteosarcomogenic doses to rat skeleton were in the range of 15 to 50 krads for beta emitters (Sr 89, Sn 90, Ba 140, Cs 137, Y 90, Y 91, Ce 144, Pm 147, La 140, and P 32) and 0.7 to 1.8 krads for the alpha emitter Pu 239. Beta emitters with a short effective half-life (Y 90, La 140, and Cs 137) when compared with beta emitters with a long effective half-life (Y 91, Ce 144, and Sr 90) have shown relatively low osteosarcomogenic activity. A sharply decreased osteosarcoma incidence was observed after fractional administration of beta emitters as compared to a single injection of the same dose of isotope. Fractionation of Pu 239 administration had no significant effect on osteosarcoma incidence. The radionuclide-induced osteosarcoma incidence was identical for both male and female rats but significantly age dependent for each sex. When the sciatic nerve was cut prior to Ce 144 administration, fewer osteosarcomas appeared on the denervated extremities. (Auth)

<48>
Fabrikant, J.I., T.H.S. Hsu, D.H. Knudson, and C.L.D. Smith, University of Connecticut, School of Medicine, Department of Radiology, Farmington, CT; George Washington University, School of Medicine, Department of Radiology, Washington, DC; Institute of Cancer Research, Department of Biophysics, Sutton, Surrey, England. 1973, June

Effect of LET on Radiation Carcinogenesis: Comparison of Single and Fractionated Doses of Plutonium 239, Americium 241, Phosphorus 32, and X Rays on the Production of Osteosarcomas in Rats. CONF-720505; AEC Symposium Series No. 29; Part of Sanders, C.L., et al (Eds.), Proceedings of the 12th Annual Hanford Biology Symposium on Radionuclide Carcinogenesis held at Richland, Washington, May 10-12, 1972, (p. 322-346), 500 p.

Serial radiography, high-resolution autoradiography, histopathology, and the analysis of tumor-cell population kinetics were used to investigate carcinogenic effects of alpha and beta emitting radionuclides and localized x radiation on the induction of bone tumors in male August and hybrid (August crossed with Marshall) rats. Comparisons have been made over a period of 27 months on the effects of single and fractionated doses of high-linear-energy-transfer (LET) and low-LET (x ray) radiations in young rats to assess the characteristic development of radiation-induced changes, neoplastic transformation, and tumor-growth kinetics. Among the lesions observed radiographically following fixation of radionuclides in bone were failure of longitudinal bone growth, abnormal bone molding, pathological fractures, and the production of sclerosing, lytic, and mixed forms of osteosarcoma primarily in the appendicular skeleton but in certain situations in the axial skeleton as well. Fractionation of the administered dose of P 32 resulted in an increase in bone-tumor incidence and some indication of earlier development of neoplasia. With high-LET radiation (Pu 239 and Am 241), fractionation did not affect tumor incidence but did shorten the latent interval. With low-LET radiation, on the other hand, fractionation of dose decreased the tumor incidence, the extent of peritrabecular fibrosis in the metaphyses, and the development of epiphyseal plate abnormalities, but, in general, pathological lesions also included impaired limb growth and reversible and progressive forms of bony architectural damage in the femoral and tibial metaphyses and epiphyses leading to the production of sclerotic and lytic bone tumors. Characteristic early premalignant changes were dependent on the site of irradiation, such as deposition and retention of radionuclide, rather than on LET only. These alterations were frequently metaphyseal sclerosis, followed by growth extension within the bone, secondary cortical destruction, and delayed extension to surrounding soft tissues. The significance of histopathologic changes in relation to autoradiography and radiography for the identification of sites and cellular mechanisms essential to premalignant changes, the induction neoplasia, the accurate determination of latent periods for tumor development, dose-tumor relationships, the dependence of tumorigenesis on LET, and tumor-growth kinetics are discussed. (Auth)

<49>

<49>
Marshall, J.H., and E. Lloyd, Argonne National Laboratory, Radiological Physics Division, Center for Human Radiobiology, Argonne, IL. 1973, June

The Effect of the Remodeling of Bone Upon the Relative Toxicities of Radium and Plutonium in Man and Dog. CONF-720505; AEC Symposium Series No. 29; Part of Sanders, C.L., et al (Eds.), Proceedings of the 12th Annual Hanford Biology Symposium on Radionuclide Carcinogenesis held at Richland, Washington, May 10-12, 1972, (p. 241-436), 500 p.

When the rates of bone formation and resorption are high, monomeric plutonium does not remain for long on bone surfaces. Dogs injected with radioisotopes at little over one year of age (as in the Salt Lake Project) have bone turnover rates that exceed those in adult man by at least an order of magnitude. Therefore, the skeletal toxicity of monomeric plutonium relative to radium in man be significantly larger than that in the experimental dogs. The probable magnitude of this effect is estimated by constructing expressions for the dose rate to bone surface from Pu 239 and Ra 225 as a function of time since injection and as a function of the remodeling rate of bone. Skeletal plutonium is assumed to be initially deposited on bone surfaces; as time from injection increases, this initial deposit is displaced from bone surface by resorption and by burial due to new bone formation, eventually approaching a volume distribution. On the other hand, radium is treated as a volume distribution throughout. The relative biological effectiveness (RBE) of plutonium vs. radium in either man or dog is then assumed to be the ratio of the average skeletal dose from radium to that from plutonium under the condition that the doses to bone surface within the mean induction time of osteosarcomas are equal. Using best estimates of the parameter values from existing literature and taking RBE (Pu/Ra) equal to 6 for the Salt Lake dogs, the model leads to an estimate for RBE (Pu/Ra) in man of 17 plus or minus 6, about three times that in the dogs. The need for more data concerning this probable effect is emphasized. (Auth)

<50>
Norwood, W.D., J.A. Norcross, C.E. Newton, Jr., D.B. Hylton, and C. Lagerquist, Hanford Environmental Health Foundation, Richland, WA; Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA; Dow Chemical Company, Rocky Flats Division, Golden, CO. 1973, June

Preliminary Autopsy Findings in United States Transuranium Registry Cases. CONF-720505; AEC Symposium Series No. 29; Part of Sanders, C.L., et al (Eds.), Proceedings of the 12th Annual Hanford Biology Symposium on Radionuclide Carcinogenesis held at Richland, Washington, May 10-12, 1972, (p. 465-474), 500 p.

The first 14 autopsies presented to the Registry serve to indicate areas of differences between organ depositions determined by calculations or in vivo radiation measurements made before death and extrapolations from measured deposition in organ samples. They also show some marked differences in the concentration of Pu 239 in different areas of an organ, emphasizing the need for large samples or whole organs. In one autopsy 92% of the total lung deposit was found in pleura and subpleural lung parenchyma. Studies are in progress to determine more accurately the deposition in pleura, lung parenchyma, and lymph nodes in the chest. In one autopsy the concentration of the Pu 239 in vertebrae was 3.5 times that in the rib. In several other cases the difference between the concentration in rib and that in sternum has varied from 2 to 30, the concentration in ribs being higher in some cases and lower in others. Whole bodies will be studied to help determine the best organ samples to use in extrapolating total organ deposition from a measured sample. Perhaps greater emphasis should be placed on maximum concentration in organs rather than on total organ burden, which is presently used in setting permissible organ limits. Pertinent health physics and medical data for the 14 cases are tabulated. (Auth)

<51>
Taylor, L.S., National Council on Radiation Protection and Measurements, Washington, DC. 1972

What We Do Know About Low-Level Radiation. TID-25857; Part of Kline, A.B., Jr., The Environmental and Ecological Forum, 1970-1971, (p. 168-186), 186 p.

The criteria of the National Council of Radiation Protection (NCRP) and measurements used for setting radiation protection standards in the USA were reviewed. Dose-effect relationships for man in the dose range of 100 rems upward delivered at high dose rates can be regarded as well established on the basis of clinical and experimental data. While a tremendous effort has been made to discover significant deleterious effects of very low dose level and dose rate radiation on man all results have been convincingly negative. The range considered covers: an acute exposure to 1 or 2, or even a few more, rads received at once and not frequently repeated; larger doses of 10 to 20 rads received all at once and rarely repeated; and chronic exposure to levels of millirads or less per day over long periods of time and totaling some 5 or 10 rads distributed over a lifetime. In spite of the lack of observable effects from low-level radiation doses, the NCRP has maintained the basic philosophy that there could be deleterious effects in the low dose range proportional to those observed at vastly higher doses. The upper limit of 170 mrem/yr average recommended for the human population for exposure from all man-made radiations, other than medical applications, is some hundred times lower than the lowest dose that has been shown to cause a statistically significant pathological change in man. This population dose limit is at least some hundred times higher than the average dose to the population estimated for the operation of all the nuclear power plants expected to be built up to the year 2000 assuming no improvements in production technology. (Auth)(HP)

<52>
Sanders, S.M., Jr., E.I. du Pont de Nemours and Company, Savannah River Plant, Aiken, SC. 1961, April

Plutonium Excretion, Study Following Treatment with Zirconium Citrate and Edathamil Calcium-Disodium. Archives of Environmental Health, 2, 474-483

On December 1, 1958, a laboratory technician routinely analyzing Pu solution samples received a wound in her hand found to be contaminated with 2500 c/m alpha. Two hrs and 35 min. after the accident, 1.2 g of zirconium was administered intravenously with citrate in 200 ml of solution. The following day 1.0 g of calcium disodium ethylenediaminetetraacetate (Ca EDTA) was administered intravenously. About 90 dpm Pu was excreted in the first 17 hr. Feces collected 15 hr after the accident contained 1.35 dpm Pu. Feces from the fifth day contained 1.08 dpm Pu. No increase in Pu excretion was apparent during the administration of Ca EDTA. (HP)

<53>
Sanders, S.M., Jr., and S.C. Leidt, E.I. du Pont de Nemours and Company, Savannah River Plant, Aiken, SC. 1961

A New Procedure for Plutonium Urinalysis. Health Physics, 6, 189-197

A simple method of urinalysis, sensitive enough to detect 0.007 dpm plutonium in 250 ml of urine, is described. In this method, anion exchange is used to separate plutonium from other inorganic ions remaining after evaporation and oxidation of the urine. The quantity of plutonium is then determined by counting alpha tracks in an autoradiograph of the metal disk upon which the plutonium has been electrodeposited. (HP)

<54>
Jones, E.S., Oak Ridge National Laboratory, Oak Ridge, TN. 1962, November 2

Microscopic and Autoradiographic Studies of Uranium Distribution in the Rat Kidney. ORNL-3307; Part of Morgan, K.Z., Health Physics Division Annual Progress Report for Period Ending July 31, 1962, (p. 128-141), 180 p.

The concentration ratio is defined as the ratio of the average counts in the fields in the cortex to the average number of tracks per unit area, assuming the entire activity spread evenly over the whole kidney. The concentration ratio of uranium in the rat kidney is usually 1.3 but tends to approximate 1 at the 10-day postinjection time at the 1000 ug/kg level. At the 100 ug/kg level and at 4 days postinjection, the concentration ratio also approximates 1, and this may indicate a time when active removal of uranium from the kidney takes place. The comparison between the autoradiographic and radiochemical methods of measuring activity gave a gross check in spite of the experimental difficulties and large variance of some of the estimates. The possibility that the greater amounts of uranium cause a malfunctioning at first cannot be overlooked. The observed location of the uranium tracks is consistent with the pathological conditions, and the pathological conditions corroborate earlier findings on chemical injury. (HP)

<55>
Saccomanno, G., St. Mary's Hospital, Grand Junction, CO. 1968, November 20

Uranium Miners Health. COO-1862-4; Part of Hearings on Safety and Health Standards, (13 p.)

Cancer of the lung in uranium miners who are non-cigarette smokers is almost unheard of and the incidence of cancer of the lung is increased in cigarette-smoking uranium miners at least four-fold over and above the incidence levels of heavy cigarette smokers. Cigarette smoking and uranium mining are synergistic in relation to lung cancer. (HP)

<56>
Sagan, L.A., Palo Alto Medical Clinic, Department of Environmental Medicine, Palo Alto, CA. 1971, December

Human Radiation Effects, An Overview. Health Physics, 21, 827-833

Late somatic and genetic effects of radiation exposure are reviewed. Emphasis was on the human experience, but animal experience was included where necessary. Particular attention was directed to dose-response relationships and studies of low dose effects where they exist. Longevity, cancer (leukemia and other forms), and genetic effects are discussed. The author feels that the evidence is inconclusive with respect to effects in the range of exposures permitted by current radiation standards. (HP)

<57>
Gene, P.J. (Comp.), Australian Atomic Energy Commission, Research Establishment, Lucas Heights, Australia. 1972, May

Uranium Mining and Processing in Australia. AAEC-LIB/BIB-349; 17 p.

Ninety-seven references were selected from various secondary sources and annual reports of the Australian time period, 1952 to April, 1972. Author, title, publication description, and publication date are arranged alphatetically by author within years of publication. (HP)

<58>

<58>
Smith, D.D., and et al, Western Environmental Research Laboratory, Las Vegas, NV. 1972, May

Radionuclide Concentrations and Botanical Composition of the Diet of Cattle Grazing the Area 18 Range of the Nevada Test Site, 1966-1970. SWRHL-110-r; 38 p.

The radionuclide content and botanical composition of the diet of the cattle grazing on Area 18 range of the Nevada Test Site was determined by analyzing rumen samples collected from fistulated steers. A value for November 26, 1969 of 22 nCi/g was found that could be the result of ingestion of a single particle by the grazing animal. The radionuclide concentrations of the rumen samples both from world-wide fallout and from NTS events were either below the minimum detectable amount or are of very low magnitude. No pathology has been found that can be attributed to radiation. Detectable levels of Zr 95, Ru 106, Ba 140 and Ce 144 were usually found in samples collected during the late spring and early summer. Levels of Ru 106 and Zr 95 persisted into the fall. Samples collected following a contaminating event usually showed I 131 and Ba 140. Grass was a major portion of the diet. Squirreltail grass and Indian rice grass were predominant. Galleta grass, the dominant grass in Area 18 appeared in large amounts in June 1966, July 1967, July, August, September 1968 and in September 1969. Desert bitterbush and gambel oak were the principal browse species during most months. (HP)

<59>
Grindler, J.E., Argonne National Laboratory, Argonne, IL. 1962, March

The Radiochemistry of Uranium. NAS-NS-3050; 350 p.

References are cited for general reviews of the inorganic and analytical chemistry of uranium and also for general reviews of the radiochemistry of uranium. A table of the isotopes of uranium shows the half-life, type and energy of radiation, and method of preparation. A review of the nuclear and chemical features of uranium that are of particular interest to the radiochemist is given, followed by a discussion of problems of dissolution of a sample, counting techniques, and a collection of radiochemical procedures for the element as found in the literature. (PMM)

<60>
Dilley, J.V., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1970, August

Therapeutic Removal of Inhaled Plutonium. BNWL-1306 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1969, (p. 51), 90 p.

Forty therapeutic agents were tested in studies of the removal of inhaled Pu 239 PuO2 from the lungs of rats. Promazine HCL, Halotestin, Estradiol, Diuril, Phenergan, Progesterone, Diamox and Miltown, appeared to show some effectiveness. Diamox, Diuril and Miltown decreased the rat lung burden but increased the translocation to other tissues. When the animals were treated with these drugs in combination with DTPA the systemic burden was reduced 45 to 90% in each group and the lung burden was decreased as much as 25 to 50% in the Diamox plus DTPA and Diuril plus DTPA groups. Miltown plus DTPA did not decrease the lung burden. These studies suggest that the primary drug treatment is somehow responsible for making the inhaled Pu 239 PuO2 available for chelation by DTPA. (Auth)

<61>
Park, J.F., B.B. Howard, and W.J. Bair, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1970, August

Chronic Effects of Inhaled Plutonium 239 PuO2 in Beagles. BNWL-1306 (Part 1); Part of Thompson R.C. (Ed.), Annual Report for 1969, (p. 44-46), 90 p.

The long-term study of the biological effects of inhaled Pu 239 PuO2 in beagle dogs is in its eleventh year. Of 40 exposed dogs, 30 have died and five were sacrificed for tissue distribution data. Twenty-two dogs which have come to autopsy had multiple primary pulmonary tumors. All 15 of these dogs that survived as long as 4 months postexposure had lung tumors. The lowest plutonium lung burden associated with a tumor was 0.05 uCi at death 9 years after exposure. Analysis of hematology data indicated that dogs surviving for 93 months after exposure to Pu 239 PuO2, with body burdens of 0.2 to 1.0 uCi, continue to show lymphopenia compared to controls of similar age. The absolute lymphocyte count of the exposed dogs was 1.5 plus or minus 0.3 x 10(E+3)/mm3 (95% confidence interval) compared to 2.5 plus or minus 0.2 x 10(E+3)/mm3 for the controls. Plutonium analyses were completed on four dogs, 85 to 110 months after plutonium inhalation. The estimated initial alveolar deposition ranged from 0.6 to 1.8 uCi. The terminal body burdens were 0.4 to 1.4 uCi with 7 to 21% retained in the lungs, 41 to 56% in the tracheobronchial and mediastinal lymph nodes, 16 to 23% in the liver, 5 to 10% in the skeleton, 6 to 10% in the abdominal lymph nodes and 1.4 to 1.6% in the spleen. The lymphatic system contained 52 to 66% of the total plutonium retained in these animals. The livers of several dogs were divided along their anatomical fissures and each sample analyzed to determine the gross distribution of plutonium in the liver. Concentrations varied by about a factor of two between the highest and lowest lobe in a dog. This information is of significance to the interpretation of analyses on human liver tissue collected at postmortem. (Auth) (PMM)

Table 2 shows the Pu concentration in dog tissues 85 to 110 months after inhalation of Pu 239 PuO2.

<62>
Sikov, M.R., and S.S. Mahlum, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1970, August

Plutonium in the Placenta. BNWL-1306 (Part 1): Part of Thompson, R.C. (Ed.), Annual Report for 1969, (p. 24-25), 90 p.

Monomeric Pu 239 was intravenously administered to pregnant rats at a single time between 14 and 19 days of gestation; fetuses and placentas were collected at intervals thereafter. Autoradiographs demonstrated a pronounced localization of plutonium in the villus visceral splanchnopleure portion of the yolk sac. Significant amounts were also seen in the decidua and labyrinth layers of the placenta. The concentration was lower in the spongiotrophoblast, the activity being primarily localized in the giant cells. Although high radiation doses were received by these localized areas, no intrauterine mortality was observed at doses of up to 50 uCi to the dam. There was no indication of altered placenta function. Only a small amount of plutonium crossed the placenta; autoradiographically, this appeared to be entirely in the monomeric form and was primarily located in the fetal bone. Studies in progress, with plutonium injected after 9 days of gestation, show similar localization in the placenta and fetal membranes, but doses as low as 6.25 uCi to the dam have produced extensive prenatal deaths. (Auth) (FMM)

<63>
Rhoads, W.A., and R.B. Platt, EG&G, Inc., Santa Barbara Division, Goleta, CA; Emory University, Biology Department, Atlanta, GA. 1971, November 15

Beta Radiation Damage to Vegetation from Close-In Fallout from Two Nuclear Detonations. BioScience, 21(22), 1121-1125

The report recounts first field experiments associated with nuclear events and concerned with vegetation damage attributed primarily to beta radiation. It is supported by the first extensive field dosimetry for measuring both beta and gamma radiation doses simultaneously. Two small nuclear cratering experiments, Palanquin on April 14, 1965 and Cabriolet on January 26, 1968 occurred at the Nevada Test site. Vegetation studies were made on two species of sagebrush, ARTEMISIA ARBUSCULA and ARTEMISIA TRIDENTATA. Downwind to Palanquin, shrubs and trees were killed over an area of more than 3 km2, and in Cabriolet they were killed over a few hundred square meters beyond the area covered by material thrown from the crater. At Palanquin, the killed and damaged areas coincided with areas of elevated radiation backgrounds. Doses at Cabriolet were documented with special dosimetry to measure the field of beta doses in the presence of gamma radiation. Conclusions were drawn that damage and death of ARTEMISIA downwind to Palanquin and Cabriolet were attributable to fallout radiation, and beta radiation, with its large potential doses, was primarily responsible. (BBM)

<64>
Martin, J.R., and J.J. Koranda, University of California, Lawrence Radiation Laboratory, Biomedical Division, Livermore, CA. 1971, July

Distribution, Residence Time, and Inventory of Tritium in Sedan Crater Ejecta. Nuclear Technology, 11, 459-463

Radioecological studies were conducted over a five year period to characterize the distribution and residence time of tritium in soil samples from ejecta of the Sedan Crater. Extracted water was assayed by liquid scintillation counting. Kangaroo rats were trapped and monthly body-water tritium concentrations were plotted as a function of time. Residence half-time for tritium in the rats was determined to be 14.5 plus or minus 1.4 months. The agreement of tritium residence time in the body water of the rat with that obtained from the soil data suggests that the surface-to-six-foot interval is the biologically significant zone for tritium in the desert ecosystem at Sedan Crater. The tritium inventory in the ejecta at T sub 0 is reported as (1.5 plus or minus 0.2) x 10(E+6) uCi. (BBM)

<65>
Not given, International Atomic Energy Agency, Vienna, Austria. 1971

Rapid Methods for Measuring Radioactivity in the Environment. CONF-710705; IAEA-SM-148; Proceedings of an International Symposium held in Neuherberg, Germany, July 5-9, 1971, 967 p.

Twelve invited papers and 64 others are included. Topics include chemical and physical laboratory methods, field methods, normal and emergency surveillance, and data evaluation. A panel on future developments is included. (JMC)

<66>

<66>
Sakanoue, M., M. Nakaura, and T. Imai, Kanazawa University, Faculty of Science, Kanazawa, Japan. 1971

Determination of Plutonium in Environmental Samples. CONF-710705; IAEA-SM-148/54; Part of Proceedings of an International Symposium on Rapid Methods for Measuring Radioactivity in the Environment held in Neuherberg, Germany, July 5-9, 1971, (p. 171-181), 967 p.

Instead of the time-consuming method using ion-exchange resin separation, a simple solvent extraction method for determining plutonium in environmental samples has been developed and applied for various samples, for example, soil from the Nagasaki area, subjected to the first plutonium atomic bomb explosion in 1945 was analyzed in 1969, as well as corals from the east Pacific Ocean coast, and seawater from the Pacific Ocean. As yield tracer, the alpha emitter Pu 234 (5.75 MeV) was first spiked into the sample, and the sample solution was prepared in 8 M nitric solution either by direct leaching of the sample with nitric acid or by dissolving the ferric hydroxide precipitate made from the acidic solution of solid samples or natural water. Solvent extraction with tri-octylamine was applied to this aqueous solution and followed by the scrubbing of uranium and thorium with 8 M HNO3 and 10 M HCl, respectively. Finally, plutonium was stripped with 8 M HCl and 0.2 M HF, and determined by alpha spectrometry using a counting source prepared by electrodeposition on either a stainless steel plate or nickel foil. In addition to a gross alpha-track counting on cellulose nitrate, the very sensitive fission track method was also examined for determining Pu 239 and the evaluation of the interference from the contaminating uranium was studied. Contamination of the natural environment with plutonium isotopes was found in various samples and the content of each isotope was determined. (Auth)

Figure 6 shows the Pu 239 content in soil samples from various locations, with some data on Sr 90 content. Table 1 shows the Pu 239 content of the bottom sediments of the four water reservoirs in Nagasaki. Table 2 shows the content of Pu isotopes in coral and seawater.

<67>
Dutton, J.W.R., and N.T. Mitchell, Ministry of Agriculture, Fisheries Radiobiological Laboratory, Fisheries and Food, Lowestoft, Suffolk, England. 1971

Rapid Methods for Specific Radionuclide Analysis and their Application to Aquatic Emergency Conditions. CONF-710705; IAEA-SM-148/13; Part of Proceedings of an International Symposium on Rapid Methods for Measuring Radioactivity in the Environment held in Neuherberg, Germany, July 5-9, 1971, (p. 745-755), 967 p.

The responsibilities of the Fisheries Radiobiological Laboratory, Lowestoft, include monitoring of the aquatic environment as part of the control system to ensure safe disposal of liquid radioactive waste. In addition to planned discharges this responsibility extends to surveillance of the consequences to the aquatic environment of nuclear accidents. Laboratory methods of analysis for routine disposals have been developed and many of these can be adapted for use in emergency conditions. Some methods are already rapid; others are readily amenable to modification so that a result is produced quickly, in an hour or so or even less. A range of laboratory analytical methods in current use for controlled disposals is described, together with an account of procedures at successive stages of sample preparation, chemical separation (where necessary), radiometric measurement and processing of data. They include both manual and automated procedures, using a range of detector systems, and are directed to estimation of specific radionuclides. The main alpha radionuclides which are analyzed regularly at the Fisheries Radiobiological Laboratory are Pu 239, Pu 240, and Am 241. Occassionally Cm 242 is present as are traces of other plutonium radionuclides. In conclusion an account is given of how these methods would be applied in the event of an emergency, and integrated with field measurement techniques. The way in which they would be adapted to overcome limitations imposed by their operation outside controlled laboratory conditions is also considered. (Auth) (PMM)

<68>
Not given, Southwestern Radiological Health Laboratory, National Center for Radiological Health, Las Vegas, NV. 1968, December

Nimbus-B/SNAP-19 Launch, May 18, 1968, Off-Site Radiological Surveillance. SWRHL-50-r; 15 p.

The Southwestern Radiological Health Laboratory monitored the off-site area during and after the launch of the Nimbus-B/SNAP-19. Shortly after launching, the vehicle was destroyed because of an undesirable flight part. The best estimates placed the impact area of the generator package about 5 miles north of San Miguel Island in the Santa Barbara Channel. A variety of environmental samples was collected from the mainland, sea, and channel islands and compared to previous data from the area. During the recovery operations, additional samples were taken. No increase in environmental radioactivity levels was observed from this operation. (HP)

<69>
Tait, G.W.C., and J. Beal, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. 1964

The Integrating Impactor, a Monitor for Airborne Alpha Emitters. Health Physics, 10, 279-282

A monitor for airborne alpha emitters is described which provides warning on a continuous basis. The sensitivity is adequate for protection of workers against Pu 239 to the standard called for by the ICRP. The effects of natural background are eliminated. (Auth)

<70>
Lynn, R.L., D.G. Crandall, R.K. Mullen, and W.A. Rhoads, EG&G, Inc., Santa Barbara Division, Goleta, CA. 1970, September

Gamma Radiation Spectra in the Vicinities of Projects Shoal and Faultless. EGG-1183-2255; 15 p.

The scintillator array used in the Aerial Radiological Measurement Survey (ARMS) System was employed in ground-based gamma radiation surveys of the Project Shoal and Project Faultless sites. Measurements were made at nine locations at the Project Shoal site and at four locations at the Project Faultless site. On the basis of an unconfirmed report of possible low-level radioactive contamination at the Project Shoal site, six rodents were trapped and removed from that site for whole-body gamma spectral analysis. Computerized analysis of the gamma spectra obtained at the Project Shoal site revealed a radiation peak in the 0.650-0.670 MeV region at some, but not all, of the locations where measurements were made. The origin of this radiation, which has tentatively been identified as Cs 137, is unknown. Similar analysis of the gamma spectra obtained at the Project Faultless site revealed no radiation peaks not attributable to normal background. Whole-body counts made on the rodents secured from the Project Shoal site revealed no radiation burden other than normally occurring K 40. The lack of any discernable peak in the 0.650-0.670 MeV region would suggest that the radioactive contaminant present at the Project Shoal site is not involved in the food-chain kinetics of the resident rodent population. (Auth)

<71>
Lotz, W.E. , U.S. Atomic Energy Commission, Division of Biology and Medicine, Washington, DC. 1964

Symposium of Inhaled Radioactive Particles and Gases, Statement on the Problem. Health Physics, 10, 863-866

The widespread use of radioisotopic power units for space missions will depend on the degree of confidence mission planners have that the devices are reliable electrical power sources, that they can be depended on to operate without failures over the lifetime of the mission, that they can be employed in space safely and that the radioactive fuel will not create a hazard for local populations. The biological effects of dispersed radioactive particles are an important parameter in the SNAP programs. The hazards resulting from nuclear rockets from a premature and uncontrolled re-entry and impact could be serious or negligible depending on where the reactor was started and where the failure occurred. Potential exposures from Rover are 1) external whole body doses, 2) beta skin doses and 3) lung and gastrointestinal tract doses. (HP)

<72>
Not given, Air Resources Laboratory, Las Vegas, NV. 1972, April 28

Weather Prediction and Surface Radiation Estimates for the Sulky Event. PNE-711F; 39 p.

This report documents the activities performed by the Air Resources Laboratory, Las Vegas, Nevada in support of Project Sulky. The objectives and functions of the Weather Bureau in the Sulky experiment are outlined. The meteorological facilities and procedures are discussed along with the meteorological forecasts and radiation estimates which were issued. These forecasts are compared with meteorological and radiological data collected during and after the detonation of Sulky. The post-shot meteorological trajectories are described and the results of a tetroon tracking experiment run in conjunction with the Sulky shot are presented. (Auth)

<73>
Saut, W.H., T.R. Garland, and J.J. Roemer, Atlantic Richfield Hanford Company, Richland, WA. 1969, June

Improvements in Radiochemical Analysis and Data Reduction of Environmental Air Samples. ARH-SA-29; CONF-690606-3; Part of Proceedings of the 24th Northwest Region Symposium of the American Chemical Society held in Salt Lake City, Utah, June 12-13, 1969, (18 p.)

An environmental air sample radioactivity monitoring program used at the Redox Analytical Laboratory is described. A proposed revision and computerization of this program to meet the current and projected needs is outlined. The limits specified by the existing authority are referenced and explained. Methods of attaining improved lower detection limits and computer calculated results together with computer plots of long term data are outlined. (Auth)

<74>
Russell, S., H. Levine, and R. Schneider, U.S. Public Health Service, Division of Radiological Health, Radiation Surveillance Network, Rockville, MD. 1966, August

Plutonium in Airborne Particulates, November 1965-March 1966. Radiological Health Data and Reports, 7(8), 483-484

Analysis of monthly results in picocuries per 1000 cubic meters of air are tabulated for the eleven station locations from November, 1965-March, 1966.

<75>

<75>
Not given, Western Environmental Research Laboratory, Environmental Surveillance, Las Vegas, NV. 1972, February

Final Report of Off-Site Surveillance for the Pin Stripe Event, April 25, 1966. SWRHL-59-r; 78 p.

The Public Health Service provided off-site surveillance in support of the Pin Stripe Event conducted on April 25, 1966, at the Nevada Test Site. This support consisted of tracking the effluent, monitoring radiation dosage to the off-site population, collecting and analyzing environmental samples of air, milk, water and vegetation, and conducting an intensive public relations program for the off-site residents. The maximum net gamma exposure rate measured by a portable survey instrument was 8 mR/hr. This reading was taken along a gravel road used only occasionally and well away from any continuously occupied area. The highest net gamma exposure rate measured at a continuously occupied location was 1.5 mR/hr. The above exposure rates were taken during cloud passage. The maximum gross beta concentration found on an air filter from a continuously populated area was 25,000 pCi/m3. This filter showed an I 131 concentration of 5300 pCi/m3. The highest concentration of I 131 in a domestic water supply was 3860 pCi/l and the highest concentration of I 131 in a single milk sample was 4800 pCi/l. This concentration (4800 pCi/l) appeared three days after the event and was not representative of the levels of I 131 actually consumed by any off-site resident. Dilution of milk from this dairy with milk from dairies outside of the contaminated area, lowered the level of I 131 to a maximum of 100 pCi/l. (Auth)

Appendix includes tables on additional air sampling results, complete water sampling data, vegetation sampling data, and complete milk sampling data.

<76>
Bernard, S.R., and C.F. Holoway, Oak Ridge National Laboratory, Health Physics Division, Oak Ridge, TN. 1965

Estimates of f sub 1 for Plutonium Compounds. ORNL-3849; Part of Health Physics Division Annual Progress Report for Period Ending July 31, 1965, (p. 212-213), 263 p.

The experimental data of Weeks, et al, and Ballou are used to derive mathematical equations for f sub 1 (percent of plutonium deposited in rats at four days). The valence state, the fraction as polymer, and the pH of the solution are the most important variables. Experimental values varied from 0.02% to 0.00002% of the administered dose. (JMC)

<77>
Kashima, M., D.D. Mahlum, and M.R. Sikov, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Metabolism and Effect of Monomeric and Polymeric Plutonium in the Immature Rat Liver. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 749-752

The distribution of monomeric and polymeric Pu 239 after administration to newborn, week-old, weanling, or adult rats was studied autoradiographically. The effects of Pu 239 on the liver were evaluated using hepatic incorporation of Au 198 colloid and blood clearance of I 131 rose bengal. The uptake of gold by the liver was markedly decreased at 21 days after exposure of newborn or week-old rats to 60 uCi/kg monomeric Pu 239. Polymeric Pu 239 (30 uCi/kg) decreased gold uptake only in animals injected as newborns. Blood clearance of I 131 rose bengal was decreased in animals injected at birth or at 1 week of age with either monomeric or polymeric Pu 239. Animals injected as weanlings or adults with either form showed no impairment of ability to clear I 131 rose bengal from the blood or to incorporate Au 198 into the liver. (Auth)

<78>
Kochurnikova, N.A., V.P. Aristov, V.K. Lemberg, G.S. Mushkacheva, M.G. Poplyko, and I.A. Tseveleva, Ministry of Public Health, Institute of Biophysics, Zhivopisnaya 46, Moscow, USSR. 1972, June

Mechanism of Development of Plutonium-Induced Pulmonary Sclerosis. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 753-758

The mechanism of development of plutonium-induced pulmonary sclerosis following the inhalation of soluble plutonium compounds was studied by light and electron microscopy and with biochemical methods. Plutonium-induced pulmonary sclerosis is a consequence of radiation injury. The effects seen are due to excessive reparative functioning of connective tissue when disturbance of physiological regeneration takes place, and due to intensified destruction of parenchyma as a result of radiation injury. Endothelial elements of capillaries show the greatest susceptibility to radiation damage. Interalveolar sclerosis develops as a consequence of intensified proliferation of fibroblasts. Collagen fibers are formed in the basal layer of the alveolar-capillary barrier and in positions previously occupied by capillaries. Infection and the consequent aggravation of pneumonic processes is a significant factor in development of sclerosis. (Auth)

<79>
Sanders, C.L., and T.A. Jackson, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Induction of Mesotheliomas and Sarcomas from "Hot Spots" of Plutonium 239 PuO2 Activity. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 755-759

Albino rats were given an intraperitoneal injection of approximately 2.8 uCi, submicron-sized Pu 239 PuO2 particles. From 30 to 35% of the initially injected dose was found in the omentum within fibrous adhesions by 6 months after plutonium injection. About 27% of the animals developed mesotheliomas and 38% sarcomas of various types. All but 3 of these tumors originated from the omental area with a median induction period of about 1 yr. The tumors spread by implantation on serosal surfaces, by infiltration and by metastasis. In addition to omental tumors, two osteogenic sarcomas and one reticulum cell sarcoma were found in PuO2 animals. The pathogenesis of PuO2-induced mesothelioma was similar to previously described mesothelioma formation following intracavitary administration of asbestos fibers. The distribution of PuO2 in fibrous adhesions was similar to that seen in tracheobronchial lymph nodes of beagle dogs following inhalation of Pu 239 PuO2. Likely sites for tumor formation from inhaled PuO2 may include mesenchymal tissue from lungs and thoracic lymph nodes and mesothelial lining of the pleura, particularly when the PuO2 is redistributed into "hot spots" of alpha activity. (Auth)

<80>
Jee, W.S.S., R.B. Dell, and L.G. Miller, University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT; Idaho Nuclear Corporation, Reactor Development Branch, Idaho Falls, ID. 1972, June

High Resolution Neutron-Induced Autoradiography of Bone Containing Plutonium 239. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 761-763

The detailed neutron-induced autoradiographic process for bone containing Pu 239 produces autoradiographs with both fission fragment tracks and a corresponding bone image. Seven-microns-thick undecalcified bone sections were affixed on 300-um-thick Lexan (polycarbonate) film coated with 0.5% calf skin gelatin and exposed to neutrons in the thermal column of the Material Testing Reactor (MTR) at the National Reactor Testing Station in Idaho. The specimens were immersed in 28% KOH at 50 C for 1-1 1/2 hr to etch pinholes at the location of each fission track and to pit the film at the location of the bone. When the films were etched immediately after irradiation, no bone image was produced, but when the bone sections were allowed to remain on the film for several weeks after irradiation, the irradiated bone caused a pitting of the film surface. Betas from P 32 seemed to be the main charged particles available to produce the pitting. This detailed neutron-induced autoradiographic process has advantages over the nuclear emulsion autoradiography of bones because it eliminates long exposure times and fading of latent image. It is a rapid, effective procedure. (Auth)

<81>
Smith, V.H., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Therapeutic Removal of Internally Deposited Transuranium Elements. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 765-778

Treatment for the accidental incorporation of the transuranic elements is mainly dependent on chelation therapy. Most of the therapeutic experience has evolved, justifiably, for the removal of plutonium. The plutonium therapeutic regimens may serve as a rough guide to the treatment of other transuranides, although, quantitatively, dissimilarities based on chemical and incorporated mass differences are to be expected. With the added complication of the biological disposition of the daughter products and the high specific activities of some of the isotopes, any significant incorporation should be treated, and treated promptly. While progress in the treatment of plutonium has been slow, a better understanding of removal from specific tissues, such as liver, bone and lung, for soluble and insoluble plutonium materials, is being achieved. The brightest spot is the ability to remove about half the inhaled particulates, plutonium or other transuranics, from the lung by lung washing. Coupled with the judicious use of chelation therapy this should significantly reduce the hazard from inhaled transuranics. These and other aspects of the treatment for poisoning by the transuranic elements will be discussed. (Auth)

Tables are given for: a.) Characteristics of hazard concern for some isotopes of the transuranium elements, b.) oxidation states of actinides, c.) effect of DTPA on the retention of intravenously injected neptunium and plutonium citrates in rats, d.) effect of Zn DTPA on retention of Eu 253 21 days after intramuscular injection into both hind legs of rats, e.) effect of DTPA on retention of Cf 252 and Am 241 in mice, f.) effect of Ca DTPA on removal of inhaled Pu citrate in rats, and g.) removal of inhaled Pu 239 PuO2 by pulmonary washing with isotonic saline in baboons and dogs. Charts are given for: a.) therapy for americium and curium depositions in man, and b.) experimental removal of americium and curium in animals.

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Seidel, A., and V. Volf, Kernforschungszentrum Karlsruhe, Institut fur Strahlenbiologie, Karlsruhe, German Federal Republic. 1972, June

Removal of Internally Deposited Transuranium Elements by Zinc DTPA. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 779-783

The comparative effectiveness of Ca DTPA and Zn DTPA in removing internally deposited Pu 239, Am 241, and Cm 242 was tested in the rat. The radionuclides were administered in a citrate solution and treatment with three chelate injections (1 mmol/kg/d) was begun 6 days later. No essential differences were observed between the two chelates tested. The data indicate that the removal of the isotopes from the liver cannot be a suitable criterion for the effectiveness of treatment in other soft tissue organs. The liver isotope content was reduced to 10% of the controls, whereas the content of other organs, including bone, was never reduced to less than 40% of the control. In liver and lung, the response to treatment was different for Am 241 and Cm 242 as compared to Pu 239. There was no such difference as far as other organs are concerned. (Auth)

Tabular data are given on the influence of Ca DTPA and Zn DTPA on the removal of Pu 239, Am 241, and Cm 242 from the rat.

<83>
Baxter, D.W., and M.F. Sullivan, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Gastrointestinal Absorption and Retention of Plutonium Chelates. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 785-786

The intestinal absorption of plutonium nitrate is increased approximately 700-fold when chelated with DTPA. Within 2 days, virtually all of the absorbed plutonium-DTPA complex is excreted in the urine. Thus, plutonium retention in the liver and skeleton is quite low, but more than twice as high as when DTPA is not present. Citrate is less effective than DTPA in increasing absorption, but more effective in increasing retention. Since both absorption and retention are increased by chelation, consideration must be given to this added risk when therapeutic procedures result in the chelation of plutonium entering the gastrointestinal tract. (Auth)

<84>
Jech, J.J., B.V. Andersen, and K.R. Reid, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Interpretation of Human Urinary Excretion of Plutonium for Cases Treated with DTPA. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 787-792

Urinary excretion data are reviewed for selected human cases which were treated with DTPA following plutonium intake via inhalation and injection. Data obtained out to several years postintake are compared to the data for non-treated cases. These data point out the difficulties involved in determining the effectiveness of the DTPA and in evaluating the systemic deposition. Utilizing urine results obtained between treatment dates to determine the DTPA effect may be misleading, underestimate the effectiveness and result in a premature cessation of treatment. The extended data indicate that the urine excretion rates eventually stabilize to the rates predicted by the Langham or Healy models. However, the rates appear to remain elevated above that expected for periods up to a hundred days posttreatment. Evaluations based on data in the period prior to stabilization of the excretion rate may lead to overestimates of the systemic deposition. (Auth)

<85>
Mays, C.W., and T.F. Dougherty, University of Utah, College of Medicine, Radiobiology Division, Salt Lake City, UT. 1972, June

Progress in the Beagle Studies at the University of Utah. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 793-801

Young adult beagles are given single intravenous injections of monomeric Cf 252, Cf 249, Am 241, Pu 239, Th 228, Ra 228, or Sr 90 in citrate solution to achieve reproducible deposition patterns in tissue. Injected transuranium atoms become attached to transferrin and other substances in blood plasma. The skeleton and liver are the primary sites of deposition, although high local concentrations of californium, berkelium and americium also occur in the thyroid and kidney, and radium also concentrates in the eye. The initial skeletal deposition of monomeric transuranium elements is on bone surfaces. The mean local dose-rate to the soft-tissue layer 0-10 u from the mineralized bone surfaces of the beagle is about 20 times higher when Pu 239 is on bone surfaces than for an equal amount of Pu 239 randomly distributed throughout the bone mineral. Thus, the rate of bone-surface remodeling has a very important influence on the skeletal toxicity of the transuranium elements. The initial liver deposition of monomeric transuranium elements is rather uniform and mainly in the hepatic cells. Subsequently, much of the radioactivity shifts into the liver reticulcendothelial cells that line the sinusoids. At long times after injection, the distribution is very non-uniform, being highest in the portal region and lowest in the regenerative nodules. All, or virtually all, of the life-shortening from medium and low doses has been due to radiation-induced cancer. Bone sarcomas have been the most frequent form of malignancy, but head sinus carcinomas, liver tumors, and eye melanomas have also been induced. On the basis of average skeletal dose, 1 rad from Pu 239 is the equivalent of 5-10 rads from Ra 226 in the induction of bone sarcomas. This is because in the skeleton a considerable fraction of the Pu 239 disintegrations occur on bone surfaces near cells, whereas most of the skeletal disintegrations from Ra 226 take place within bone mineral. Plutonium will continue to be the chief interest, not only at low doses, but perhaps at different ages and in different chemical forms. Other radionuclides of practical and fundamental importance will continue to be studied. This is the first experiment in which tumor induction by fission fragments (Cf 252) is being determined. (Auth)

<86>
Park, J.F., W.J. Bair, and R.H. Busch, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Progress in Beagle Dog Studies with Transuranium Elements at Battelle-Northwest. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 803-810

Studies were initiated 10-12 yr ago to determine the biological effects of inhaled plutonium. Sixty-five beagle dogs inhaled Pu 239 PuO2 and were held for life-span observations. Sixty dogs died or were euthanized when death was imminent due to plutonium-induced pulmonary fibrosis and/or neoplasia 2-135 months postexposure. Twenty-four of the dogs had primary pulmonary neoplasia, including 20 of the 21 dogs that survived at least 4.5 yr posterposure. Most lung tumors were bronchiolo-alveolar carcinomas of peripheral origin with metastases to several other tissues. Two squamous cell carcinomas, three epidermoid carcinomas and three thoracic sarcomas were also observed. The estimated initial alveolar deposition in the dogs with plutonium-induced tumors ranged from 0.2 to 3.3 uCi. Approximately 10% of the alveolar-deposited plutonium was retained in the lungs after 8-10 yr posterposure, with an accumulated average radiation dose to the lungs of 2000 to 12,000 rads in the tumor-bearing dogs. Forty to fifty percent of the plutonium was translocated to the tracheobronchial and mediastinal lymph nodes, 10-15% to the liver, 5% to the skeleton and 5% to the abdominal lymph nodes. The highest plutonium concentrations occurred in the tracheobronchial, mediastinal and abdominal lymph nodes, followed in descending order by lungs, liver and skeleton. Respiratory insufficiency and lymphopenia were the primary clinical signs associated with the fibrotic, metaplastic and neoplastic changes in the lungs, and with the fibrosis of the lymph nodes. The pathology in these tissues may have influenced the clearance and translocation rates of the plutonium. Alveolar deposition of more than about 1 nCi/g of lung, about 30 times the quantity, at equilibrium, resulting in an average lung dose of 0.3 rem/week, might be expected to cause premature death due to pulmonary pathology. Experiments were initiated in 1970 to study dose-effect relationships at low dose levels in 200 dogs depositing 0.002-3.0 uCi of Pu 239 PuO2 or Pu 238 PuO2. The lowest level corresponds to an average lung dose of 0.3 rem/week. This study should further identify the critical tissues for inhaled plutonium at low dose levels. (Auth)

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Watters, R.L., and J.L. Lebel, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO. 1972, June

Progress in the Beagle Studies at Colorado State University. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 811-814

Air oxidized plutonium, Pu(NO3)4 and high fired PuO2 (850 degrees C) which had known amounts of Am 241 were implated over the left metacarpus in beagle dogs and the concentrations of Pu 239 and Am 241 in various tissues were measured as a function of time. The effect of DTPA therapy upon organ depositions was also studied. For air oxidized plutonium, rapid movement of Pu 239 and Am 241 to the proximal lymph node (superficial cervical) has been observed by in vivo counting. Approximately 3% of the implant material reached the lymph node within 2 weeks and continued an exponential build-up to 17% at 1 yr. Results of plutonium assays in blood indicate a 14-fold increase in movement to the circulation from the Pu(NO3)4 implants as compared with the air oxidized plutonium. This is supported by comparison of the depositions in the liver and the proximal end of the femur where the Pu(NO3)4 experiment produced twenty-four times higher levels of plutonium than did the air oxidized plutonium experiment. The effect of DTPA therapy was greater for the nitrate than for the air oxidized plutonium implants. (Auth)

<88>
McClellan, R.O., Lovelace Foundation for Medical Education and Research, Albuquerque, NM. 1972, June

Progress in Studies with Transuranic Elements at the Lovelace Foundation. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 815-822

Research directed toward developing an improved understanding of the biomedical consequences of inhaling transuranic elements was initiated at the Lovelace Foundation in 1968, recognizing the need for additional information on these radionuclides as well as the opportunity to obtain data for comparison with those previously collected and being collected on fission product radionuclides. The research is being performed to develop information that will assist in predicting potential effects in man from inhaled transuranic elements, and to provide the data necessary for establishing realistic radiation protection guides. Recognizing the need for quantitative data on the influence of particle size on the toxicity of inhaled alpha emitters, a major, and successful, effort has been directed toward the production of monodisperse aerosols of respirable particles. Studies on the metabolism and toxicity of Pu 239, Am 241, Cm 244 and Cf 252 have been performed or are under way in mice, Chinese hamsters, Syrian hamsters, rats and beagle dogs. The effectiveness of bronchopulmonary lavage for removing inhaled radioactivity, including Pu 239 is also being studied. This study, in part, provided the basis for the use of bronchopulmonary lavage to recently treat an individual who accidentally inhaled Pu 239. (Auth)

<89>
Stover, B.J., University of North Carolina, Department of Pharmacology, Chapel Hill, NC; University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1972, June

Life Shortening Consequent to Internal Irradiation from Plutonium 239. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 823-827

Survival data for beagles at 6 dose levels of Pu 239, which range from 0.016 to 2.9 uCi Pu 239/kg injected, are compared with those for beagles that received no Pu 239. The criterion for life shortening is that defined mathematically by the steady state theory of mutation rates. A brief summary of this theory is presented. The life-shortening decreased with decreasing dose level through the first 5 levels but none was observed at the lowest level. The death rate curves for the lowest dose level and the controls were essentially coincident. Osteosarcomas do occur at this dose level, so it may be a matter of "trading of causes of death" rather than decreasing the length of the animal's life. A brief commentary on the chemistry of plutonium and the transplutonic elements is included. The retention and distribution of plutonium in these beagles is reviewed. Finally, suggestions are made about experimental factors that should be varied in order to evaluate the toxic effects of plutonium. (Auth)

<90>
Bistline, R.W., R.L. Watters, and J.L. Lebel, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO. 1972, June

A Study of Translocation Dynamics of Plutonium and Americium from Simulated Puncture Wounds in Beagle Dogs. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 829-831

The translocation dynamics of plutonium and americium from simulated wounds contaminated with Pu(NO3)4 and high fired PuO2 (calcined at 850 degrees C) in the paw of dogs were analyzed by in vivo counting equipment. Measurements were made over the implant site and the major superficial cervical lymph node with a NaI(TI) detector system. The difference in accumulation dynamics between the two chemical forms and effects of DTPA treatment are shown. In all cases, measurable levels of plutonium movement to this lymph node was seen within minutes. (Auth)

<91>
Craig, D.K., J.M. Thomas, J.R. Becker, and J.F. Park, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Alveolar Deposition of Plutonium 239 PuO2 Aerosols in Beagle Dogs as a Function of Respiration and Aerosol Parameters. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 845-855

Beagle dogs are currently being exposed to Pu 239 PuO2 aerosols as part of a low-level effects study which will include both Pu 238 and Pu 239. Desired alveolar burdens range from 2 nCi to 3 uCi, divided into 6 groups. Respiration parameters measured during exposure include total inspired volume (VOL), respiratory frequency (RF) and tidal volume (TV). Aerosol parameters measured are concentration (CONC) and the aerodynamic equivalent size distribution, characterized by the activity median aerodynamic diameter (AMAD) and geometric standard deviation (GSD). These latter two measures were combined into one parameter, percentage activity less than 0.5 um aerodynamic equivalent diameter (LS 0.5), to describe the aerosol size distribution. Alveolar deposition (NCI) was determined from thorax counts 14 days postexposure. Percentage alveolar deposition, defined as DEP equals (100 times NCI)/(VOL times CONC), varied from 0 to 54 for 36 exposed dogs. A correlation matrix involving aerosol, respiration and physiologic (RT) parameters was computed to determine those factors which most significantly influenced DEP. Subsequent stepwise regression analysis yielded the equation DEP equals 3.11 LS 0.5 plus 0.015 TV, which accounted for 74% of the variability in DEP. Unlike tidal volume, respiration rate was not significantly correlated with DEP. AMAD was found to be highly correlated with LOG10 CONC (R equals 0.895) while GSD was significantly correlated with AMAD (R equals -0.597). This suggested that the pre-exposure value of CONC could be used indirectly to compute LS 0.5. Since an estimate of TV could also be obtained during the exposure, DEP values could be estimated from the suggested regression equation, and the volume (VOL) that a dog should inhale to obtain the required alveolar burden (NCI) could be calculated. The results obtained using this procedure are discussed. (Auth)

<92>
Parker, H.G., S.R. Wright, A.de G. Low-Beer, and D.J. Yaeger, University of California, Donner Laboratory and Lawrence Berkeley Laboratory, Berkeley, CA. 1972, June

The Metabolism of Einsteinium 253 in Mice. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 647-651

Es 253, a pure alpha emitter with a half-life of 20.5 days, is now available in microgram amounts. The potential for human exposure to it and the lack of published observations on its behavior in animals led us to study its whole-body retention, excretion and organ distribution in mice. Citrated Es 253 was injected intramuscularly; half the mice also received DTPA treatment beginning 2 hr after the injection. Daily whole-body counts were obtained by L x ray counting, and the organ and tissue activities were measured by x ray and alpha counting at 4 and 14 days. Comparison was made with our earlier Am and Cf study in mice. Einsteinium behaved according to predictions based on its place among the actinides. DTPA therapy was about as effective for Es as for the other actinides. The validity of the L x ray method for whole body, organ, tissue and excreta counts, using empirically determined correction factors, was established for the mouse. The method offers simplifications for future studies of this sort. (Auth)

The technique for Es whole-body counting could be applicable to counting other nuclides, such as Pu 239 and Cm 244 in which only the low-energy x rays provide detectable photons. The most conclusive check of the method was made in a similar experiment using Am 243 instead of Es.

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Menot, J.C., R. Masse, M. Morin, and J. Lafuma, Commissariat a l'Energie Atomique, Department de la Protection Sanitaire, Fontenay-aux-Roses, France. 1972, June

An Experimental Comparative Study of the Behavior of Neptunium 237, Plutonium 238, Plutonium 239, Americium 241 and Curium 242 in Bone. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 657-665

Actinides, whether administered by intramuscular injection or by aerosol, had different rates of uptake from the contaminated site and resulted in different bone deposits. Neptunium, especially when injected as an acid solution with valence 5, had a metabolic fate similar to elements with valence 2, yet its urinary excretion was higher than that of the alkaline earths. Because of their valences both curium and americium (valence 3) and plutonium (valence 4) could be compared to lanthanides. Following intramuscular injection, Pu 238 and Pu 239 could be distinguished from americium and curium by a greater uptake in bone. The part played by mass, noticeable after intramuscular injections, was still more noticeable after pulmonary administration. Bone deposits were higher with Pu 238 than with Pu 239. A study of the various plutonium compounds or complexes showed that bone burdens decreased as their stability in vivo increased. The smallest bone burden was obtained with the Pu-DTPA complex, the highest one with the Pu-transferrin complex. Bone-seeking actinides could also be distinguished by their histological distribution. Uptake areas were periosteum, perivascular spaces, endosteum, the inner epiphyseal plate, metaphysis and marrow. No element seemed to deposit noticeably on the mineral matrix; yet some migrating elements could be found in deep bone, closely connected with the osteocytes and their canaliculi. A rough assessment of actinide bone deposits could be obtained quickly by determining the total amount of urinary excretion of the element prior to any medical treatment. Estimating the bone burden to be twice the cumulative urinary excretion before initiating treatment with DTPA would usually overestimate bone deposition, which would not impair the therapeutic decision. DTPA was effective in treating bone deposits of elements of valence 3 and 4; they were decreased by one third within 3 months. It has not been determined whether this action will last beyond the fourth month. (Auth)

<94>
Lloyd, R.D., C.W. Mays, G.N. Taylor, and J.L. Williams, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, June

Californium Excretion and Retention by Beagles Injected with Californium 249 or Californium 252. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 667-673

The metabolism of californium was studied in 11 beagles 0-160 days after intravenous injection of Cf 249 or Cf 252 as Cf(+3) citrate. Total excreta collections were made for the first 21 days after injection, and the samples were analyzed for their californium content by gamma-ray counting of the 333 and 188 keV gamma-rays of Cf 249 or the fission gamma-rays of Cf 252. It was found that the excretion of californium during this period was mainly in the urine. About 3/5 of the total activity excreted during the first 3 weeks appeared in the first day's collection. A combination of total-body and partial-body counting was used to determine serially the total-body retention and partitioning of retained Cf between liver and non-liver tissue. These measurements indicated that 1 week following injection, about 20% of the injected Cf was deposited in the liver and that about 60% remained in non-liver tissue (mainly skeleton). The relative bone-to-bone distribution of Cf 239 in the skeletons of 2 dogs sacrificed 7 and 21 days after injection was similar to that of Cf 249 and Pu 239 injected as citrates. (Auth)

Tabular data for excretion of Pu, Am, and Cf in beagles during the first 3 weeks after intravenous injection, biological retention of injected Cf in beagles, and gross distribution of Cf 249 in beagle skeleton compared with Am 241 and Pu 239 are given.

<95>
Atherton, D.R., and R.D. Lloyd, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, June

The Distribution and Retention of Californium 249 in Beagle Soft Tissue. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 675-677

Beagles injected intravenously with Cf 249 in citrate buffer of pH 3.5 were sacrificed 7 days and 3 weeks after injection. As with americium, the concentration of californium in the liver was highest of all soft tissue but the total was about 18-20%, whereas the beagle liver retains about 50% of injected americium at comparable times. Concentrations in other soft tissue ranged from 70% of that in the liver downward. The thyroid, kidney, spleen, lymphatic tissue and dura mater showed significant concentrations. The presence of californium was ubiquitious but in very low concentrations throughout all other soft parts; the brain, lungs, heart, gastrointestinal tract, pancreas, gonads, thymus, pituitary and adrenals being measured specifically, as were large samples of fat, muscle and pelt. From these initial studies it is seen that of the soft tissues, liver, thyroid and kidneys will be at greatest risk following administration of Cf 249. (Auth)

Tabular data for retention of Cf 249 and Am 241 in tissues as percentage of injected dose and concentration of retained Cf 249 and Am 241, (%/gram) x 10(E+3) are given. See also Report CCO-119-246, (p. 299-306).

<96>
Stevens, W., and F.W. Bruenger, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, June; 1972, March 31

Interaction of Californium 249 and Californium 252 with Constituents of Dog and Human Blood. CONF-710910; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 679-683; COO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 319-330), 380 p.

Beagles were injected with Cf 249 or Cf 252 in citrate buffer. The concentration of nuclide in plasma and whole blood was measured from 5 min to 48 hr postinjection. Small amounts of californium were found associated with the cellular elements. The concentration of californium in plasma decreased rapidly during the first few hours after injection. At 24 hr postinjection less than 1% of the injected dose was circulating. Calfornium 249 and 252 disappeared from the circulartion at the same rate. Separation of plasma constituents by gel filtration demonstrated that californium in plasma was associated with compounds with a molecular weight of approximately 70,000. Additional information obtained by ion exchange chromatography indicated that this protein was transferrin. Data obtained in vivo from canines were extended by in vitro experiments with human blood. Gel chromatography of human plasma protein incubated in vitro with californium indicated that a Cf-protein complex was formed and appeared to be nearly identical to that seen in dogs. Re-chromatography of these fractions on DEAE-Sephadex showed that transferrin and californium did not coincide exactly. Thus californium-transferrin is either held more tenaciously by the ion exchange resin than iron-transferrin or apo-transferrin, or the shift was caused by the presence of another as yet unidentified minor protein component. The stability of the protein complex(s) formed is less than that of the plutonium-transferrin complex and this decreased stability is responsible for the high rate of its disappearance from the bloodstream. (Auth)

Table 1 gives the percent of injected dose of Cf 249, Cf 252, Am 241, Pu 239, and Th 228 circulating in blood at 5 min to 48 hr post-injection. Figures are given on the disappearance of Cf 249 and Cf 252 from the blood of beagles, elution profiles of plasma proteins and Cf 249 from Sephadex G-100-G-200 and DEAE Sephadex ion exchange columns.

<97>
Bruenger, F.W., D.L. Atherton, and W. Stevens, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, June; 1972, March 31

Intracellular Distribution of Californium 249 in Canine Liver. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 685-689; CCO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 307-318), 380 p.

Three beagles were injected intravenously with Cf 249 in citrate buffer. One of these dogs was sacrificed at 7 days, another at 21 days; liver biopsies were performed on the third dog starting at one day after injection. Liver specimens from all dogs were homogenized in sucrose-Ca(+2) and subjected to differential centrifugation. Most of the Cf 249 was initially bound by soluble proteins, probably ferritin. At later times, increasing quantities were associated with intracellular organelles. Homogenate fractions free of nuclei and debris (homogenate after 6000 g min) were subjected to centrifugation for 220,000 g min in a continuous linear sucrose gradient of 12-52%. All fractions were collected and analyzed for Cf 249, protein, acid phosphatase (lysosomal marker), and cytochrome c oxidase (mitochondrial marker). At one day after injection more than 50% of the nuclide was found in the three lightest fractions and approximately 10% in the three heaviest fractions. This pattern was reversed with time and at 21 days 10% was found in the lightest fractions and 43% in the heaviest fractions. At this time more than 50% of the nuclide in the liver was associated with the fraction collected at 60,000 g. min, designated as mitochondria. This fraction showed high cytochrome oxidase activity and also acid phosphatase activity. It is presently assumed that redistribution occurs from soluble proteins into mitochondria and then into lysosomes. Similar data have been obtained from kidney and spleen homogenates. (Auth)

In the liver, the main association of californium was with ferritin, as has been described for Pu(+4) and Am(+3).

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Taylor, G.N., W.S.S. Jee, C.W. Mays, R.B. Dell, J.L. Williams, and L. Shabestari, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, June

Microscopic Distribution of Californium 249 and Berkelium 249 in the Soft Tissues of Beagles. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 691-693

The microscopic distribution pattern of Cf 249 and Bk 249 in the soft tissues of beagles, one to three weeks following a single intravenous injection of a citrate solution, was found to be very similar to that of Am 241. Relatively high concentrations occurred in the hepatic cells of the liver, the glomeruli of the kidney, the interfollicular region of the thyroid, the cartilaginous tissues of the lung, and the media of the smaller arterioles of most organs. Very intense, but sparsely scattered "hot spots" were also present in the renal papillae and in the submucosa of the bronchioles. Lesser sites of localization were the endocardium of the AV heart valves, the glassy membranes of the larger hairs of the coat, the zona pellucida of the Graafian follicles and the zona arcuata of the adrenal cortex. With the exception of the liver, where the radionuclide was principally within the hepatic cells, most of the deposition sites were extracellular, within or associated with connective tissue which gave a positive periodic acid-Schiff reaction. (Auth)

<99>
Brooks, A.L., J.A. Mewhinney, and R.O. McClellan, Lovelace Foundation for Medical Education and Research, Albuquerque, NM. 1972, June

The In Vivo Cytogenetic Effects of Californium 252 on Liver and Bone Marrow of the Chinese Hamster. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 701-706

Hamsters were injected with graded activities of Cf 252 citrate at pH 6.0 (4.5 x 10(E-2), 1.5 x 10(E-2), 5 x 10(E-3), 1.7 x 10(E-3) and 5.6 x 10(E-4) uCi/g body weight), and sacrificed at 6, 15 and 42 days postinjection. The frequency of aberrations in the bone marrow was very low at all times and activity levels. When the animals injected with the three highest levels of Cf 252 were considered collectively, the aberration frequency was four times that of the control animals. Many of the aberrations were balanced and had apparently survived cell division. These results suggest that rapidly dividing tissues, such as bone marrow, do not reflect chromosome damage from chronic irradiation to the same degree as slowly dividing tissues, such as liver, because cell division appears to select against damaged cells. The frequency of rings plus dicentrics in the liver, fitted by a power function and a linear regression, increased according to the 1.0 power of the dose with a coefficient of aberration production of 1.7 x 10(E-3) aberrations/cell/rad. There was a linear increase in the total aberration frequency in liver cells with increasing dose through all the time intervals studied. This increase could be described by the equation Y equals 0.05 plus 3.3 x 10(E-3) D where Y equals aberrations/cell and D is dose in rads. The coefficient of 3.3 x 10(E-3) aberrations/cell/rad was approximately half the 7.1 x 10(E-3) aberrations/cell/rad seen following exposure to Am 241, a pure alpha emitting radionuclide. When only the dose from the alpha emissions of the Cf 252 was considered, the aberration coefficient (6.3 x 10(E-3) aberrations/cell/rad) was not significantly different from that for Am 241. (Auth)

<100>
Sikov, M.R., and D.D. Mahlum, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Plutonium in the Developing Animal. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 707-712

It is evident that many of the parameters used for calculation of permissible limits of exposure to radionuclides are different for the immature individual than for the adult. We have assembled the available data on such metabolic parameters as absorption, partition and retention, and find distinctive changes in these parameters which occur during maturation. Moreover, the radiation sensitivity of individual organs, and of the whole organism, changes during development. We have examined the effect of these changes on the selection of the critical organ in the immature animal. (Auth)

<101>
Matsuoka, O., M. Kashima, H. Joshima, and Y. Noda, National Institute of Radiological Sciences, Chiba, Japan. 1972, June

Whole-Body Autoradiographic Studies on Plutonium Metabolism as Affected by Its PhysicoChemical State and Route of Administration. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 713-722

A comparative investigation of autoradiograms was carried out on specimens obtained from animals administered monomeric or polymeric plutonium. Results were compared with those obtained from animals administered metabolically stable reference particles of known particle size. In addition to whole-body autoradiography and measurements of whole-body retention by counting of L x rays, blood clearance was examined, as well as the modification of plutonium distribution and excretion by DTPA. Following intravenous injection, the blood clearance of plutonium was influenced by particle size. A general rule was proposed relating the size of particles and their behavior in RES organs. The whole-body autoradiographic technique reveals characteristic distribution patterns at early stages following intraperitoneal or subcutaneous injection. The behavior of plutonium soon after administration is largely influenced by its particulate character rather than by its elemental (chemical) nature. The results obtained following inhalation of a plutonium nitrate aerosol showed no obvious translocation of plutonium to the liver, despite the water solubility of the nitrate form. The initial uniform distribution of inhaled plutonium changed to a nonuniform distribution after 3 months. The effectiveness of DTPA treatment was studied in experiments involving injection of premixed Ca DTPA and plutonium, or successive injections of Ca DTPA to plutonium-burdened mice. The effectiveness of treatment was influenced by the physico-chemical state of the plutonium as well as by biological factors. It was demonstrated by diffusion chamber techniques that the chelating action of Ca DTPA on plutonium colloids depends largely on their degree of polymerization. (Auth)

<102>
Moskalev, Yu.I., Ministry of Public Health, Institute of Biophysics, Shiropisnaya 46, Moscow, USSR. 1972, June

Plutonium 239: Problems of Its Biological Effect. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 723-729

This paper will review the results of recent studies by Soviet scientists on problems of the biological action of Pu 239, one of the most dangerous radionuclides. The biological action of various compounds of this radionuclide is considered as a function of the dose, routes and character of the intake into the body, including inhalation, intravenous and subcutaneous administration. Main attention is given to the analysis of late effects (tumor and non-tumor effects) developing in the body as a result of injury by Pu 239: dose-effect curves for bone and lung tumors; estimation of minimum carcinogenic dose levels, and determination of doses not affecting the natural life-span. Data will be presented characterizing the comparative toxicity of Pu 239, Am 241, Np 237, and Cm 242. (Auth)

<103>
Durbin, P.W., M.H. Porovitz, and E.H. Close, Lawrence Berkeley Laboratory, Division of Biology and Medicine, Berkeley, CA; Lawrence Berkeley Laboratory, Division of Mathematics and Computing, Berkeley, CA. 1972, June

Plutonium Deposition Kinetics in the Rat. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 731-741

A conventional kinetic model was constructed to describe the transport and deposition of intravenously injected Pu(+4) citrate in the rat. A digital computer program (NIMIC) was used to generate numerical solutions to the differential equations representing the compartment model. Tissue data and information on the rate of Pu-protein binding in plasma were drawn from published sources. The model consisted of: two blood compartments, unbound Pu (Pu sub f) and protein-bound Pu (Pu sub b), assumed to be bound for the most part to the Fe-carrying protein, transferrin (TF); two extracellular fluid (ECF) compartments, Pu sub f and Pu sub b; and four effectively non-returning sinks: liver, skeleton, soft tissues and excreta. The implications of the solution of the model led to the following working hypotheses: (a) Pu sub f reacts with protein, presumably TF, in ECF as well as in plasma. The Pu-TF complex is the most likely form in which diffusible Pu is mobilized from parenteral injection sites, and the most likely form in which orally administered Pu is carried once it reaches the plasma. (b) Little, if any, Pu sub b, is excreted or deposited in the liver. Formation of the Pu-TF complex is probably not a necessary preliminary to liver deposition of diffusible Pu. (c) Both Pu sub f and Pu sub b are sources of Pu deposited in bone. The surface of the reticulocyte (where Fe is released from the Fe-TF complex) is considered the most likely site of dissociation of the Pu-TF complex. Pu released at that site could either recombine with TF and recirculate as Pu-TF, effectively prolonging Pu circulation, or recirculate temporarily as Pu sub f providing the necessary feedback of Pu sub f, or diffuse to the most readily accessible bone surface. (Auth)

Summaries are given for experimental studies by different researchers of kinetic studies of Pu 239 in rats. Tabular data are given for recalculated distribution of intravenously injected Pu 239(+4) citrate in tissues of young rats.

<104>
Rosenthal, M.W., E. Moretti, J.J. Russell, and A. Lindenbaum, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1972, June

Marrow Deposition and Distribution of Monomeric and Polymeric Plutonium 239 in the Mouse, Estimated by Use of Iron 59. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 743-748

Iron 59 has been used in mice as a tracer for bone marrow to extrapolate from the plutonium measured in a standard sample of tibial marrow to the plutonium in total marrow 5-6 days after intravenous injection of different physical-chemical forms of plutonium. A factor of 44 was obtained from conversion of the radioactivity measured in the tibial sample to total body marrow. Using this factor, and calculating the total skeletal plutonium burden as the amount measured in two femurs times 13, one can calculate the proportion of skeletal plutonium located in the marrow. For monomeric, mid-range polymeric and highly polymeric plutonium, values of 2, 7-15 and 62%, respectively, were obtained. Similarly, for monomeric americium and a highly polymeric americium, 7 and 20% of the total skeletal burden was calculated to be in the marrow. In two experiments, in which monomeric plutonium had been found to be about twice as carcinogenic in bone as the mid-range polymeric plutonium, the amount of plutonium in all the bones and spinal segments was measured at 15 days. Using these data and the Fe 59 measurements, the marrow content of these two forms of plutonium throughout the skeleton have been calculated and tabulated. The total marrow burdens, calculated from the tibial samples, were 0.796% of the injected monomeric vs 3.66% of the mid-range polymeric plutonium. These amounts were 2.35 vs 14.3% of the amount of plutonium measured in the total skeleton, respectively. (Auth)

Tabular data are given for: a.) Fe 59 distribution in mice 5 hr after intravenous injection, b.) distribution of Fe 59 in mouse skeleton 5 hr after intravenous injection, c.) distribution of Fe 59 in mouse skeleton 15 days after intravenous injection, and d.) percent of Pu 239 content of individual bones that is located in the marrow.

<105>
Gomez, L.S., J.L. Lebel, and R.L. Watters, Colorado State University, Department of Radiology and Radiation Biology, Fort Collins, CO. 1972, June

The Effect of Lymph Node Removal on Plutonium Dioxide Translocation. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 833-836

The translocation of high-fired PuO2 via the lymphatic system from a simulated puncture wound in the left dorsal metacarpus of beagle dogs was studied. Comparisons were made between dogs with and without excision of the left superficial cervical lymph node. Accumulation of plutonium in the lymph node was determined by counting the low-energy x ray complex with a thin NaI(Tl) detector. The dogs were killed less than 2 weeks after implant and the activity determined for selected tissues. Higher levels of plutonium were found in the liver, spleen and hepatic lymph nodes of lymphadenectomized dogs than in the intact dogs. Implications of these data with regard to therapeutic lymph node removal for workers contaminated with plutonium are discussed. (Auth)

<106>
Woshkin, V.E., Woods Hole C[illegible]ic Institution, Woods Hole, M[illegible] June

Ecological Aspects of Plutonium Dissemination in Aquatic Environments. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 537-549

The available data concerning the dissemination of plutonium and other transuranics in the aquatic environment are drawn together for appraisal. The most studied isotope has been Pu 239 derived from worldwide fallout. Essentially all the published work has been concerned with levels in the marine environment where plutonium is found widespread among planktonic, pelagic and benthic organisms. The concentrations are higher in organisms feeding on sediment or on surfaces than in those drawing largely on the water itself. Among the species where data are available are a variety of convenient indicator organisms for plutonium. There is some evidence that plutonium concentrations are increased in organisms of higher trophic levels. Bone and liver are major repositories for plutonium in marine vertebrates while muscle tissue of both marine vertebrates and invertebrates contain relatively lower concentrations. Plutonium is geochemically separated from both Sr 90 and Cs 137 in the water column and the sedimentation of Pu 239 may be more involved with biological processes than has been found for fallout rare earth isotopes. In marine sediments, as in soils, plutonium is more mobile than was originally expected. What little is known of the behavior of plutonium in the marine environment should be used conservatively to assess the behavior and distribution of new plutonium additions derived from sources other than fallout, and even more conservatively in predicting the impact of other transuranics in the aquatic environment. Considerably more understanding of the aquatic radioecology of several of the elements is a major priority especially since it now appears that when the relative biological effectiveness of alpha vs gamma or beta radiations is considered, fallout Pu 239 contributes more than fallout Sr 90 or Cs 137 to the artificial radiation exposure of many marine species. (Auth)

Data collected from a review of literature are presented in tabular form for many locations from 1957-1961. Included are: (a) americium 241 and plutonium 239 concentrations in Porphyra in the vicinity of Windscale, (b) plutonium 239 in seawater (fCi/l), (c) plutonium 239 in aquatic sediments (pCi/g, dry, and aCi/km3), (d) plutonium 239 concentrations in marine invertebrates and algae (Pu 238, Cs 137 and Sr 90 concentrations shown when given in reference), (e) plutonium 239 concentration factors in marine invertebrates and algae, (f) plutonium 239 in marine vertebrates, pCi/kg wet or fresh weight, and (g) plutonium 239 concentration factors in marine vertebrates.

<107>
Romney, E.M., and J.J. Davis, University of California, Los Angeles, CA; Nevada Operations Office, Las Vegas, NV. 1972, June

Ecological Aspects of Plutonium Dissemination in Terrestrial Environments. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 551-557

The technology of plutonium production and processing is already established, but the realization of its peaceful applications depends largely upon the development of methods for preventing its distribution in the environment. Because of safeguards and effective control measures, no accidental plutonium contamination of the public domain has imposed serious risks to a population group. Trace amounts of plutonium from above-ground nuclear detonations are contained in world-wide fallout; however, the levels of plutonium in foodstuffs and other components of the environment are insignificant compared to the amounts known to be hazardous. There has thus been very little interest in the study of ecological aspects of plutonium contamination. The result is a paucity of information on the behavior of plutonium in ecosystems and its radiological effects on natural fauna and flora. The Nevada Applied Ecology Group is embarked upon a program at the Nevada Test Site to investigate the long range effects of plutonium disseminated into the desert ecosystem. Emphasis has been placed upon standardization of analytical methods, delineation of contaminated areas, problems of resuspension and redistribution, food chain transport and ecological effects. (Auth)

<108>

<108>
Wallace, A., University of California, Laboratory of Nuclear Medicine and Radiation Biology, Department of Agricultural Sciences, Los Angeles, CA. 1972, June

Increased Uptake of Americium 241 by Plants Caused by the Chelating Agent DTPA.
CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 559-562; UCLA-12-858; Part of Annual Progress Report for the Period Ending June 30, 1972, (p. 33), 103 p.

The chelating agent diethylenetriaminepentaacetic acid (DTPA), which has the ability to increase uptake by plants of several metals and is widely used as a practical means of correcting iron deficiency in plants, has been shown to greatly increase the uptake from soils of Am 241 by plants. Application of high levels of zinc or manganese salts decreased Am 241 content of plants only slightly, indicating little, if any, competing effect. Most accumulated Am 241 was transported to leaves of all species studied. The ability of plants to accumulate Am 241 was not related to root temperature. During a subsequent growth period after applications of Am 241 to bush beans, some of the Am 241 was transported from the old leaves to the new leaves and also to new roots. The chelating agent DTPA had no effect on the retranslocation, however. Extraction studies with soil indicated that DTPA, but not EDDHA, could quantitatively extract Am 241 from soil. (Auth)

Tables are given for: (a) Am 241 uptake by soybeans growing in hacienda loam containing 8 uCi 241 Am/500 g soil, as affected by various micronutrients, (b) influences of 2 chelating agents (DTPA and Ra 157) on Am 241 content of stems and leaves of valencia oranges grafted to rough lemon or trifoliate orange, (c) Am 241 present in new growth of citrus plants after 1 year growth in soil containing Am 241 and 30 days after application of 135 ppm DTPA to soil, (d) effect of root temperature on Am 241 uptake and distribution in bush beans, and (e) distribution and redistribution of Am 241 in bush bean plants.

<109>
Miller, C.L., J.G. Payne, Jr., E.W. Bretthauer, and A.A. Moghissi, Western Environmental Research Laboratory, Las Vegas, NV. 1972, June

Transfer of Plutonium from Milk into Cheese.
CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 563-565

Plutonium 238 in citrate solution was added to cows' milk and was injected intravenously into goats. Aliquots of milk were refrigerated, or pasteurized and refrigerated, and held for preselected time periods ranging from 0.1 day to 8.0 days. Rennin-coagulated cheese was then prepared from the aliquots and plutonium analyses were conducted on the cheese and whey samples. The results showed plutonium transfers of 97.5 plus or minus 2.2% to the cheeses in all cases: in vivo and in vitro labeled milk, pasteurized and nonpasteurized, stored and non-stored milk. This quantitative transfer is probably due to coprecipitation of the plutonium with milk solids. (Auth)

A table is given for plutonium transfer from milk into cheese. Results are presented as cheese production in grams of cheese/liter of milk, and plutonium in the cheese as % of total received.

<110>
Taylor, D.M., Institute of Cancer Research, Sutton, Surrey, England. 1972, June

Interactions Between Transuranium Elements and the Components of Cells and Tissues.
CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 575-581

Comparative studies of the interactions of plutonium, americium and curium with serum proteins from varicus species, with proteins isolated from the organic matrix of bone, and with some other proteins have all shown that plutonium is bound very much more firmly by protein than either americium or curium. Investigations of the sub-cellular distribution patterns of these elements in liver and testes have shown that all three elements become associated with lysosomal structures and that different mechanisms of lysosomal uptake are involved for polymeric and monomeric plutonium, americium and curium. The implications of these findings are discussed in relation to the types of biological damage which has been observed in experimental animals. (Auth)

A table is given for binding of transuranic elements Pu(+4), Am(+3), and Cm(+3) to biological ligands in vitro at pH 7.4. Binding is expressed as percentage of applied radioactive metal eluted from Sephadex G-50 gel column with the protein fraction.

<111>
Jee, W.S.S., University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1972, June

Distribution and Toxicity of Plutonium 239 in Bone. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 583-595

The deposition of Pu 239, the classical transuranium element upon bone surfaces is governed by the route of administration, physicochemical state of the plutonium, and the age of the animal. The effectiveness of the various routes of administration in delivering plutonium to bone, in decreasing order, is: intravenous about equals intraperitoneal > subcutaneous > intramuscular > intratracheal > inhalation > oral > direct application upon skin. Reticuloendothelial cells in the marrow compete with bone for polymeric plutonium and thus decreases the plutonium available for bone surfaces. The uptake in young and adult bones differed by a factor of 2. The fate of the plutonium surface deposits is modified by bone growth, modeling and remodeling in growing animals and remodeling in adults. These age-related processes remove the plutonium from bone surfaces and/or bury the surface deposits with new bone. The endpoints of low dose plutonium skeletal toxicity are bone necrosis and the induction of osteogenic sarcoma. The factors involved in bone tumor production are believed to be the delivery of sufficient radiation to bone surfaces (the sensitive site), the volume of cells at risk and, most important, the proliferative activity of the osteogenic tissue. (Auth)

Tabular data is given for maximum skeletal uptake of Pu 239, by various species of animals, in various chemical forms and by various routes of administration as percent of the administered dose. Tabular data is given for skeletal Pu 239 content as percent of administered dose in animals at various ages, distribution of Pu deposits on or under the surface of trabeculae of beagles injected with 0.3 uC, (P3 dogs) and 0.0157 uCi (P1 dogs) of Pu 239/kg, and minimum dose of Pu 239 for development of osteogenic sarcoma.

<112>
Lindenbaum, A., and M.W. Rosenthal, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1972, June

Deposition Patterns and Toxicity of Plutonium and Americium in Liver. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 597-605

The deposition and retention of plutonium and americium in the mammalian liver after administration of about 5 uCi/kg or less are briefly reviewed. Inferences are drawn regarding physiological mechanisms and radiotoxic consequences. The initial deposition patterns, but not the retention patterns, of plutonium and americium in the liver are generally similar in a variety of species. The major biological process responsible for the variable and non-uniform hepatic deposition appears to be phagocytosis. The amount of radionuclide phagocytized is dependent upon the extent of hydrolysis and polymerization of the administered actinide. The different biological half-times of plutonium and americium in the liver of different species suggest that there may be species differences in phagocytic function, protein binding, etc. The main route of elimination of plutonium (and probably americium) is via the bile and feces. There is a gradual aggregation of radionuclide by Kupffer cells and, at least in the mouse, also by parenchymal cells. This aggregation is believed to result from a repeated sequence of phagocytosis, irradiation death of the phagocyte, and rephagocytosis. In the mouse and dog, 20 nCi of Pu 239 or Am 241 per gram of liver appears to be the threshold concentration that results in sufficient radiation-induced tissue damage to produce accelerated radionuclide loss into the blood, and translocation to the skeleton. In man it is postulated that progressive aggregation of low levels of actinide in the liver could also lead to radiation damage and subsequent translocation to critical osteogenic bone surfaces. (Auth)

Tabular data are given for long-term translocation of plutonium and americium from liver to skeleton in mice, beagles, and rabbits.

<113>
Sanders, C.L., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, June

Deposition Patterns and the Toxicity of Transuranium Elements in Lung. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 607-615

Cellular sites of plutonium in the lung influence the toxicity of inhaled plutonium compounds. The loss of plutonium from macrophages, the death of macrophages, the engulfment of plutonium by the alveolar epithelium and the sequestration of plutonium in foci of fibrosis account for the relatively long retention times for PuO_2 in the lung. The concentration of plutonium in particles-- disproportionately in a few larger particles--in specific cellular elements of the lung, and in subpleural, fibrotic areas of the lung, provides for high radiation dose rates in limited tissue volumes. Such "hot spots" of alpha irradiation may cause epithelial metaplasia and eventually, alveolo-bronchiolar carcinoma. Such factors may be of great importance when determining the acceptable limits of exposure to man to airborne plutonium and other transuranic elements. (Auth)

Tabular data are given for: long-term clearance rates for alveolar deposits of inhaled plutonium particles, and distribution of Pu 239 activity among particles of various sizes within alveolar macrophages obtained by saline washings after inhalation of Pu 239 by rats.

<114>

<114>
Lindenbaum, A., and J.J. Russell, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1972, June

Autoradiographic Determination of Alpha Activity by Variable Exposure to Plutonium 239 and Americium 241 in Mouse Liver. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 617-620

A quantitative autoradiographic technique for assay of plutonium or americium deposited in animal tissues was tested for linearity in the relationship between photographic exposure time and number of alpha tracks formed. Liver sections were prepared from mice injected intravenously with several polymeric preparations of Pu 239 or Am 241 at dose levels ranging from 6.6 to 93 uCi/kg. Exposure times varied between 2 and 42 days, depending on anticipated track concentrations. The normalized data showed a linear increase in the number of countable tracks with increased exposure times. Also, there was generally good agreement between liver burdens determined autoradiographically or radiochemically. These results indicate the reliability of comparisons based on autoradiographic measurement of discretely deposited plutonium or americium in liver (and other tissues) despite wide differences in deposition levels and exposure times. (Auth)

<115>
Rosen, J.C., N. Cohen, and M.E. Wrenn, New York University Medical Center, Institute of Environmental Medicine, New York, NY. 1972, June

Short Term Metabolism of Americium 241 in the Adult Baboon. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 621-626

The distribution and retention of Am 241 was measured in two adult female baboons after single intravenous injections of Am 241 citrate. Retention of Am 241 in the whole body, skeleton and liver was determined by in vivo scintillation measurements of the 60 keV gamma-ray. In addition to "specific site" in vivo measurements, serial biopsy samples were obtained to determine the rate of clearance of Am 241 from the liver. Clearance of Am 241 from the blood was rapid. Less than 1% of the injected dose remained at 48 hr and less than 0.05% remained one month postinjection. Greater than 99% of the activity was associated with the plasma fraction. From analysis of daily excreta, 1% of the injected dose was excreted by the end of the first week and 15% by the end of the first month. Approximately 70% was urinary excretion; however, the urine to fecal clearance ratio varied from 0.06 during the first week to greater than 20 at 3 months. Estimates of the effective half-time of americium in the total body from excreta analysis and from in vivo measurements were 274 and 263 days, respectively. Clearance half-times from the liver evaluated by in vivo and biopsy analysis were 150 and 154 days, respectively. In vivo measurements over the head showed no detectable clearance from the skull during the same period. The animals were sacrificed at one and three months postinjection. In order of decreasing total activity the major loci were the skeleton, liver, lungs and kidney, which accounted for about 85% of the retained americium. At the end of one month the highest concentration of activity was found in the liver with concentrations decreasing in the order of bone, lung, aorta, kidney and spleen. Among various bones, the concentration of Am 241 varied within a factor of 2, being highest in vertebrae. The concentration in the ends of long bones was 2-3 times higher than in the shafts. (Auth)

Tabular data are given for: (a) excretion of Am 241 by baboons, (b) tissue distribution of Am 241 in baboons, and (c) skeletal distribution of Am 241 in baboons.

<116>
Hollins, J.G., and A.B. Purakovic, National Research Council of Canada, Division of Biology, Ottawa, Ontario, Canada. 1972, June

The Metabolism of Americium in Lactating Rats. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 627-631

The metabolism of Am 241 in lactating and control rats was investigated by measurements of whole-body retention and distribution in bones and liver. At the end of lactation, lactating rats contained more americium than controls. The retention of americium by the liver of lactating rats was also higher. In general, the amount of americium in the skeleton did not differ between experimental groups. The results show that the resorption of bone in lactation does not result in a loss of americium and emphasize the importance of remodeling bone surfaces in the incorporation of americium in vivo. (Auth)

Tabular data for distribution of americium in rats injected: (a) intravenously on the day before breeding, (b) intraperitoneally four days before parturition, (c) intravenously on the day of parturition, and (d) intravenously on the fifteenth day of lactation are given.

<117>
Ovcharenko, E.P., Ministry of Public Health, Institute of Biophysics, Zhivopisnaya 46, Moscow, USSR. 1972, June

An Experimental Evaluation of the Effects of Transuranic Elements on Reproductive Ability. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 641

The study of the effects of transuranic elements on reproductive ability was performed on rats of the Wistar strain, including parents of both sexes, the first generation offspring from day 4 of antenatal life to sexual maturity, and, in a separate series, the second generation offspring. All the transuranic elements studied were characterized by a high retention in the placenta, an increased transplacental transfer to the offspring during the late periods of pregnancy, and a decrease with age of the radionuclide content in the carcasses of sucklings. The highest concentrations in percent of the dose administered to the mother) of Pu 239 (citrate), Am 241 (citrate), and of Np 237 (nitrate) were: in the placenta, 7.55 plus or minus 0.82, 1.22 plus or minus 0.32 and 0.31 plus or minus 0.02; in the fetuses, 1.16 plus or minus 0.22, 0.45 plus or minus 0.08 and 0.17 plus or minus 0.04; and, in the total milk intake of 1 litter of the month-old rats, 4.24 plus or minus 1.10, 1.04 plus or minus 0.30 and 0.32 plus or minus 0.06, respectively. The transfer of polyseric Pu to the offspring was 15 to 20 times lower than that of Pu 239 citrate. Following the administration of Pu 239 and Am 241 citrates, a study of the estrus cycle of female rats, mating ability, death of embryos, fertility of male and female, survival, weight, physical development, sex function, radiosensitivity of the offspring and a histological investigation of median sections of gonads and of serial sections of fetuses, revealed that the character and depth of radio-induced changes depended upon the amount of activity injected and the time elapsed since injection. Eight to twelve months following administration of Am 241 in amounts of from 0.004 to 0.002 uCi/g, of the 15 rats examined five had follicular or lutein cysts, and seven had thecomas and adenomas. Nine months after the administration of 0.02 uCi/g a pronounced atrophy of the testes was observed. The administration of Pu 239 and Am 241 to rats of both sexes resulted in an increased incidence of intrauterine lethality among offspring. The experiments with Am 241 indicated that in females the increase of prenatal deaths of offspring was related to the disorders of the developing placenta, as well as to an indirect influence of injury of the mother's system. Following exposure of males, the increase of intrauterine deaths of embryos was due to an effect on the fertility of unpoisoned females that had been mated to the experimental males. In the course of investigating the postnatal development of the offspring of experimental animals, a number of peculiarities were observed: decrease in viability, delayed physical development, variations in weight, disturbance of blood-formation, change in radiosensitivity, and depression of sex function. On the basis of the integral index of reproductive ability (number of viable rats at the age of 1 month as calculated per pregnant female) Am 241 proved to be more damaging than Pu 239. (Auth)

<118>
Ledik, T.I., V.K. Lemberg, L.A. Buldakov, E.R. Lyubchanskii, and V.M. Pesternikov, Ministry of Public Health, Institute of Biophysics, Zhivopisnaya 46, Moscow, USSR. 1972, June

Biological Effectiveness of Neptunium 237. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 643-645

The intravenous injection of neptunium nitrate and oxalate at doses ranging from 2.0 to 0.017 uCi/kg was characterized by the occurrence of osteosarcomas (incidence ranging from 58 to 9% at cumulative skeletal radiation doses ranging from 520 to 5 rads, respectively). The major manifestations of injury after intratracheal administration of the two neptunium compounds at the same doses were the development of pneumosclerosis and malignant lung tumors (incidence ranging from 37 to 11% at cumulative lung doses of 3220 to 5 rads, respectively); and, to a lesser extent, of osteosarcomas (incidence ranging from 25 to 5% at skeletal doses of 408 to 4 rads, respectively). Comparing the potential hazards from Np 237, Pu 239, and Am 241, it is seen that for inductions of osteosarcomas and lung cancers, Np 237 exhibits the highest efficiency, Pu 239 occupies the second place, and Am 241 is the least effective of the three radioelements. (Auth) (BBM)

<119>

<119>
Kotrappa, P., C.J. Wilkinson, and H.A. Boyd, Lovelace Foundation for Medical Education and Research, Albuquerque, NM. 1972, June

Technology for the Production of Monodisperse Aerosols of Oxides of Transuranic Elements for Inhalation Experiments. CONF-710919; Part of Thompson, R.C. and Bair, W.J. (Eds.), Proceedings of the 11th Hanford Symposium on the Biological Implications of the Transuranium Elements held in Richland, Washington, September 27-29, 1971. Published in Health Physics, 22(6), 837-843

A method of preparing and aerosolizing monodisperse particles of oxides of transuranic elements is discussed. A four-step process, involving source aerosol preparation, centrifugal separation, resuspension and aerosolization has been applied to plutonium dioxide. The procedure consists of generating an aerosol by nebulizing a solution of a transuranic element such as plutonium chloride, degrading the particles that are formed with a high temperature heating column to form a polydisperse aerosol of the oxide, separating and collecting this polydisperse aerosol in monodisperse aerodynamic size groups on a stainless steel collection foil in the Lovelace Aerosol Particle Separator (LAPS) and resuspending the monodisperse particles in water for future aerosolization by nebulization. The LAPS is a centrifugal device that provides a continuous separation of aerosol particles down to an aerodynamic diameter of 0.5 um. Air activity and particle size data obtained during an actual exposure of beagle dogs to monodisperse aerosols of PuO2 obtained by this method are presented. The method was used to provide monodisperse aerosols of plutonium oxide, over a wide size range, with controlled and reproducible physico-chemical characteristics. Adaptation of the procedure for other transuranic oxides is discussed. (Auth)

<120>
Not given, Health and Safety Laboratory, New York, NY. 1972, February

Surface Air Sampling Program, 80th Meridian Network, January-December 1969. Radiation Data and Reports, 13(2), 92-98

The Health and Safety Laboratory began its Surface Air Sampling Program in January 1963, as a continuation of the 80th Meridian Program conducted by the U.S. Naval Research Laboratory. The objective of this program is to study the spatial and temporal distribution of nuclear weapons debris and lead in the surface air. The basic network consists of a line of sites approximately along the 80th Meridian extending from about 76 degrees N to 90 degrees S latitudes. The longer-lived fission products and Pu 239 concentrations should decrease the general distribution in surface air of all previous nuclear debris which was transferred from the lower stratosphere to the troposphere during the collection period. While Pu 238 is present in low concentrations in nuclear weapons debris, about 17,000 curies of Pu 238 were disseminated at high altitude in the stratosphere in April 21, 1964 during the reentry burnup of a SNAP-9A power source. The results of analyses on standard samples are shown in a table. Although most of the results are satisfactory, the August and September 1969 deviations for both plutonium isotopes are extremely high. The very low blank values during these months indicate no plutonium contamination. The Pu 238 to Pu 239 and Pu 239 to Sr 90 ratios for actual samples collected during these months are all reasonable and therefore there is no reason to suspect that they are in error, however, no explanation can be offered to account for the poor quality control results. (PMM)

<121>
Wagner, H.A. (Chairman), Edison Electric Institute, Committee on Nuclear Fuels, New York, NY. 1965, June

Plutonium Survey, 1964. EEI-65-41; 21 p.

A survey is given of the status, current rate of development, and future outlook of plutonium-fuels technology and its application to both thermal and fast reactors. The need for the development of plutonium-fuels technology applicable to the present and near-future commercial reactors has become urgent. This is due, in part, to the projected increased plutonium production resulting from a more optimistic near-term nuclear power growth forecast, but more importantly to the implications of the recent legislation covering private ownership of nuclear fuel. In addition, there is increasing evidence that plutonium will be a suitable fuel in thermal reactors. There is general agreement that the economic feasibility of fast reactors will be demonstrated in the 1970's, but the need for large quantities of plutonium as startup inventories is not expected to materialize much before the 1980's. Analyses show that the calculated value of plutonium is at least equal to that of U 235 as a thermal reactor fuel. The market price of plutonium is expected to hold close to the present price of $10 per gram of fissile plutonium as nitrate during the 1970's. During the late 1970's and early 1980's, the development of fast reactors and optimum plutonium use in thermal reactors are expected to increase the market price of plutonium, possibly to as much as $15 per gram. (PMM)

<122>
Not given, Western Environmental Research Laboratory, Las Vegas, NV. 1972, February

Air Surveillance Network, July 1971. Radiation Data and Reports, 13(2), 88-92

The Air Surveillance Network, operated by the Western Environmental Research Laboratory (WERL), consists of 104 active and 18 standby sampling stations located in 21 western states. The network is operated in support of nuclear testing conducted by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), at the Nuclear Rocket Development Station which lies adjacent to the NTS, and at any other western testing sites designated by the AEC. The monthly average gross beta radiation in air particulates during July 1971 is presented in a table. The minimum reporting concentration for gross beta radioactivity is 0.1 pCi/m3. From gamma spectrometry results, zirconium-niobium95, ruthenium 106, and cerium 144 from worldwide fallout were identified in varying combinations on filters collected in several states within the network. The highest concentrations of these radionuclides, respectively, were 1.0 pCi/m3 (Shoshone and Scotty's Junction), 1.8 pCi/m3 (Furnace Creek and Lathrop Wells), and 1.6 pCi/m3 (Shoshone). (FMM)

<123>
Mishima, J., and L.C. Schwendiman, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, December

Airborne Release of Plutonium and Its Compounds During Overheating Incidents. BNWL-1651 (Part 1); Part of Simpson, C.L., et al, Annual Report for 1971, (p. 82-87), 188 p.

Studies to evaluate the fractional airborne release of plutonium under various postulated accident conditions are described. Data generated in earlier laboratory scale studies are reveiwed. A larger scale facility--the radioactive aerosol release facility--was placed in operation providing the capability for measurement of fractional airborne release of radioactive particles from burning raterial on a more realistic scale. The amount and aerodynamic equivalent size distribution of particles that may become airborne under conditions found in some shipping accidents were measured in experiments conducted in a special wind tunnel in the radioactive aerosol release test facility. (Auth)

<124>
Mishima, J., and L.C. Schwendiman, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1972, December

Characterization of Radioactive Particles in a Plutonium Processing Plant Exhaust System. BNWL-1651 (Part 1); Part of Simpson, C.L., et al, Annual Report for 1971, (p. 88-90), 188 p.

Filter and cascade impactor samples were taken of the stack gases and various exhaust streams of a plutonium processing plant to characterize by aerodynamic characteristics the amounts and distribution of particles with their associated radioactivity. Only general conclusions can be drawn from the limited data obtained thus far: the overall efficiency of the exhaust system is high; little, if any, of the alpha activity leaving the stack is being recycled back into the ventilation system; and the plutonium present appears to be attached to large, nonactive particles. (Auth)

<125>
Sakagishi, S., Japan Atomic Energy Research Institute, Division of Health Physics and Safety, Tokai-mura, Naka-gun, Ibaraki-ken, Japan. 1968, June

Environmental Survey. JAERI-5017; Part of Activities in the Division of Health Physics and Safety, April 1, 1967-March 31, 1968, (p. 131-139), 177 p.

Several technical developments on the analyses of radionuclides in soil were made and applied to the routine monitoring. Relating to the environmental hazard evaluation, wind speed and atmospheric stability were analyzed statistically. Environmental hazard was evaluated for the design of several facilities and the start of operation in the establishment. The analysis of sea current in the coastal area off Tokai, which was difficult until the preceding year because of insufficient data, was made systematically. (Auth)

Table 2-18 shows the activity of Th 232, U 238, K 40, Mn 54, Zr 95-Nb 95, and Cs 137 in soil.

<126>
Sakagishi, S., Japan Atomic Energy Research Institute, Division of Health Physics and Safety, Tokai-mura, Naka-gun, Ibaraki-ken, Japan. 1968, June

Internal Exposure. JAERI-5017; Part of Activities in the Division of Health Physics and Safety, April 1, 1967-March 31, 1968, (p. 149-153), 177 p. (Japanese)

A report is given of studies that were carried out in 1967. They are as follows: day-to-day variation of dietary intake and urinary excretion of fallout Cs 137 and stable K in man, determination of Pu in blood by anion exchange methods (preliminary report), and measurement of recovery by Sr 85 tracer in the chemical determination of fallout Sr 90 in urine, feces and total diet. (Auth)

<127>

<127>
Sakagishi, S., Japan Atomic Energy Research Institute, Division of Health Physics and Safety, Tokai-mura, Naka-gun, Ibaraki-ken, Japan. 1968, June

Radioactive Waste Treatment and Decontamination. JAERI-5017; Part of Activities in the Division of Health Physics and Safety, April 1, 1967-March 31, 1968, (p. 163-165), 177 p. (Japanese)

Reports on research and development carried out on radicactive decontamination in 1967 were presented. Studies were done on radioactive contamination and decontamination of solid surfaces, and on plutonium 239 contamination of pig skin and its decontamination by water, synthetic detergent, EDTA and sodium hypochlorite. (Auth) (FNM)

<128>
Ito, I., and K. Matsumoto, Tokai Works, Power Reactor and Nuclear Fuel Development Corporation, Tokai, Ibaraki, Japan. 1972, April

Experience on Scrap Recovery and Waste Disposal in the Plutonium Fuels Development Laboratory. PNCT-831-72-01; Part of Tokai Works Semi-Annual Progress Report, January-June, 1971, (p. 58-75), 194 p.

Plutonium in the scraps discharged from the fabrication steps of plutonium-uranium mixed oxide fuel was recovered by an anion exchange (NO3-form) method and liquid waste from the facility was treated by a coagulation process. Plutonium and uranium in the liquid waste from the recovery process and analytical laboratory were precipitated by neutralization, and the precipitates were sorted. The volume of effluent of the precipitation process was about 5.6 m3 per year and the effluent was treated with the Fe(OH)3-Ca(OH)2 coagulation process to remove plutonium and uranium. The treated effluent was diluted with washing and laundry waste and then discharged to the sea. The activity level of the discharged effluent was below one tenth of (Mpc)w. (Auth) (FNM)

<129>
Ishiguro, M., T. Higuma, T. Igarashi, K. Nakata, and M. Kinoshita, Tokai Works, Power Reactor and Nuclear Fuel Development Corporation, Tokai, Ibaraki, Japan. 1972, April

Development of Plutonium Dust Monitor Using a Solid State Detector. PNCT-831-72-01; Part of Tokai Works Semi-Annual Progress Report, January-June, 1971, (p. 165-179), 194 p.

A new plutonium dust monitor was developed which is sensitive to an activity of 13 uCi of Pu corresponding to 2.2 MPCahr in air. Some special characteristics of the monitor are a silicone surface barrier solid state detector which is 23 millimeters in diameter, a cellulose asbestos filter which is 25 millimeters in diameter and the air sampling head which is placed in front of the room exhaust. One detector monitors the airborne contamination by counting the activity of air dust gathered from several sampling heads. The monitoring system instantly detects airborne plutonium in the event of a contamination incident and gives the alarm to the operator near the glove box. (FNM)

<130>
Kurabayashi, M., and S. Ouchi, Tokai Works, Power Reactor and Nuclear Fuel Development Corporation, Tokai, Ibaraki, Japan. 1972, April

Uranium Concentration of Fishes and Plants Associated with the Discharges of the Low Level Uranium Liquid Waste. PNCT-831-72-01; Part of Tokai Works Semi-Annual Progress Report, January-June, 1971, (p. 180-184), 194 p.

Low level uranium liquid waste, about 1 x 10(E-7) to 2 x 10(E-7)uCi/cm3 in gross beta activity has been discharged from the Tokai Works to the Shinkawa River downstream for about 10 years since 1958. The uranium concentration of some fish and plants in the vicinity of the discharge point was determined. No appreciable contamination was found in fish or crayfish, but the uranium content of some plant samples was a little higher than that of other natural samples. Some laboratory studies done on the uptake of uranium by fish organ showed that accumulation occurred largely in the scales and gills and little in the muscle. In rice and kidney bean plants the accumulation of uranium was greater in roots than in leaves, the concentration factor being 2 to 5 for roots and 0.1 to 0.2 for the leaves. (FNM)

<131>
Kuwana, K., and K. Nakata, Tokai Works, Power Reactor and Nuclear Fuel Development Corporation, Tokai, Ibaraki, Japan. 1972, April

low Level Alpha Counting System with Six Solid State Detectors. PNCT-831-72-01; Part of Tokai Works Semi-Annual Progress Report, January-June, 1971, (p. 190-194), 194 p.

An instrument was designed for the purpose of measuring samples with very low level alpha emitters. These samples are obtained from the chemical separation of plutonium in urine or feces. It is necessary that the counting system should have many detectors in order to measure simultaneously many samples. A cheap and effective instrument using six solid state detectors was developed. (FNM)

<132>
Galibin, G.P., and Yu.D. Parfenov, Ministry of Health, Institute of Biophysics, Moscow, USSR. 1971

Inhalation Study on Metabolism of Insoluble Uranium Compounds. CONF-700931; Part of Walton, W.H. (Ed.), Proceedings of the 3rd International Symposium on Inhaled Particles held in London, England, September 14-23, 1970, Vol. 2. Unwin Brothers Limited, The Gresham Press, Old Woking, Surrey, England, (p. 201-208), 1090 p.

When rats are subjected to a single inhalation (10 mg/m3 and 30 mg/m3) of insoluble uranium compounds-ammonium diuranat ((NH4)2U2O7), uranium tetraflucride (UF4) and uranium octoxide (U3O8), 14-25% of the total amount inhaled is retained in the body of the animals. The principal organ for deposition of these uranium compounds is the skeleton. The biological half-life of uranium in the skeleton is 310-375 days. The lungs, kidneys and liver are other organs of retention. The deposition level of ammonium diuranat and UF4 in the liver is 3-5 times as high as that of U3O8. The mobilization of uranium from the lungs is described by the sum of 4 exponentials. The effective half-life of uranium in the liver and kidneys is not more than 30 days. A similar pattern of uranium metabolism is obtained for chronic inhalation of these compounds. The estimation of the uranium content in the body is based on the concentration in the urine. (Auth)

<133>
Langmead, W.A., United Kingdom Energy Authority, Atomic Energy Research Establishment, Health and Safety Branch, Harwell, Berkshire, England. 1971

Air Sampling as Part of an Integrated Program of Monitoring of the Worker and His Environment. CONF-700931; Part of Walton, W.H.(Ed.), Proceedings of the 3rd International Symposium on Inhaled Particles held in London, England, September 14-23, 1970, Vol. 2. Unwin Brothers Limited, The Gresham Press, Old Woking, Surrey, England, (p. 983-995), 1090 p.

The general principles of monitoring of the worker and his environment are discussed in relation to work with uncontained radioactivity with particular reference to the control of air contamination hazards. The methods of using static samplers and personal air samplers for monitoring the work-place are described, and the interpretation of the results in terms of the basic standards of MPC in air to confirm that operating conditions are satisfactory is discussed. The place of particle-size measurements in air sampling is also reviewed. Proposals for the assessment of working areas at three alternative levels of risk are presented as part of an integrated program of control of radioactive contamination. (Auth)

Table 3 gives the characterisitcs of some uranium and plutonium aerosols.

<134>
Grummitt, W.E., Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada. 1972, November

Liquid Effluent Monitoring. PR-B-95; AECL-4360; Part of Biology and Health Physics Division Progress Report, July 1 to September 30, 1972, (p. 36), 65 p.

At Chalk River Nuclear Laboratories, four liquid effluent streams discharge radioactivity to the Ottawa River. Three of these, the Process and Sanitary Sewers plus the 04 Storm Sewer, drain the active inner area. Perch Creek, draining Perch Lake and the disposal areas, also flows into the river. Each of these is sampled regularly and is analyzed for individual nuclides. The total amount of radioactivity discharged to the river per day is calculated from the measured flow rate and graphs are presented for Sr 90, Cs 137, Ce 144, Ru 106, Pu 239, and nominal beta activity. At no time did the average concentrations of radioactivity in any of the effluents exceed 1% of the ICRP 40-hour occupational MPC for water. (Auth) (Complete text)

<135>
Yaniv, S.S., University of Pittsburgh, School of Public Health, Pittsburgh, PA. 1969

Plutonium and Americium Measurement in Humans by X and Gamma-Ray Spectral Analysis. WASH-1241; D.Sc. Thesis, University of Pittsburgh, 183 p.

The interactions of relevant x and gamma rays with human tissues and detector materials are analyzed, and the development of a method that permits the evaluation of plutonium-americium body burdens is described. The method is based on analyses of spectral distributions of radiation emanating from plutonium and americium. The spectra were obtained using a xenon-filled proportional counter. The interactions of plutonium and americium L x rays and americium 60 KeV gamma rays, with the xenon-filled proportional counter were investigated. Mathematical relationships, based on theoretical considerations and experimental data, relating the observed spectra to plutonium and americium body content were developed. A computer program to calculate the body content was derived and is presented. Experimental tests, using a human phantom, indicate that the method can be used for measurements of plutonium-americium mixtures located in soft tissues up to a depth of not more than about 4 cm. (Auth) (PHM)

Table 24 shows measurements of Pu and Am in average-man rando phantom, liver region. Table 25 gives measurements for the lung region. Table 26 shows relative body burden contribution of Pu isotopes from reactor fuel irradiation at 6000 MWD/t.

<136>

<136>
Allred, D.M., Brigham Young University, Department of Botany, Provo, UT. 1973, July

Effects of a Nuclear Detonation on Arthropods at the Nevada Test Site. Brigham Young University Science Bulletin, Biological Series, 18(4), 1-20

Fifty-three arthropod species were studied in an area affected by an underground nuclear detonation (Project Sedan). These were represented by 10 species of ants, 17 beetles, 5 orthopterans, 4 scorpions, 6 solpugids, and 11 spiders. Relative populations were determined prior to the detonation and at three periods after the detonation: 1) one and two months after (August and September 1962), 2) 11 months after (June 1963), and 3) 13 months after (August 1963). One and two months after the detonation, the number of species was reduced from the expected by 48%, by 52% after 11 months, and by 66% after 13 months. Greatest reduction of specimens occurred with spiders, followed by ants and beetles. Fewest changes occurred in the number of scorpions. Populations of each group changed significantly in each period. Reductions from 30% to 100% occurred in all groups in all periods after the detonation except for the scorpions one and two months after, when an increase of 160% was noted. After 11 months, spiders had increased 33%. Within specific sectors, populations did not vary significantly from the expected except in a few instances. In August and September 1962, immediately after the detonation, populations of arthropods in sectors 3, 4, and 5 were much higher than expected. This represented the area from approximately 65 m to 140 m from GZ. The increase may have been due primarily to the physical transport and initial survival of those arthropods living closer to GZ than 65 m. (Auth)

<137>
Anderson, J.B., E.C. Tsivoglou, and S.D. Shearer, U. S. Public Health Service, Dallas, TX; R. A. Taft Sanitary Engineering Center, Cincinnati, OH. 1963

Effects of Uranium Mill Wastes on Biological Fauna of the Animas River (Colorado-New Mexico). Part of Schultz, V. and Klement, A.W., Jr. (Eds.), Proceedings of the 1st National Symposium on Radioecology held at Colorado State University, Fort Collins, Colorado, September 10-15, 1961, (p. 373-383), 786 p.

Bottom fauna in the Animas River from the mill to the New Mexico state line were much less abundant than above the mill and in unpolluted tributary streams. Few or none of the insects important as food for fishes were found in approximately 30 to 40 miles of polluted river below the mill. Fly larvae were the most resistant to pollution and were found at nearly all stations. The reduction of food supply and the direct toxic effects of the mill wastes reduced numbers of fish below the mill. Toxicity tests using rainbow trout with various mill wastes were useful in determining the most harmful wastes. Median tolerance limit values ranged from 0.09% to 0.22% for organic raffinate wastes. Other wastes were less toxic. Based upon the volumes of wastes discharged to the river and their toxicity, it was estimated that about 600 cubic feet per second were needed in 1958 to dilute wastes in the river to protect fish life. By the fall of 1959 a program of waste treatment and storage of the most toxic waste in ponds had been effected. It was estimated from the toxicity studies that river dilution requirements had been reduced to 144 cubic feet per second. The data regarding the radium 226 content of attached filamentous algae, aquatic insects, and fish from the Animas River and other streams yield a good deal of information regarding the fate of this material in the water environment and its uptake by the aquatic biota. The natural, or background, radium 226 concentrations of these various forms have been shown, together with associated water and silt concentrations, and for the lower forms the radium 226 concentrations have been related to the gross alpha radioactivity. Radium 226 concentration factors for algae, insects, and skeletons and flesh of large suckers have been derived and appear to be consistent among themselves and among the types of biota. Thus, it has been indicated that a concentration factor for attached filamentous algae is in the range of 500 to 1,000, and that the corresponding factor for aquatic insects is no different. Radium 226 concentration factors for sucker skeletons appear to be about 100, while for sucker flesh a concentration factor of only three was observed, demonstrating the bone-seeking qualities of radium 226. (Auth) (PMM)

<138>
Anspaugh, L.R., P.L. Phelps, G.W. Huckabay, and T. Todachine, Lawrence Livermore Laboratory, Biomedical Division, Livermore, CA. 1973, July 5

Field Spectrometric Measurements of Radionuclide Concentrations and External Gamma Exposure Rates at the Nevada Test Site, A Demonstration Study. UCRL-51412; 19 p.

A study was conducted at the Nevada Test Site to demonstrate the feasibility of using a portable Ge(Li) detector system to conduct a large-scale survey of the gamma-emitting radionuclides present in the environment. The technique of using field spectrometry to quantitate radionuclide concentrations and external gamma exposure rates is briefly summarized. Measurements were made at 14 locations close to the Baneberry and Sedan fallout fields. Fifteen radionuclides were identified and quantitated, including twelve fallout radionuclides: Mn 54, Co 60, Ru 106, Rh 101, Rh 102m, Sb 125, Cs 134, Cs 137, Eu 152, Eu 154, Eu 155, and Lu 174. Most were associated with the Sedan fallout field, but Baneberry contributed significantly to the present levels of Mn 54, Co 60, Ru 106, Sb 125, and Cs 134. Cs 137 was the most abundant radionuclide at 10 of the 14 locations and varied from 438 to 9960 nCi/m2. The most abundant radionuclide at any location was Rh 102m, which had a maximum level of 19,160 nCi/m2. External gamma exposure rates varied from 15.4 to 406 uR/hr; the latter is equivalent to 3.1 rad/yr and is mostly due to the presence of Co 60 and Rh 102m. The levels of naturally-occurring radionuclides varied by as much as a factor of 2. The field spectrometry method is compared with other methods of conducting a large-scale survey. (Auth)

<139>
Archer, V.E., J.K. Wagoner, and F.E. Lundin, U.S. Department of Health, Education and Welfare, Health Services and Mental Health Administration, National Institute for Occupational Safety and Health, Division of Field Studies and Clinical Investigations, Salt Lake City, UT; National Institute of Child Health and Human Development, Bethesda, MD. 1973, October

Lung Cancer Among Uranium Miners in the United States. Health Physics, 25, 351-371

Excess respiratory cancer has been demonstrated among all groups of uranium miners who have had more than 120 working level months of radon daughter exposure. Lung cancer incidence rose with increasing exposure. Factors which might distort the exposure-response relationship were reviewed. Exposure to other agents such as cigarettes probably contributed to the excess, but these factors should not be considered in setting permissible levels. Respiratory cancers are continuing to appear at a high rate among the study group even though radon daughter levels have been markedly reduced and most of the study group have stopped mining. (Auth)

Table 5 gives copious data on respiratory cancer cases among study group white underground uranium workers, 1950-1971.

<140>
Not given, Argonne National Laboratory, Argonne, IL. 1972

Radiological and Environmental Research Division Annual Report, Ecology, January-December 1972. ANL-7960 (Part 3); 163 p.

The ecology report is organized into three sections, namely, Great Lakes Radioecology, Great Lakes Thermal Studies and Terrestrial Ecology. The radioecology program is concerned with the biogeochemical behavior and pathways to man of radionuclides and toxic trace elements in the Great Lakes. Two papers dealing with Pu 239 in water and biological samples are abstracted separately and the other papers cover studies on the Opossum shrimp, Cs 137 concentrations of alewives and sculpins, measurement of sedimentation rates using natural and fallout radionuclides, and sediments in Lakes Michigan and Superior. The Thermal Studies Group investigates the biological effects of thermal discharges at the Point Beach Nuclear Power Plant near Two Creeks, Wisconsin. Work is focused on the behavior response of Lake Michigan fish to heated effluent and studies of fish distribution in thermal plumes. The terrestrial ecology studies are concerned with tritium behavior in air-plant-soil systems, sulfur dioxide resistance in plants, a model of strontium and manganese dynamics in a tropical rain forest and radiation effects on carbohydrate synthesis and utilization in trees. (FHM)

<141>
Astley, C., and C.L. Sanders, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Biliary Excretion of Injected Plutonium 238. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 35-36), 103 p.

Biliary excretion is an important mechanism for clearance of liver Pu. The experimental manipulations used to study biliary excretion may influence the tissue distribution and excretion of Pu by other routes. Groups of five rats were subjected to several manipulations required for bile duct cannulation and bile collection. The results show that only 2.4% of injected Pu 238 was found in the bile collected continuously for 5 days after Pu injection. Bile flow rates were twice as high when bile was collected for only 1 hr/day and diverted back into the G.I. tract the remaining 23 hr/day, as compared to bile flow rates when the bile was collected continuously during a 5 day period after cannulation. Cannulation of the bile duct prior to injection of Pu 238 greatly reduced the amount of Pu 238 in liver, while increasing the amount of Pu 238 present in bone. About 0.3% of Pu 238 given to rats by gavage along with bile and NaOH to neutralize stomach HCl, was retained in the body at 10 days after administration. Less than half the Pu 238 excreted in feces was accounted for in the bile, indicating loss of Pu 238 in feces via diffusion or secretion from gut mucosa. (FHM)

Table 1 shows tissue distribution and excretion of intraperitoneally injected Pu 238.

<142>
Grummitt, W.E., Atomic Energy of Canada Limited, Chalk River Nuclear Laboratories, Biology and Health Physics Division, Chalk River, Ontario, Canada. 1971, December

Liquid Effluent Monitoring. AECL-4075; PR-B-91; Part of Progress Report, July 1 to September 30, 1971, (p. 32), 56 p.

The total amount of Pu 239 discharged to the Ottawa River in mg/d is given in Figure 2. At no time did the average concentrations of radioactivity in the effluents exceed 1% of the ICRP 40 hr occupational MPC for water. (BP)

<143>

<143>
Not given, Australian Atomic Energy Commission, Research Establishment, Lucas Heights, Australia. 1973, April

Environmental and Radiological Safety Aspects of the Mining and Processing of Uranium. AAEC/E-272; CONF-711227; Proceedings of the AAEC Symposium held in Lucas Heights, Australia, December 9-10, 1971, 97 p.

The prime purpose of the symposium was an educational one, that is to draw attention to the problems associated with the protection of man and the environment in the vicinity of uranium mining projects and to collect relevant information for future reference. Twelve papers were presented two of which are abstracted separately for the data base. The main topics covered in the symposium were: sources of pollution in uranium mining and processing activities and methods for their control, environmental studies for uranium provinces, practical dosimetry in uranium mining, biolcgical effects of radiations, radiological safety and prospects for control of radiological hazards in uranium mining. One paper consisted of a bibliography on radiological health and safety aspects of uranium mining and ore treatment. (FMM)

<144>
Bair, W.J., D.H. Willard, J.P. Herring, and L.A. George, General Electric Company, Hanford Atomic Products Operation, Biology Labcratory Richland, WA. 1962; 1963, January 15

Retention, Translocation and Excretion of Inhaled Plutonium 239 Dioxide. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 126-135); Health Physics, 8, 639-649

Beagle dogs were given single exposures to one of seven Pu 239 PuO2 aerosols that differed in particle size from 0.2 to 7.6 u mass median diameter (MMD). Translocation of plutonium to other tissues and excretion in both urine and feces up tc a month after exposure were greatest for dogs exposed to aerosols with the smallest median diameter. Dogs exposed to an aerosol with a MMD of 4.3 u were studied for about 10 months. The half-time for retention of Pu 239 in lungs was about 300 days; however, during this period there was continuous accumulation of Pu 239 in tronchial lymph nodes, which resulted in about a 1500-1800 day half-time for total body retention of plutonium. Inhaled and intravenously injected plutonium nitrate (0.2 N HNO3) were compared in still other dogs. After inhalation, 70% of the body burden was in the lungs, 10% in the liver and 15% in bone. After intravenous injection, more than 80% of the body burden was in liver and about 6% each in the spleen and bone. The rate of excretion in urine was about five times greater after inhalation than after intravenous injection. Corresponding differences were observed in the levels of plutonium in blood. The results of these studies emphasize the importance of the chemical form and the particle size of inhaled plutonium aerosols on retention, translocation and excretion, and point out the problems to be encountered in estimating the body burden from excretion analysis. (Auth)

<145>
Ballou, J.E., and W.G. Morrow, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Long-Term Effects of DTPA Treatment of Plutonium Deposition in Rats. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 58-59), 103 p.

Six weekly treatments of inhaled DTPA were given to rats starting 20 days after Pu inhalation. The animals were sacrificed periodically over their lifetime for pathologic examination. Aerosols of Pu 239 (NO3)4 were generated from a 0.27 N HNO3 solution. Groups with Pu or DTPA only, and sham treatment groups were included. DTPA treatments decreased the Pu content of soft tissues and bone compared to the amounts found in sham treated controls. After the series of 6 DTPA treatments the lung burden tended to be reduced to about 70% of that in sham treated rats. The total rat burden was reduced by half. No gross pathologic response was observed in the DTPA treated rats out to 200 days; histopathology results are not yet available. (FMM)

<146>
Ballou, J.E., and W.G. Morrow, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Chelatability of Plutonium in Blood. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 62-63), 103 p.

Blood taken from a dog at various times after intravenous or intratracheal injection with Pu nitrate or Pu citrate, was heparinized and centrifuged and the plasma was ultrafiltered using Visking cellulose tubing. DTPA (7 x 10(E-3) M) was added to these samples of blood, and the percent of ultrafilterable Pu in the plasma was taken as a measure of the amount of Pu available for chelation. Following intravenous injection of Pu citrate, Pu in blood was initially 30 to 80% chelatable; after 3 hr approximately 60% of the blood was chelatable. However, during this interval the total blood Pu level decreased about 90%, so the net amount of Pu available for chelation remained fairly constant up to 3 hr after injection. The results after intratracheal injection of Pu nitrate and Pu citrate, still very tentative, indicate that blood Pu is from 50 to 60% chelatable up to 4 hr after injection. The amount in blood increased 3 to 10 fold for the nitrate and citrate salts, respectively, during the first 4 hr following intratracheal injection. In separated plasma or serum, Pu rapidly becomes less available, suggesting the involvement of formed elements of blood. (Auth)

<147>
Baumgartner, W.V., M.V. Larson, G.H. Crook, and C.E. Newton, Jr., Battelle Memorial Institute, Pacific Northwest Laboratories, Radiation Protection Department, Richland, WA; General Electric Company, Richland, WA. 1965

The Treatment and Evaluation of Internal Deposition from a Plutonium Wound. BNWL-SA-39; 5 p.

Fragments of plutonium with activity exceeding 10 uCi, resulting from an explosive disintegration of plutonium metal, penetrated a hood glove and lodged in the left upper arm of an employee. The health physics and medical aspects of the incident were followed rigorously: urine samples continuously analyzed for plutonium activity; blood samples obtained and analyzed prior to the administration of some 70 intravenous injections of diethylenetriaminepenta acetic acid (DTPA); and the activity in the wound measured frequently. Observations on modifications of prior methods of treatment are presented, i.e., washing open wound with solutions of DTPA and effect of intramuscular injections of DTPA into the wound site. Discussions are presented that include methods of evaluating the internal deposition. The use of digital and analog computer techniques using the standard models with observed data is analyzed and the value of the analog computer for aiding the understanding of excretion patterns from plutonium deposition cases discussed. (Auth)

<148>
Baxter, D.W., M.W. Rosenthal, and A. Lindenbaum, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1973, July

Decorporation of Monomeric Plutonium from the Dog by Glucan and/or DTPA. Radiation Research, 55(1), 148-152

Monomeric Pu 239 was injected intravenously into beagle dogs to determine the effectiveness of DTPA (diethylenetriaminepenta acetic acid) and glucan, a polysaccharide derived from yeast cell walls, as agents for plutonium decorporation. DTPA therapy (100 mg/kg) was initiated six days after plutonium injection and continued, on a twice weekly basis, for 88 days. Glucan (15 mg/kg), given in conjunction with DTPA to a second group of dogs, was administered on days 6, 33, and 62. Control animals received sterile saline in place of both DTPA and glucan. When all animals were sacrificed on day 90, the liver burden in control dogs was the same as previously determined at day 6. DTPA therapy removed over 96% of this plutonium; removal from spleen, lungs, kidneys, testes, muscle, and lymph nodes ranged between 50 and 90%. The total skeletal content was also reduced by 50%. Adjunct therapy with glucan did not result in significant additional removal of plutonium, probably because of the high effectiveness of DTPA given alone. Species differences in the deposition of plutonium in liver as related to the effectiveness of DTPA therapy, with possible implications for man, are discussed. (Auth)

Tables 2 and 3 show the distribution and concentration of Pu in dog tissues as affected by glucan and/or DTPA therapy.

<149>
Baxter, D.W., M.W. Rosenthal, J.J. Russell, E. Moretti, D. Chladek, and A. Lindenbaum, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1972, December; 1973

Comparison of Monomeric and Polymeric Plutonium in the Dog and Mouse. ANL-7970: Part of Annual Report, 1972, (p. 126), 236 p.; Radiation Research, 58, 556-565

Monomeric or polymeric plutonium was injected intravenously into beagles and CF #1 mice in order to compare total body distribution of the two forms of this actinide in these species. Blood clearance rate, intralobar liver distribution, and urinary and fecal excretion were also determined for the dog. Monomeric plutonium was cleared from dog blood less rapidly than polymeric plutonium. During the first 15 min only 20% (vs 99%) had left the circulation. At sacrifice, 6 days postinjection, significantly more monomeric plutonium remained in the blood although the amount of each form was less than 1%. Monomeric plutonium was deposited chiefly in liver and skeleton of both species. Polymeric plutonium was deposited in liver, spleen, and lungs, with a comparatively small amount deposited in the skeleton. Autoradiographic measurements of plutonium deposition within the dog liver lobe showed a relatively homogeneous distribution of monomeric plutonium, whereas polymeric plutonium tended to be associated with sinusoidal (phagocytic) cells at the center of the liver lobe. The roles of phagocytosis and protein binding in plutonium transport and retention, with possible implications for man, are discussed. (Auth)

Tables 1 and 2 show the distribution and concentration of monomeric and polymeric Pu in tissues of dog and mouse after IV administration.

<150>
Blair, H.A., University of Rochester, School of Medicine and Dentistry, Department of Radiation Biology and Biophysics, Rochester, NY. 1972, December

Radiation Dose-Time Relations for Induction of Osteosarcoma in Mice and Dogs and their Bearing on Maximal Permissible Burden of Strontium 90 in Man. Health Physics, 23, 759-765

A method is discussed for deriving latent periods when survival times and quantities of injected carcinogenic nuclides are the only data available. It is proposed, with examples from the dog and the mouse, that the toxicities with respect to bone cancer production by Ra 226, Pu 239 and Sr 90 are related better on the basis of either radiation dose or injected dose causing cancer in equal times than on total incidence over an indefinite time. On this basis the toxicity of Ra 226 per injected dose probably does not exceed 40 times that of Sr 90 in both dog and mouse. The ratio in contrast to 200 used by Marinelli in calculating the maximal permissible burden of Sr 90 in man lowers his value from 9.5 to 1.9 uCi. (Auth)

<151>

<151>
Borg, I.Y., Lawrence Livermore Laboratory, Livermore, CA. 1973, March 5

Comparison of Shock Effects in Granitic Rock Recovered from the Monique Event, Algeria, and the Piledriver Event, Nevada Test Site. UCRL-51349; 14 p.

Shocked granite samples from the Monique Event in the Hoggar Mountains, Sahara, have been microscopically examined and compared with fractured granodiorite recovered from postshot cores at the Piledriver site, Nevada Test Site. One sample, nominally from the pulverized zone adjacent to the Monique cavity wall, is estimated to have been shocked to 155 plus or minus 35 kbar pressure and to have been recovered a few meters or 1.03 plus or minus 0.02 r sub c from the shot point. The second sample, nominally in the fractured zone, is estimated to have been shocked to 35 plus or minus 5 kbar and recovered 1.45 plus or minus 0.08 r sub c from the shot point. From all indications the dimensions of the pulverized and fractured zones measured at both the Monique and Piledriver sites are comparable when scaled to cavity radius (r sub c) rather than to yield (W(E+1/3)). The Higgins and Butkovich equation is equally successful in predicting r sub c for the two events, which belies the common impression that Hoggar cavities are always smaller than those produced by comparable U.S. explosions. From the point of view of phenomenology, the Monique and Piledriver events differ in two, possibly related, respects. A zone of residual stresses exists beyond the fracture zone at Monique and was not recognized at Piledriver in postshot drilling operations. Secondly, on a microscopic level samples shocked ostensively to the same pressures contain a slightly more pervasive and closely spaced network of fractures at the Monique site than at Piledriver. (Auth)

<152>
Borisov, V.P., A.T. Ivannikov, and S.M. Mikhailovich, Not given. 1966

Antidote Therapy of Uranium and Polonium Poisoning. AEC-tr-6944; Part of Moskalev, Yu.T., Distribution and Biological Effects of Radioactive Isotopes, (p. 670-677), 718 p.

On poisoning rats with U 238 in the form of soluble uranyl nitrate, the most effective means of first aid for reducing uranium absorption from the intestine proved to be disubstituted sodium phosphate (or its neutral mixture with monosubstituted sodium phosphate). On poisoning with Po 210 in the form of the soluble nitrate salt in bismuth, an effective antidote proved to be the official antidote against heavy metals--the alkali solution of hydrogen sulfide (ANTIDOTUM METALLORUM), as well as hydroquinone sulfohydrate, an anhydrous preparation of hydrogen sulfide. Carbolen, activated charcoal, universal adsorbent and bismuth nitrate proved to be ineffective. (Auth)

<153>
Boss, M.R., P.D. Hobbs, R.W. Loser, and D.E. Michels, Dow Chemical Company, Rocky Flats Division, Golden, CO. 1973, April 13; 1973, August

Annual Environmental Monitoring Report, Rocky Flats Plant, January through December 1972, Including Estimates of Releases to the Environment from Plant Operations. RFP-ENV-72; WASH-1259; Part of Environmental Monitoring at Major U.S. Atomic Energy Commission Contractor Sites, Calendar Year 1972, (p. 197-229), 1217 p.

Results of the environmental monitoring program in the vicinity of the Rocky Flats Plant during 1972 indicate that yearly average environmental concentrations of plutonium in air and water were less than 2% of applicable federal standards. Total long-lived alpha emitter concentrations in air, including natural background, were less than 30% of the soluble Pu 239 standard. No apparent changes were noted in the distribution of plutonium in soil from previous years. Changes in the distribution isopleths compared with 1971 are a result of additional sample results in the computer modeling program and do not reflect physical movement of plutonium in soils. (Auth)

In an addendum to the monitoring report it is stated that the concentrations of U and Pu in public areas as a result of air and water effluent releases from the Rocky Flats Plant are all below 1% of the relevant AECM 0524 Radioactivity Concentration Guides. Table 15 gives the Pu concentrations in vegetation samples. Table 16 gives the Pu concentrations in soil samples from around the Rocky Flats Plant. Table 13 gives the Am concentrations in reservoir water samples.

<154>
Boyd, G.A., A. Williams, W.L. Minto, D.V. Tiedeman, R.M. Fink, G. Casarett, and R.G. Metcalf, University of California, School of Medicine, Los Angeles, CA. 1950

Simultaneous Studies on the Intravenous Lethal Dosage of Polonium, Plutonium, and Radium in Rats. Part of Fink, R.M. (Ed.), Biological Studies with Polonium, Radium, and Plutonium, Chapter 8. McGraw-Hill Book Company, Inc., New York, New York, (p. 295-404), 411 p.

Comparative lethal-dosage studies of radium, plutonium, and polonium in rats were made to determine the relative toxicities of plutonium, polonium, and radium. Clinical observations, gross and microscopic pathological studies, and hematological studies were made. At death the rats were analyzed for total polonium and radium remaining in their bodies. The retention of plutonium was not determined. The LD 50 (lethal dosage for 50%) for polonium, plutonium, and radium at 20 days was 43, 83, and 2,100 microcuries per kilogram, respectively; at 60 days it was 23, 46, and 735 microcuries per kilogram; and at 100 days it was 17, 37, and 320 microcuries per kilogram. If the toxicity of an element is defined as the reciprocal of the LD 50, the ratios of toxicities show polonium and plutonium to be 49 and 25 times as toxic as radium at 20 days, 32 and 16 times as toxic at 60 days, 18 and 9 times as toxic at 20 days, 144,000 and 1.01 times as toxic at 60 days, and 82,000 and 0.55 times as toxic at 100 days, respectively. The most pronounced clinical effect of the three elements is a continual loss of weight from injection to death. The rate of loss increased as the dosage increased. The pathological changes found, in common, in rats injected intravenously with plutonium, radium, and polonium included pulmonary infection, lung hemorrhage and edema, liver necrosis, gastrointestinal hemorrhage, depletion of germinal cells and sperm in the testes, marked decrease of functional cells in the hematopoietic organs (spleen, lymph nodes, and bone marrow), atrophy of the spleen, hemorrhage and atrophy of the lymph nodes, and hemorrhage in the bone marrow cavities. Apparent regeneration of functional cells in the lymph nodes and bone marrow was observed. In the spleens of animals injected with plutonium and radium there was hyperplasia (increased cellularity) of the pulp. In rats injected with plutonium there was a suggestion of a slightly abnormal degree of degeneration of follicular cells in the ovaries of half the female rats studied. Degenerative changes and disorganization in the epiphysis of the femur were found in approximately half the animals injected with plutonium and in a third of the rats injected with radium, with marked depletion of osteoblasts and osteoclasts in almost all the rats in each of these groups. (Auth)

Appendix 1 deals with the effect of relative time of injection in survival time and Appendix 2 gives survival time for individual rats.

<155>
Boyd, G.A., H.E. Silberstein, R.M. Fink, A. Frenkel, W.L. Minto, R.G. Metcalf, G. Casarett, and G.M. Suter, University of California, School of Medicine, Los Angeles, CA. 1950

Pilot Studies on the Intravenous Lethal Dosage of Polonium, Plutonium and Radium in Rats. Part of Fink, R.M. (Ed.), Biological Studies with Polonium, Radium, and Plutonium, Chapter 7. McGraw-Hill Book Company, Inc., New York, New York, (p. 211-294), 411 p.

Pilot studies were made on polonium, plutonium, and radium to determine the 20 day LD 50 (the dosage that is lethal for 50% of mature rats in 20 days). Polonium dosages ranged from 50 to 170 uCi/kg, plutonium dosages ranged from 18.5 to 185 uCi/kg, and radium dosages ranged from 17 to 8,000 uCi/kg. The 20 day LD 50 dosage values in terms of uCi/kg for polonium, plutonium, and purified radium (polonium at approximately 0.07% of equilibrium value) were found to be approximately 50, 130, and 4,000 uCi/kg, respectively. The toxicities relative to purified radium as defined by the ratio of the 20 day LD 50's were approximately 93 and 32 microcuries for polonium and plutonium, respectively. A radium preparation estimated to contain about 2 microcuries of polonium per 1,000 microcuries of radium appeared to be 2 to 4 times as toxic as the purified radium in the period 40 to 100 days after injection. The weights seemed to be the best clinical criterion of the condition of the rat. In general, as the dosages increased, the rate of weight loss increased. Pathology studies were made on some of the animals at death. Polonium produced changes in the hematopoietic system at all dosage levels used. These changes consisted of a marked atrophy of lymphoid elements in the spleen and lymph nodes, as well as a marked depression of cellular elements in the marrow. Visceral engorgement was a constant finding. Liver changes were unimpressive. The changes in the 50 uCi/kg range suggest a lesser degree of toxicity than at higher levels. Radium caused changes in the hematopoietic system, liver, kidney, bowel, bone, testis, aorta, and coronary arteries. The changes in the hematopoietic system, bone, testis, and bowel were compatible with x radiation effects. Liver, renal, and vascular effects were unlike changes produced by x radiation. Plutonium produced damage to the hematopoietic system, bone, liver, testis, and kidney similar to that caused by x radiation. The testis may be less sensitive in comparison with other tissues than it is in high-voltage x radiation experiments. (Auth)

<156>

<156>
Brasson, P.E., and J.P. Corley, Battelle Memorial Institute, Pacific Northwest Laboratories, Occupational and Environmental Safety Department, Richland, WA. 1973, April

Environmental Surveillance at Hanford for CY-1972. BNWL-1727; 52 p.

Samples of surface water, groundwater, air, foodstuffs, soil and vegetation were collected at the Hanford site and analyzed for radioactivity. Columbia River water also received chemical and biological analysis. Additionally, measurements were made of river immersion exposure rate, surface exposure rate (1 meter above soil surface) and radionuclide deposition on soil surfaces and highways open to public access. In 1972 the average river radionuclide concentrations were less than 1% of the concentration guides for all identified radionuclides. Unidentified alpha emitters were 2.2% of which about 0.4% was due to Hanford operations. Airborne radioactivity concentrations at the Hanford boundary were, on the average, the same as the more distant sampling locations, indicating that Hanford operations did not contribute detectably to off-site airborne radioactivity. Average airborne beta, alpha, and I 131 concentrations were 0.3, 6.6 and 0.1%, respectively, of the concentration guides for 1972. A number of foodstuffs were sampled and analyzed for radioactive content. Average concentrations of Zn 65, Sr 90, I 131 and Cs 137 in local milk were less than 1% of the concentration guide for water. Trace radionuclides were also measured in local meat, poultry, eggs, produce, gamebirds, white fish and Willapa Bay oysters. There are no applicable concentration guides for these foods. Zn 65 concentration in the oysters decreased through 1972 at a rate closely corresponding to its radioactive decay rate and averaged 1.7 x 10(E-6) uCi/gm in 9 samples. Soil and vegetation samples were analyzed for Pu, U, Sr 90 and gamma emitters. Individual results showed no particular geographical pattern and the concentrations are believed to be the result of natural occurrence and regional fallout. Local Pu concentrations are typical of arid western states. The average external radiation exposure rate in the vicinity of Hanford was about 0.22 mR/day. The immersion exposure rate in the Columbia River at Richland averaged 0.14 mR/day, and the Columbia River shoreline exposure rate averaged 0.24 mR/day at Richland, both lower than measured upstream. Estimated 1972 dose to the average Richland resident from Hanford sources was less than 1 mrem (0.6% of the standard), about the same as for 1971. (Auth)

See Also Report BNWL-1727 (Add).

<157>
Brewer, L.W. (Ed.), Sandia Corporation, Industrial Hygiene Laboratory, Environmental Health Department, Albuquerque, NM. 1968, February

The Determination of Actinides in Urine. SC-M-67-3044; Part of Analytical Procedures for the Environmental Health Laboratory, (p. 3-1 - 3-2), 147 p.

Urine is ashed using nitric acid and hydrogen peroxide. The ash is dissolved in hydrochloric acid and the actinides, Am 241, Th 230, Po 231, U 233, Np 237, Pu 239, and Cm 244, electroplated from an ammonium chloride plus hydrochloric acid electrolyte. The isotope is identified and quantitated by alpha spectrometry. (Auth)

<158>
Brewer, L.W. (Ed.), Sandia Corporation, Industrial Hygiene Laboratory, Environmental Health Department, Albuquerque, NM. 1968, February

Analytical Procedures for the Environmental Health Laboratory. SC-M-67-3044; 147 p.

This manual was compiled from techniques used in the Industrial Hygiene Laboratory of Sandia Corporation at Albuquerque, New Mexico. The procedures are similar to those used in other laboratories devoted to industrial hygiene practices. Some of the methods are standard and others are modified. Some were developed at Sandia. New and revised procedures will be issued as supplements to this document. Three of the procedures have been abstracted separately for the data base. Others include the determination of several organic compounds in air, Sr 90 and Cs 137 in soil, vegetation and water, mercury, arsenic and chromium in urine and other elements and compounds in environmental and biological samples. (Auth) (PMM)

<159>
Brewer, L.W. (Ed.), Sandia Corporation, Industrial Hygiene Laboratory, Environmental Health Department, Albuquerque, NM. 1968, February

The Determination of Enriched Uranium in Urine. SC-M-67-3044; Part of Analytical Procedures for the Environmental Health Laboratory, (p. 13-1 - 13-3), 147 p.

Uranium is separated from urine by coprecipitation with ammoniacal alkaline earth phosphate precipitate. The precipitate is ashed, and the uranium is purified by solvent extraction. The extract is evaporated onto a steel planchet for counting. (Auth)

<160>
Brewer, L.W. (Ed.), Sandia Corporation, Industrial Hygiene Laboratory, Environmental Health Department, Albuquerque, NM. 1968, February

The Determination of Total Uranium on Fallout Trays and in Soil, Urine, and Water. SC-M-67-30##; Part of Analytical Procedures for the Environmental Health Laboratory, (p. 33-1 - 33-5), 187 p.

Fused mixtures of uranium in sodium fluoride (2% lithium fluoride) exhibit strong fluorescence (at 560 mu) in ultraviolet radiation. The intensity of fluorescence is proportional to uranium concentrations from less than 0.001 ppm to more than 10 ppm. The method is nearly specific for uranium, and sensitivities in the range of 0.000# microgram (plus or minus 10%) per fusion button can be obtained. Large amounts of quenching interferences are removed, and uranium purified, by solvent extraction. Methods of preparation of samples of urine, water and fallout trays are described. (Auth) (FNM)

<161>
Brightwell, J., and A.G. Hepplestcn, University of Newcastle upon Tyne, Royal Victoria Infirmary, Department of Pathology, Newcastle upon Tyne, England. 1973

Inhibition of Urethane-Induced Pulmonary Adenomas by Inhaled Plutonium 239. British Journal of Radiology, 46(543), 180-182

Exposure of inbred mice belonging to an A strain to the inhalation of plutonium dioxide significantly inhibited the capacity of urethane to induce pulmonary adenomas, but tumor size was unaffected. Cell kinetic studies suggested that proliferation of cells comprising the adenomas diminished with time, though the decrease was less evident in irradiated than in nonirradiated animals. Alpha irradiation may act by interfering with the immuno-depressive effect of urethane. (Auth)

<162>
Brodsky, A., J.A. Sayeg, M. Wald, R. Wechsler, and R. Caldwell, University of Pittsburgh, Graduate School of Public Health, Pittsburgh, PA; Presbyterian University Hospital, Radiation and Medicine Department, Pittsburgh, PA; NUMEC, Inc., Apollo, PA. 1967

The Measurement and Management of Insoluble Plutonium-Americium Inhalation in Man. CONF-660920; Part of Snyder, W.S., et al (Eds.), Proceedings of the 1st International Congress of Radiation Protection held in Rome, Italy, September 5-10, 1966, Part 2. Pergamon Press, Oxford, England, (p. 1181-1190), 1623 p.

A drybox explosion on January 17, 1966, exposed three individuals to inhalation of dust containing a mixture of Pu 239 and Am 241. Preliminary measurements at the University of Pittsburgh whole body counter 27 hr after the incident, using a 1 mm thick, 2 in. D, NaI detector indicated a possible lung burden as high as 0.4 uCi Pu 239 in one of the individuals. Although a considerably fraction of the contamination was believed to be Am 241, upper-limit estimates of Pu 239 in the lung were still as high as 0.2# uCi on day 4 (postexposure), so the decision was made to administer 1 g/day DTPA intravenously for the next three days. On day 5, a hundredfold increase appeared in the count-rate and changes occurred in the spectral shapes indicating a sudden appearance of new surface contamination on the anterior chest. This activity, as well as its probably source (another spot of contamination found on the forehead) was removed. Subsequent spectral shapes indicated that further measurements were indicative of lung radioactivity. Isotopic analyses of contamination and air samples showed that the major fraction of the activity was Am 241. Interim estimates of lung burden were then: 7 x 10(E-3) uCi of Am 241 on day 4; 4 x 10(E-3) uCi on day 11; 6 x 10(E-4) uCi on day 28; and 4 x 10(E-4) uCi on day 57. These values are consistent with the elimination of about 36,600 d/min of Am 241 and 5# d/min of Pu 239 in the first fecal sample. Urine excretion rates, initially less than 0.4 dpm/24 hr, increased 50-100 times between days 5-8, suggesting the efficacy of DTPA in removing insoluble Am 241 from the lung. (Auth)

<163>
Botton, J.C.E. (Comp.), Australian Atomic Energy Commission, Research Establishment, Lucas Heights, Australia. 1973, April

Radiological Health and Safety Aspects of Uranium Mining and Ore Treatment, A Bibliography. AAEC/E-272; CONF-711224; Part of Proceedings of the AAEC Symposium on Environmental and Radiological Safety Aspects of the Mining and Processing of Uranium held in Lucas Heights, Australia, December 9-10, 1971, (20 p.), 97 p.

The bibliography on radiological health and safety aspects of uranium mining and ore treatment is compiled under the following fourteen broad headings: environmental problems; external radiation measurement; general radiological health and safety aspects; historical aspects; internal contamination hazards; internal contamination measurement; internal contamination protection; medical aspects; monitoring programs; radioactivity fundamentals; radiological exposure limits; standards and regulations; ventilation; and waste management. (FNM)

<164a>

<164>
Lyaginskaya, A.M., and Ye.P. Ovcharenko, Not given. 1971

Effect of Americium 241 on the Histopathology of the Ovaries of Rats. AEC-tr-7387; Part of Moskalev, Yu.I. (Ed.), Remote Aftereffects of Radiation Damage, (p. 455-462), 574 p.

Experiments were carried out on 126 white rats of the Wistar line with an initial weight of 160-170 g; 18 of them served as controls. The experimental rats were administered Am 241 intravenously in a 2% solution of sodium citrate (pH equals 6.0) in the following quantities: 0.096 uCi/g (first group), 0.035 uCi/g (second group), 0.02 uCi/g (third group), 0.01 uCi/g (fourth group), 0.004 uCi/g (fifth group) and 0.002 uCi/g (sixth group). The animals were killed 1, 3, 5, 7, 8, 9 and 12 months after administration of the radioisotope. The morphological changes in the ovaries are described and indicate a considerable damaging effect of the various amounts of Am 241 on the sex glands of female rats. There was a dependence of morphological changes on the administered dose. The time of development of changes in the ovaries is dependent on the Am 241 quantity administered to rats. For example, in the radiotolerant primordial folliculi, it was observed that after Am 241 administration in quantities of 0.096 and 0.035 uCi/g a considerable decrease in their number occurred after a month; in the case of a decrease in the administered quantity to 0.02 and 0.01 uCi/g--after five months; with the administration of small quantities (0.004 and 0.002 uCi/g)--after eight of nine months. In animals of all the experimental groups an irritation period preceded the depression period. With administration of large Am 241 quantities (0.096 and 0.035 uCi/g) this period was brief and represented by a large number of mitoses in the follicular epithelium cells. With the administration of small Am 241 quantities (0.004 and 0.002 uCi/g) it occupies an interval of three to five months and is morphologically manifested by an increase in the number of mature folliculi. In 12 of the 15 experimental rats which received Am 241 in small quantities (0.004 and 0.002 uCi/g) at late times (8-12 months) it was possible to detect multiple follicular and luteinic cysts and tumors of the thecoma and adenoma types. It should be noted that the appearance of these tumors occurred when there was a low absorbed dose in the ovaries (0.73 rad).(FMM)

<165>
Lindenbaum, A., and M.A. Smyth, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1971

Determination of Plutonium 239 and Americium 241 in Animal Tissues by Liquid Scintillation Spectrometry. CONF-700716; Part of Horrocks, D.L. and Peng, C.T. (Eds.), Proceedings of the International Conference on Organic Scintillators and Liquid Scintillation Counting held in San Francisco, California, July 7-10, 1970. Academic Press, New York, New York, (p. 951-963), 1078 p.

Plutonium 239 or americium 241 in ashed samples of bone, liver, spleen, feces and urine, dissolved in 0.7 N HCl, was assayed by a liquid scintillation method, using Triton N-101-xylene-PPO. A commercially available liquid scintillation spectrometer was used, and essentially 100% counting efficiency was achieved. There was close agreement between analytical results obtained with this liquid scintillation method and with a previous one employing toluene-ethanol-PPO; also between results obtained with liquid scintillation spectrometry (LS) as compared to proportional counting (PC). LS is generally superior to PC because it is less laborious and time-consuming, yields closer replication of analytical values, and permits more analyses per experiment, since tissues low in activity can be counted individually, rather than pooled. The Triton N-101-xylene-PPO scintillation fluid has advantages over toluene-ethanol-PPO: it permits the use of larger volumes of aqueous samples, holds more insoluble matter in suspension (due to gelation), and, in most cases, allows vials to be stored indefinitely without apparent loss of activity. Simple instrumental methods of detecting and correcting occasional aberrant samples are described. (Auth)

Table 2 shows Pu 239 in liver, spleen and femurs of mice measured by proportional counting and liquid scintillation.

<166>
Kirby, H.W., and M.L. Salutsky, Mound Laboratory, Miamisburg, OH; W. R. Grace and Company, Research Division, Washington Research Center, Clarksville, MD. 1964, December

The Radiochemistry of Radium. NAS-NS-3057; 205 p.

The monograph on the radiochemistry of radium is one in a series covering the radiochemistry of essentially all the elements. In it are included reviews of nuclear and chemical properties of radium, discussions of methods of sample dissolution and of separation reactions, descriptions of counting techniques, and a compilation of radiochemical separation procedures. (Auth)

<167>
Gibson, W.M., Bell Telephone Laboratories, Murray Hill, NJ. 1961, August

The Radiochemistry of Lead. NAS-NS-3040; 158 p.

The volume is one of a series of monographs on the radiochemistry of the elements. There is included in a review of the chemistry of lead of chief interest to radiochemists, a discussion of methods of dissolution of samples and counting techniques. The standard radiochemical procedures for lead are given and form the basis of most of the detailed radiochemical procedures compiled. In addition, information on techniques which have demonstrated or promise potential advantages for radiochemical applications but are not in general use by radiochemists are presented. (FMM)

Table 1 shows the isotopes of lead.

<168>
Mullins, W.T., and G.W. Leddicotte, Oak Ridge National Laboratory, Oak Ridge, TN. 1962, March

The Radiochemistry of Phosphorus. NAS-NS-3056; 32 p.

The volume deals with the radiochemistry of phosphorus, and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth)

<169>
Chiacchierini, R.P., G.L. Jessup, W.S. Nelson, N.C. Telles, E. Tompkins, and J.F. Wright, U.S. Department of Health, Education, and Welfare, Public Health Service, Bureau of Radiological Health, Division of Biological Effects, Rockville, MD. 1970, December

A Review of Radium Toxicity Studies. BRH/DBE-70-5; 31 p.

The debate concerning the linear or threshold response of somatic radiation injury has been focused on the human radium toxicity studies. Because of the critical public health significance of the data derived from these studies, a task group from the Division of Biological Effects of the Bureau of Radiological Health undertook a review of the available human and animal radium studies for the purpose of determining the extent to which animal and human data are sufficient to resolve the question of a dose-response relationship. The review contained in this report indicates that the animal and human radium experience to date is not sufficient to specify an unequivocal dose-response model. Therefore, in the low dose regions expected to be experienced by the general public, the assumption of a linear, non-threshold model continues to be a prudent public health philosophy for standards setting. (Auth)

Plutonium is only mentioned in the Utah study which was initiated in the early 1950's and designed to compare the effects of Pu 239 and Ra 226.

<170>
Carfagno, D.G., and W.H. Westendorf, Mound Laboratory, Miamisburg, OH. 1973, March 15; 1973, August

Annual Environmental Monitoring Report: Calendar Year 1972. MLM-2028; WASH-1259; Part of Environmental Monitoring at Major U.S. Atomic Energy Commission Contractor Sites, Calendar Year 1972, (p. 97-128), 1217 p.

The average concentrations of Po 210, Pu 238 and tritium detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, are presented for calendar year 1972. The average concentrations of these radioisotopes were well within the stringent standards adopted by the Atomic Energy Commission. The average concentrations of Po 210, Pu 238 and tritium measured in air during this period were less than 0.02%, 0.3% and 0.1% of their respective (RCG's) Radioactivity Concentration Guides. Water monitoring for radioactive species found the average concentrations of Po 210, Pu 238 and tritium measured at the water sampling locations during this period to be less than 0.3%, 0.1% and 0.5% of their respective RCG's. These results represent a significant reduction in concentrations of PO 210 and tritium over those measured in 1971. The average concentrations of Pu 238 measured during 1972 were slightly lower than, but within the range of, those measured during 1971. Water monitoring for nonradioactive species was conducted. Additionally, data concerning radioactive species in surface water, community drinking water, foodstuffs, soil and silt are presented. No significant uptake of radioactive species from air or water by plant or animal life has been observed. No reentrainment of radioactive species from soil or silt is indicated at this time. Soil core sample analyses will continue to establish a Pu 238 soil inventory as part of the total program to assess the impact of the Laboratory's operations on the environment. (Auth)(PMM)

Table 8 gives the concentration of Pu 238 in the Great Miami River. Table 16 gives a summary of soil core analysis for Pu 238. Table 17 gives a summary of analysis of Great Miami River silt samples for Pu 238.

<171>
Chapman, T.S., and S. Hammons, Jr., Dow Chemical Company, Rocky Flats Division, Denver, CO. 1963

Some Observations Concerning Uranium Content of Ingesta and Excreta of Cattle. Health Physics, 9, 79-81

Samples of feed and excreta were obtained from six head of Holstein heifers selected at random from a dairy herd of thirty in Larimer County, Colorado. The normal diet of the herd contained 5,000 uuCi of uranium per head per day. Most of this was in the feed concentrate. The calculated rate of excretion of uranium in the urine and milk combined was 0.6% of that in the feces. (PMM)

<172>
McClelland, J., Los Alamos Scientific Laboratory, Los Alamos, NM. 1955, August

The Determination of Plutonium in Urine. LA-1858; Part of Analytical Procedures of the Industrial Hygiene Group, Chapter 21, (p. 121-124), 173 p.

For the determination of Pu in urine, the urine sample is ashed with nitric acid, plutonium is coprecipitated with bismuth phosphate, dissolved in hydrochloric acid and then coprecipitated with lanthanum fluoride. The lanthanum fluoride precipitate is slurried on a stainless steel plate and counted for alpha activity with a low-background proportional counter. Quantities of the order of 2 d/m or 2 x 10(E-11) g of plutonium can be determined by this method. The tolerance for plutonium in urine given in the LASL Official Monitoring Handbook is 7 d/m/24 hour sample. Samples are rechecked if the results are 2 d/m/24 hour sample or higher. (Auth)

<173>
McClelland, J., Los Alamos Scientific Laboratory, Los Alamos, NM. 1955, August

Analytical Method for Americium in Urine. LA-1858; Part of Analytical Procedures of the Industrial Hygiene Group, Chapter 2, (p. 10-13), 173 p.

The method for analysis of americium in urine is based on the coprecipitation of americium with bismuth phosphate from a nitric acid solution of urine salts at a pH of 1.7. The bismuth phosphate is dissolved 6 N HCl and the americium coprecipitated a second time with lanthanum fluoride. The precipitate is slurried ontc a stainless steel plate and counted with a low-background proportional alpha counter. Quantities of the crder of 2 d/m or 6 x 10(E-19) g of americium can be determined by this method. The tolerance for americium in urine used at LASL is 7 d/m/24 hour sample. Samples are rechecked if the count is 2 d/m/24 hour sample or higher. (Auth)

<174>
Lloyd, R.D., D.R. Atherton, C.W. Mays, S.S. McFarland, and J.L. Williams, University of Utah, College of Medicine, Radichiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Curium Excretion, Retention, and Distribution Studies in Beagles. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 163-177), 400 p.

The metabolism of Cm was studied in 5 young adult beagles from 0 to 57 days after the intravenous injection of Cm 244 plus Cm 243 in citrate buffer. Total excretion during the first 3 weeks after injection was mainly urinary. Of the entire Cm eliminated in this 3 week collection period, nearly 3/5 appeared in the first day's urine. Abcut 5 times more Cm was excreted in the urine than in the feces on the first day. Following this, however, partitioning of Cm between urine and feces in the daily excretion was more nearly equal. A combination of total-body and partial-body counting of the living dogs utilizing the 209, 228, and 278 keV gamma rays of Cm 243 indicated that at a week after injection about 35% of the injected Cm was deposited in the liver and abcut 53% was in nonliver tissue (mainly skeletcn). Three dogs were sacrificed at 6, 13, and 20 days after injection. Although the liver and skeleton acccunted for the bulk of the retained Cm, some other tissues exhibited significant Cm concentrations, particularly the thyroid. Urinary excretion, retention, and tissue distribution of injected Cm were similar to that of inhaled Cm in 28 beagles reported by McClellan, et al. A comparison of Cm excretion by beagles with the other transuranium elements Pu, Am, and Cf is given. It appears that the partitioning of excreted Cm between urine and feces is more like Am than either Pu or Cf. During the first 3 weeks after injection, Am, Cf and Cm were excreted mainly in the urine while Pu excretion was predominantly fecal. Retention values for Pu, Am, and Cf at corresponding times are also compared with those of Cm. (Auth) (PMM)

Table 2 shows excretion of Pu, Am, Cm and Cf by beagles during the first 3 weeks after intravenous injection. Table 3 shows biological retention of injected Cm in beagles. Table 4 shows retention of Pu, Am, Cm and Cf by beagles one week after intravenous injection in citrate solution. Table 5 shows distribution and concentration of injected Cm in tissues of beagles.

<175>
Mahlum, D.D., J.E. Ballou, A.C. Case, W.E. Keder, and W.J. Clarke, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Metabolism and Toxicity of Neptunium 237 in the Rat. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 22-30), 269 p.

Intestinal absorption of Np in rats was influenced by valence state and mass level. Under all circumstances its absorption was substantially greater than that of Pu. The level of Np 237 deposited in femur and adrenal remained fairly constant over a 207 day retention period. The significance of zonal deposition of Np in the adrenal is discussed as it may relate to critical organ consideration. Female rats receiving 12 or 24 mg Np 237/kg died or were moribund within 48 hours. Histological examination revealed damage to the liver, kidney, spleen, and brain. Chemical analysis showed a marked increase in liver lipids. (Auth)

<176>
Hogdahl, O.T., University of Michigan, Ann Arbor, MI. 1961, December

The Radiochemistry of Palladium. NAS-NS-3052; 62 p.

The volume deals with the radiochemistry of palladium and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques for radioactive palladium isotopes and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth) (PMM)

A table of isotopes of palladium is given.

<177>
Bate, L.C., and G.W. Leddicotte, Oak Ridge National Laboratory, Oak Ridge, TN. 1961, September

The Radiochemistry of Cobalt. NAS-NS-3041; 90 p.

The volume deals with the radicchemistry of cobalt and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques for the radioactive cobalt isotopes and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth) (PMH)

Table 1 shows the radioactive nuclides of cobalt. Figure 1 shows the decay schemes of the cobalt radionuclides.

<178>
Leddicotte, G.W., Oak Ridge National Laboratory, Oak Ridge, TN. 1961, October

The Radiochemistry of Osmium. NAS-NS-3046; 20 p.

The volume deals with the radiochemistry of osmium and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth)

<179>
Steinberg, E.P., Argonne National Laboratory, Argonne, IL. 1961, August

The Radiochemistry of Niobium and Tantalum. NAS-NS-3039; 57 p.

The volume deals with the radiochemistry of niobium and tantalum and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth)

<180>
Mullins, W.T., and G.W. Leddicotte, Oak Ridge National Laboratory, Oak Ridge, TN. 1961, September

The Radiochemistry of Tungsten. NAS-NS-3042; 40 p.

The volume deals with the radiochemistry of tungsten and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth)

<181>
Marinsky, J.A., University of Buffalo, Department of Chemistry, Buffalo, NY. 1961, July

The Radiochemistry of Germanium. NAS-NS-3043; 48 p.

The volume deals with the radiochemistry of germanium and is one of a series of monographs on the radiochemistry of the elements. A review of the nuclear and chemical features of particular interest to the radiochemist is presented together with a discussion of sample dissolution and activity measurement techniques. A collection of radiochemical procedures for the element as found in the literature is also included. The information that is presented was obtained from the general review references that are cited and from a search of the Chemical Abstracts from 1941 to June 1961 and the Nuclear Science Abstracts from 1948 to June 1961. Plans include revision of the monograph periodically when new techniques and procedures warrant its modification. (Auth)

<182>
Schubert, J., J.F. Fried, M.W. Rosenthal, and A. Lindenbaum, Argonne National Laboratory, Division of Biological and Medical Research, Argonne, IL. 1961

Tissue Distribution of Monomeric and Polymeric Plutonium as Modified by a Chelating Agent. Radiation Research, 15, 220-226

Mice injected with a polymeric (colloidal) solution of plutonium (2.6 uCi/kg) retained more of the radioelement in the liver and spleen and less in the bone than did mice injected with a monomeric plutonium solution (3.3 uCi/kg). Daily DTPA therapy was initiated 3 days later, and the level of the radioelement in bone was reduced about one-half in each case. The liver burden of mice injected with the monomeric form of plutonium was nearly completely removed after a few days of treatment, but that of mice injected with polymeric form was reduced slowly and by only about one-third. (Auth)

Table 1 shows a comparison of Pu retention and effect of DTPA therapy in mice receiving two forms of Pu.

<183>

<183>
Matsuoka, O., H. Joshima, M. Kashima, and T. Noda, National Institute of Radiological Sciences, Chiba, Japan. 1970, October 1

The Effect of DTPA Treatment on Acute Toxicity in Mice. NIRS-Pu-7; Part of Research Report on Internal Exposure to Plutonium, April 1969-March 1970, (p. 70-72), 91 p.

The effect of the repeated DTPA treatment on the acute toxicity of monomeric and polymeric Pu was investigated regarding whole-body retention, survival time and body weight change. Monomeric and polymeric Pu of 0.03 uCi/g were given to mice intravenously. One day after injection, Ca DTPA saline solution of 100 mg/kg was administered repeatedly to mice intraperitonealy and spaced 3 days apart. Whole-body retention was measured in both treated and untreated groups of the two types of plutonium and in 3 additional groups, i.e., DTPA chelate Pu, monomeric plus DTPA, polymeric plus DTPA for comparison. The whole-body retention of the six groups observed was as follows in order of highest to lowest in retention; polymeric, monomeric, polymeric and DTPA treatment, polymeric plus DTPA, monomeric and DTPA treatment, monomeric plus DTPA, DTPA chelate Pu. Repeated DTPA treatment produced remarkable decreases of body retention depending on the physicochemical form of Pu. Survival time and body weight change were however, not so affected by DTPA treatment although the mean survival time depended also on the initial physicochemical state. (Auth)

<184>
Masse, R., Commissariat a l'Energie Atomique, Department de la Protection, Sanitaire, Section de Toxicologie Nucleaire, Fontenay-aux-Roses, France. 1971

Comparative Cytological Study of the Effect of Inhaled Plutonium and Silica on the Behavior of the Alveolar Macrophages. CONF-700931; Part of Walton, W.H. (Ed.), Proceedings of the 3rd International Symposium on Inhaled Particles held in London, England, September 14-23, 1970, Vol. 1. Unwin Brothers Limited, The Gresham Press, Old Woking, Surrey, England, (p. 247-259), 1090 p. (French)

Comparison of the results of cytolcgical observations and kinetic analysis of lung clearance in rats poisoned by plutonium and silica has enabled the part played by the different parameters to be established. Plutonium showed a cytotoxic and cytostatic action and inhibited the bronchial excretion of macrophages. Silica showed a cytotoxic action, enhanced cellular production and inhibited the bronchial excretion of macrophages. Plutonium action appeared as a threshold mechanism; below a limiting dose cytological changes were compensated and did not result in any distrubance of excretion. The determining factor in the blockage of alveolar clearance seemed to be a disturbance of cellular mobilization or motility depending on the cell itself and its environment. (Auth)

<185>
Major, W.J., R.A. Wessman, R. Melgard, and L. Leventhal, Tracerlab, Technical Services Division, Richmond, CA. 1964

Routine Determination of Plutonium by Tracer Techniques in Large Biological Samples. Health Physics, 10, 957-965

A precision tracer procedure was developed for the rapid analysis of non uniformly distributed plutonium in large biological samples. Liver, lung, kidney, lymph node, trachea, gastrointestinal tract, nasal mucosa, pharyngeal mucosa, bone, urine and feces samples from burros, sheep, and dogs (exposed to plutonium aerosols) were assayed for plutonium. The chemical procedure consisted of: equilibration of sample plutonium with Pu 236 tracer, wet ashing by refluxing with H_2SO_4 and a catalyst, extraction of plutonium from bulk salts with cupferron-chloroform, purification with ion exchange resins, and electrodeposition on platinum. These procedures minimized the requisite volume of acids and avoided the violent exothermic reactions of some wet ashing procedures. Problems associated with dry ashing, such as loss of the radioisotope by entrainment in solid carbon particles and formation of insoluble oxides of plutonium, were avoided. Also, the need for the large ashing furnaces was obviated. The plutonium content was measured by tracer yielding and alpha pulse-height analysis. This method ensured a high degree of accuracy, high sensitivity, and freedom from interference from other alpha emitters. A typical chemical yield was 55% and the counting precision was within 3%. Limits of detection were approximately 0.05 dis/min for a thousand minute count. (Auth)

<186>
Mahlum, D.D., and M.R. Sikov, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Age-Related Effects of Plutonium in Rats. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 9-10), 103 p.

The long-term effects of monomeric Pu 239 administered to rats at various ages were compared. Animals exposed as adults and weanlings received intravenous doses of 0.3, 1.0 and 3.0 uCi/kg; higher doses were administered to the newborn and prenatal groups. Samples of bone were taken for radioanalysis at the time of death to define the long-term dose to the bone. It was found that bone tumor incidence was initially higher in males than in females and in animals injected as adults. (Auth)

<187>
Kosburnikova, N.A., V.K. Lenterg, and E.R. Lyubchanskiy, Not given. 1971

Remote Aftereffects of Inhalation of Soluble Plutonium 239 Compound. AEC-tr-7387; Part of Moskalev, Yu.I. (Ed.), Remote Aftereffects of Radiation Damage, (p. 334-343), 574 p.

The pathological and anatomical changes detected in rats and rabbits following inhalation of soluble Pu 239 compound are described. Some of the rabbits were administered the isotope intratracheally. The results show that Pu, with its inhalation in the form of soluble compounds, in contrast to the dioxide, induces not only pneumosclerosis and pulmonary cancer, but osteosarcomas as well. Attention is drawn to the blastomogenic effects of small Pu doses. Pulmonary cancer was detected with tissue doses of about 50 rad and ostecsarcoma with doses of about 4-15 rad. The maximum occurrence of pulmonary tumor occurred with total tissue doses from 500 to 1000 rad in comparison with Pu citrate. Ammonium Pu-pentacarbonate exerted a more clearly expressed blastomogenic effect. For example, at optimum doses pulmonary tumors were detected in 63-78% of the rats which inhaled the carbonate complex and in 40-48% of the animals receiving Pu citrate. (PMM)

<188>
Sunderman, D.N., and C.W. Townley, Battelle Memorial Institute, Columbus, OH. 1961, November

The Radiochemistry of Silver. NAS-NS-3047; 55 p.

The volume deals with the radicchemistry of silver and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth)

<189>
Anders, E., Enrico Fermi Institute; University of Chicago, Department of Chemistry, Chicago, IL. 1960, November

The Radiochemistry of Technetium. NAS-NS-3021; 50 p.

The volume deals with the radicchemistry of technetium and is one of a series of monographs on radiochemistry of the elements. There is included a review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and finally, a collection of radiochemical procedures for the element as found in the literature. (Auth)

<190>
Mahlum, D.D., and M.R. Sikov, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Physicochemical Form as a Determinant of the Toxicity of Plutonium 238 in the Rat. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 5.5-5.7), 253 p.

Female rats of the Charles River CD strain, 3-4 months old, were injected intravenously with 54, 108, or 162 uCi/kg of the monomer of Pu 238, or 50, 100, or 150 uCi/kg of the polymer. These animals were kept for determination of survival times. In a second experiment rats were injected with 54 or 161 uCi/kg of the monomer, or 50 or 100 uCi/kg of the polymer, and groups were killed at 1, 7, and 33 days postinjection for tissue radioanalysis. It was shown that the acute toxicity of Pu 238 was related to the physicochemical form injected, with the polymeric form being nearly twice as toxic as the monomer. The polymeric form produced earlier deaths, and there was a substantial difference in the distribution of the monomer and the polymer. Nearly twice as much monomer, as polymer, was deposited in bone; while a substantially greater proportion of polymer was deposited in liver. The fraction in the liver decreased very little between 1 and 7 days, but was markedly reduced in the monomer injected animals after 33 days. Femur and spleen values increased beyond the first day postinjection, with particulary high spleen values attained in the polymer injected animals. Adrenal weights were increased at both the 50 and 100 uCi/kg levels of polymer, whereas spleen weights were decreased in both monomer and polymer injected animals. (PMM)

Table 2 shows distribution in liver, spleen, kidneys, adrenal and femur of rats of intravenously injected monomeric and polymeric Pu 238. See also Health Physics, 17(2), 346-347.

<191>

<191>
Lyubchanskiy, E.B., Z.M. Bukhtoyarova, and N.A. Koshurnikova, Izdatel'stvo Meditsina, Moscow, USSR. 1969

Behavior of Plutonium 239 and the Histological Picture of Injury of the Skeleton and Liver of Rats Under Single and Chronic Intake of the Isotope. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radioactive Isotopes and the Body, (p. 376-387), 458 p.

Experiments were done on rats of the Wistar strain with an initial weight of 150 plus or minus 1.1 g. A solution of Pu 239 citrate complex was administered intraperitoneally. In one series of experiments the animals received Pu six times/week for the course of 20, 40, 80 and 160 days in the quantities of 0.0033 uCi and 0.0066 uCi. In the other series of experiments the isotopes were administered once. The thigh, liver and kidneys of the animals were radiochemically analyzed after sacrifice and some tissues were studied histologically. It was shown in the experiments with a single intraperitoneal administration, that the magnitude of the deposition of Pu 239 in the skeleton decreased, did not change in the liver, and increased with age in the kidneys. Elimination from the skeleton and kidneys occurred with the same biological half-life and with two half-lives from the liver. The rate of elimination was independent of age and injected dose. The histological study of the bone tissue and liver showed the high effectiveness of alpha radiation in the chronic administration of the isotope. (Auth) (PNM)

Table 2 shows Pu 239 accumulation factor in the organs of rats after chronic intraperitoneal administration. Table 3 shows Pu 239 elimination from the organs of rats after single and chronic administration.

<192>
Lyubchanskiy, E.B., and L.A. Buldakov, Not given. 1966

On the Experimental Substantiation of the Maximum Permissible Content of Plutonium 239 in the Human Organism and in the Air of Work Premises. AEC-tr-6944; Part of Moskalev, Yu. I., Distribution and Biological Effects of Radioactive Isotopes, (p. 548-580), 718 p.

The literature data presented and the calculations of MPL norms of Pu 239 in the human organism performed on the basis of these data show that the osteosarcomogenic effect is the most sensitive test of the toxicity of plutonium; the MPL norm derived from this criterion is 0.055 uCi. This norm is 8-10 times as low as the MPL derived from the life-span criterion and 1.4 times as high as the MPL adopted in the Soviet 1960 standards (0.04 uCi). The MPC of Pu 239 in the air of work premises, derived from the available data on the patterns of metabolism of this isotope in the rat on inhalation, amounts to 3.6 x 10(E-15) Ci/liter and is 1.8 times as high as the MPC adopted in the Soviet 1960 standards (2 x 10(E-15) Ci/liter). When the Pu 239 concentration in the inhaled air does not exceed the calculated MPC norm, the actual content of Pu 239 in the human organism toward the end of active work-life (at the age of 70) is three times as low as calculated in theory (0.055 Ci); this is assured by the existing labor legislation. For the currently effective MPL of Pu 239 (0.04 Ci), the safety factor with respect to the human individuals most sensitive to the effect of ionizing radiation is 1.4. For the currently effective MPC of Pu 239 in the air of work premises (2 x 10(E-15) Ci/liter) the overall safety factor is 5.4 (1.8 x 3). As new information on the biological effect and metabolism of Pu 239 is acquired, the MPL and MPC norms should be periodically carefully revised. (Auth)

Table 3 gives calculated values of MPL of Pu 239 for man. Table 6 gives Pu 239 content in the lungs of rats at various periods following administration.

<193>
Lyubchanskiy, E.B., Izdatel'stvo Meditsina, Moscow, USSR. 1969

Behavior of a Citrate Complex of Plutonium 239 in the Body of Rats After Stopping Chronic Inhalation. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radioactive Isotopes and the Body, (p. 153-160), 458 p.

Experiments were done on rats of the Wistar strain with an initial weight of 140-150 g. The animals were subjected over the course of 160 days, 6 times per week, to a 10-minute inhalation of aerosols of a citrate complex of Pu 239,, with a pH of 6.5. The rats were killed immediately, and after 8, 32, 64, 128, and 238 days following the last inhalation. Various tissues were subjected to radiochemical analysis. The results show that after stopping chronic inhalation of the citrate complex of Pu 239 the skeleton and lungs were the basic organs for deposition of the isotope. The effective half-lives for the elimination from these organs were 8.16 and 92.5 days, respectively. The rate of elimination of Pu 239 from the lungs did not depend considerably on the manner of administration of the isotope. Concerning the high concentration and nonuniform microdistribtuion of Pu 239, the lungs were the critical organ as to radiation dose throughout the course of the entire experiment. After 400 days the integral dose in the lungs was higher than in the thigh by a factor of 3. The Pu 239 concentration and the rate of its decrease in different fragments of the skeleton were not the same. (Auth) (PNM)

Tables 1 and 2 show Pu 239 concentration in organs and tissues of rats, at various periods after stopping chronic inhalation of the citrate complex.

<194>
Dolphin, G.W., United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Health and Safety Branch, Radiological Protection Division, Harwell, Berkshire, England. 1968

Estimation of Body Content Following Inhalation of Insoluble Plutonium. CONF-448-10; STI/PUB/84; Part of Proceedings of a Symposium on the Assessment of Radioactive Body Burdens in Man held in Heidelberg, Germany, May, 1964, Vol. 2, (p. 589-602), 666 p.

The problem of estimating the body content of plutonium following the inhalation of plutonium oxide is of considerable practical importance and, on the grounds of the known insolubility of plutonium oxide, measurements of plutonium in urine might be considered valueless. The relevant published biological data from beagle dog experiments and data from two human cases are reviewed. From this review it is concluded that there is evidence for believing that the body content, following an accidental inhalation, can be estimated from the measurements of plutonium excreted in urine at times greater than about 300 days after the intake. Some possible excretion methods are discussed. Finally, there is a comment on the radiological protection aspects of insoluble plutonium in the lungs and bronchial lymph nodes and it is stressed that the particular nature of the plutonium must be taken into consideration. (Auth)

A proposed model is shown to illustrate the metabolic pathways and movement of inhaled insoluble Pu. The numbers given in the model are the percentages of the initial intake at 900 days after intake in beagle dogs.

<195>
Beach, S.A., and G.W. Dolphin, United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Health and Safety Branch, Radiological Protection Division, Harwell, Berkshire, England. 1968

Determination of Plutonium Body Burdens from Measurements of Daily Urine Excretion. CONF-448-11; STI/PUB/84; Part of Proceedings of a Symposium on the Assessment of Radioactive Body Burdens in Man held in Heidelberg, Germany, May, 1964, Vol. 2, (p. 603-615), 666 p.

The original data from 16 human experiments, as reported by Wright Langham and others, have been reanalyzed using a simple compartment model. The functions obtained from this analysis, relating the body burden to the daily excretion in urine following an injection, are used in proposed mathematical models for the slow release of soluble plutonium into the blood stream from a wound site or the lungs. The results of calculations on the model for various hold-up times at the wound site or lungs are presented graphically. The presently available data on the biological variation between men and in the day-to-day plutonium in urine excretion in an individual are analyzed and discussed with special reference to the best design of a routine urine sampling program. (Auth)

<196>
Maisin, J.R., Centre d'Etude de l'Energie Nucleaire, Departement de Radiobiologie, Mol, Belgium. 1968

Metabolism and Toxicity of Plutonium. Journal Belge de Radiologie, 51, 274-283

The toxicity and metabolism of Pu were examined and the main routes of penetration and elimination of this nuclide in the human body were reviewed. The consequences of contamination by Pu 239 and the basic principles for the treatment of contamination were discussed. The problem of assessing the Pu body burden was also dealt with. (Auth)

Table 2 shows the distribution of Pu 239 in tissues of man following intravenous injection of Pu(+4) citrate (after Langham).

<197>
McClellan, R.O., L.K. Bustad, W.J. Clarke, M.L. Dockum, J.R. McKenney, and H.A. Kornberg, General Electric Company, Hanford Laboratories, Biology Laboratory, Richland, WA. 1962

Bone-Seeking Radionuclides in Miniature Swine. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at The Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 341-348), 529 p.

Progress is reported on a long-term daily Sr 90 feeding experiment whose objective is to define relatively safe levels of dietary intake of Sr 90 for man. Miniature swine are fed four levels of Sr 90--1, 5, 25 and 125 uCi/day. Animals maintained on 25 uCi of Sr 90 per day for over two years appear normal and their 18-month-old offspring exposed to Sr 90 since conception have manifested only a slightly depressed growth rate. Adult animals fed 125 uCi of Sr 90 per day for eight months, together with their three-month-old offspring, appear clinically normal. For comparative purposes, the relative toxicity of a single injection of Sr 90, Ra 226 and Pu 239 in miniature swine is being studied concurrently. A single intravenous dose of either 64 uCi Sr 90/kg body weight, 6.4 uCi Ra 226/kg or 1.3 uCi Pu 230/kg is administered at six weeks, six months or one year of age. All animals injected are alive at 18 months following radionuclide administration and show only minimal evidence of damage. A leukopenia was noted immediately following injection, but the leukocyte count returned to normal very rapidly. Bone changes were noted radiographically in some animals, especially those injected at six weeks of age with Pu 239. (Auth) (FMM)

See also report HW-76000, (p. 1-10).

<198>

<198>
McClellan, R.O., W.J. Clarke, G.S. Vogt, and L.K. Bustad, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Comparative Toxicity of Strontium 90, Radium 226, and Plutonium 239. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 1-10), 269 p.

Male miniature swine, which received a single intravenous injection of Sr 90, Ra 226, or Pu 239 18 months previously when six weeks, six months or one year of age, were killed to study the early effects of these radionuclides. Only minimal radiographic changes were observed. Severe histological changes characterized principally by disorganization of developing bone and necrosis and fibrosis were observed in each of the age groups with all three radionuclides. On the basis of histological changes in bone, Pu 239 in swine, irrespective of age, is more damaging per rad than Ra 226 or Sr 90. Three females injected intravenously with Ra 226 at three to four years of age all developed clinical symptoms of severe renal damage and succumbed seven to nine months after injection. (Auth)

<199>
McClellan, R.O., H.W. Casey, and L.K. Bustad, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Transfer of Some Radionuclides to Milk. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 98-108), 269 p.

Mature purebred Suffolk female sheep in their second to fifth month of lactation were injected intravenously with Ca 45, Sr 90, Ru 106, Pm 147, Ra 226, U 233, or Cm 244. All of the radionuclides were administered as nitrates. Milk, plasma, and whole blood samples were collected and radioanalyzed for a ten-day period following injection. The rates of plasma clearance of the radionuclides for the ten days following administration in decreasing order are: U 233, Cm 244, Ca 45, Ra 226, Sr 90, Pm 147 and Ru 106. The average milk-to-plasma ratios were: Ca 45, 30; Sr 90, 10; Ra 226, 6; Pm 147, 2.5; Cm 244, 2; Ru 106, 0.015; and U 233, 0.08. (Auth)

<200>
McDonald, N.E., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Removal of Plutonium by Pulmonary Lavage. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972. (p. 64-65), 103 p.

The removal of insoluble Pu from the lung by pulmonary lavage was about 50% efficient in dogs after 19 weekly lavage sessions beginning 8 days after exposure to Pu 239 PuO2. The pathologic consequences of this treatment were evaluated. All lavaged lungs showed an increased goblet cell production. No lung damage was observed at 48 hr and at 7 days postlavage. Rats received Pu 239 PuO2 by inhalation; 7 days later their lungs were lavaged with the test solution; they were killed, and the lungs and lavage fluid analyzed for Pu. Physiological saline was the reference wash solution. Some of the agents tested included dimethylsulfoxide (DMSO), DMSO plus DTPA, 0.25% sucrose, KCl, 1.8% NaCl, water, Pluronic and Triton X-100. The reference wash solution, 0.9% NaCl, removed 10 to 16% of lung plutonium in a single lavage session. Removal was increased about 50% with Triton X-100 or with 1.8% NaCl and the combination of the two doubled the amount removed. Wash solutions 4 degrees C or 50 degrees C were no more effective than body-temperature solutions. Water or sucrose lavage removed only about 3% of the lung Pu. Addition of pronase to saline essentially blocked Pu removal. (PMM)

<201>
Mahlum, D.D., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1965, January

Effect of Dietary and Hormonal Manipulations on Neptunium 237 Induced Fatty Livers. BNWL-122; Part of Thompson, R.C. and Woods, S.W. (Eds.), Hanford Biology Research Annual Report for 1964, (p. 79-80), 216 p.

Neptunium 237 was administered intravenously to rats as the citrate complex, pH 4.0-4.5, and livers were removed 24 or 48 hr after administration for fat determination. It was found that liver fat accumulation induced by injection of Np 237 can be reduced by prior hypophysectomy or adrenalectomy. Oral administration of glucose or butylated hydroxytoluene also resulted in a decreased fatty response to Np 237. Thyroidectomy, ovariectomy, and testosterone treatment were without effect in female rats. Castration or injection of estradiol did not render the male more susceptible to Np 237 induced fatty livers. (Auth) (PMM)

<202>
Fahlum, D.D., General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Intercellular Binding of Neptunius and Plutonium. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 36-38), 269 p.

Female rats were injected with 6 ug Np 237/kg body weight or 16 ug Pu 239/kg of body weight. The animals were sacrificed either 1/2, 24, or 72 hours post injection. The organs were removed and 10% homogenates prepared in 0.25 M sucrose. Separation into nuclear (plus cellular debris), mitochondrial, microsomal, and soluble fractions was carried out by means of differential centrifugation. The distribution of Np 237 and Pu 234 in subcellular fractions of liver and kidney of the rat was found to vary with the tissue studied, the element used, and the chemical form of the element administered. At both 1/2 and 72 hours post injection, the distribution of Np 237 administered as the nitrate in liver fractions show that mitochondria contain the largest amount of the activity. The nuclear fraction contains the next greatest amount, with appreciable quantities appearing in the microscmal and soluble fractions. At 1/2 hour after injection, the pattern of distribution of Np 237 is quite different in the kidney compared to the liver. When Np 237 is administered in the citrate form and the animals sacrificed after 24 hr, the nuclear fraction becomes the most heavily labeled. At 1/2 hr after injection of Pu 239 in the nitrate form, the most activity is found in the nuclear fraction of both liver and kidneys. However, the mitochondrial and soluble fractions of liver each contain about 25% of the Pu 239, while the soluble fraction of kidney contains approximately three times the Pu 239 present in the mitochondria. (FNM)

Table 1 shows the distribution of Np 237 nitrate in liver and kidney fractions of rats. Table 3 shows the distribution of Pu 239 nitrate in liver and kidney fractions of rats.

<203>
McClanahan, B.J., and H.A. Ragan, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1965, January

Translocation of Subcutaneously Administered Plutonium 239 PuO2. BNWL-122; Part of Thompson, R.C. and Woods, S.W. (Eds.), Hanford Biology Research Annual Report for 1964, (p. 81-82), 216 p.

Blond miniature swine were injected with 3.5 uCi of Pu 239 PuO2 in 0.01 ml of 0.1% polypropyleneglycolethyleneoxide polymer in each foreleg at each of two sites. The animals were sacrificed 1, 7, 30, 60, and 90 days after injection. The amount of plutonium deposited in soft tissues following subcutaneous injections of Pu 239 PuO2 was about one-hundreth of that deposited when Pu 239 nitrate was injected. The regional lymph nodes were an exception, accumulating up to one-half as much when Pu 239 PuO2 was injected as when Pu 239 nitrate was injected. (Auth) (FNM)

Table 1 shows Pu 239 in tissues of swine.

<204>
McClanahan, B.J., E.B. Howard, H.A. Ragan, and J.L. Beamer, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Late Effects of Intradermally Administered Plutonium in Swine. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 4.12-4.14), 253 p.

At 9 months of age, ten Hanford miniature swine were injected intradermally with plutonium nitrate. Five years after multiple intradermal injections, liver and skeletal burdens were 6.5 and 9.2%, respectively, of the administered dose. The skin sites retained 2-7% of the injected plutonium. The liver was diffusely cirrhotic with severe fatty degeneration and necrosis of the hepatic cord cells. Some of the lymph nodes displayed a significant hyperplasia in the germinal follicles, and the hepatic node was lymphomatous. (Auth)

Table 1 shows retention of Pu in tissues of miniature swine, five years after intradermal injection.

<205>
McClanahan, B.J., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Plutonium-Contaminated Wound Studies. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 6.3-6.7), 253 p.

Lacerations were made through the skin and subcutaneous tissue of the hind leg of rats. Solutions or suspensions of the appropriate plutonium compound, containing about 5 uCi Pu 239, were placed in the wounds. One-half hour later the wounds were rinsed with 500 ml of either 0.9% NaCl or 0.2% DTPA in 0.9% NaCl. Some of these animals were subsequently injected intravenously with Na3 Ca DTPA (14 mg/kg body weight) daily for a total of five injections. In the experiments Pu was injected subcutaneously as the nitrate or as the previously formed DTPA chelate. Some of these animals were subsequently treated with DTPA intravenously, at approximately daily intervals for a total of nine treatments. It was found that plutonium was not effectively removed from contaminated wounds by irrigation with DTPA, nor from intramuscular deposition sites by suffusion with DTPA. Simultaneous administration of dimethylsulfoxide (DMSO) did not increase the effectiveness of DTPA. Plutonium injected subcutaneously as the DTPA chelate was rapidly absorbed and 85% was excreted in the first day's urine. (Auth) (FNM)

<206>

<206>
McClanahan, B.J., and H.A. Ragan, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1966, January

Translocation of Subcutaneously Deposited Plutonium. BNWL-280; Part of Thompson, R.C. and Swezea, E.G. (Eds.), Annual Report for 1965, (p. 83-85), 139 p.

Miniature swine were injected subcutaneously on each foreleg with Pu 239 PuO2 in 0.1% polypropyleneglycolethyleneoxide polymer to obtain information on plutonium translocation. The effects of diethylenetriaminepentaacetic acid (DTPA) and dimethylsulfoxide (DMSO) on translocation following subcutaneous injections of Pu 239(+4) nitrate in rats were also investigated. Following subcutaneous injection of Pu 239 PuO2 in miniature swine, soft tissue concentrations of Pu 239 showed a continuing increase over a 1 year period. Treatments designed to alter translocation of Pu 239(+4) nitrate in rats were generally of little effect. (Auth) (PMM)

Table 1 shows Pu 239 concentrations in the soft tissues of swine following subcutaneous injection of Pu 239 PuO2.

<207>
Huth, G.C., and P.J. Moldofsky, General Electric Company, Space Technology Products, Philadelphia, PA. 1971

In Vivo Measurement of Plutonium and Other Very Low Energy Emitters. IAEA-SM-143/33; STI/PUB/269; CONF-701112; Part of Proceedings of a Symposium on New Developments in Physical and Biological Radiation Detectors held in Vienna, Austria, November 23-27, 1970, (p. 225-234), 742 p.

A new type of radiation detector, the silicon avalanche diode, has made possible the previously impossible in vivo measurement of beta radiation as low as 5 keV and x ray and gamma radiation as low as 1 keV. The solid state analogue of the proportional counter, the avalanche diode provides internal charge gain within the silicon wafer, raising the radiation-induced signal far above the detector noise level. By this mechanism, radiation formerly below detector noise level can be detected with extremely low background (on the order of 1 count per minute) at temperatures up to 100 degrees C. Applications are being explored in nuclear medicine in the fields of bone scanning with I 125, eye tumor studies with P 32 and I 125, rapid analysis of skin cancer response to treatment (P 32), and in vivo detection of plutonium via the 13.6, 17.4, 20.5 keV L x rays from the uranium daughter. All these applications make use of the three principal characteristics of the avalanche detector: (1) internal gain; (2) small size--as small as 3 mm (or as large as 30 mm) diameter; and (3) low noise and high sensitivity even at elevated temperatures. Currently, in vivo measurements of plutonium lodged in bronchial and metastinal lymph nodes behind the lungs are proceeding using a flexible detector probe that is inserted in the esophagus, in effect, partially swallowed. The experiments are performed with dogs whose inhaled plutonium has been filtered by these nodes from the lungs. At present, a minimum detectable amount at an 84% confidence level of Pu 239 of typical composition (i.e. including small amounts of other isotopes) detected by an avalanche detector in the esophagus is about 20 nCi. The results of the nuclear medical investigations being carried out by a dozen physicians throughout the United States on these and other applications indicate that the avalanche detector is making possible, in many cases for the first time, reliable in vivo measurement of extremely soft radiation with drastically reduced background and over a wide temperature range. (Auth)

<208>
Anspaugh, L.R., P.L. Phelps, G. Holladay, and K.O. Hamby, Lawrence Radiation Laboratory, Biomedical Division, Livermore, CA. 1970, November 13

Distribution and Redistribution of Airborne Particulates from the Schooner Cratering Event. UCRL-72534; CONF-701106-5; Part of Proceedings of the 5th Annual Health Physics Society Midyear Topical Symposium on the Health Physics Aspects of Nuclear Facility Siting, held in Idaho Falls, Idaho, November 3-6, 1970, Vol. 2, (p. 428-446), 288 p.

Project Schooner, a 31-kt nuclear cratering detonation, was conducted on December 8, 1968, at the Nevada Test Site. Twelve sampling stations consisting of 6 each, radiation activated, high-volume air samplers were established on arcs 6 and 50 miles downwind from the detonation site. Two stations were located upwind. The air samplers were electronically programmed to operate in a sequential fashion. Intensive sampling extended up to 6 weeks following the event. More than 20 gamma-emitting radionuclides were identified in the airborne particulates by the use of a Ge(Li) detector. Several days after the event, W 181 was the predominant radionuclide detected, and served as a unique tracer. Half-life of suspended radioactive particulates was observed to be 38 days. Resuspension factors were calculated and found to vary between 6 x 10(E-5) and 10(E-1)/m. Data showed the passage of radioactive particulates not to occur as an abrupt event but for the air activity to remain high for long periods of time after the detonation. Secondary peaks of air activity were seen as late as 2 to 4 days postshot and amounted to as much as 30% of the initial activity. Contributions of redistribution effects to the long-term radiological hazards associated with nuclear events are qualitatively discussed. (Auth)

<209>
Bair, W.J., and A.D. Wiggins, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Life Span of Mice Following Inhalation of Plutonium Dioxide. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 115-117), 269 p.

Pulmonary deposition of Pu 239 PuO2 (0.038 to 0.72 nCi) in mice ranging in age from 122 to 369 days had no significant effect on their life span. Lungs and skeletons from a number of mice were analyzed for Pu 239 content and each was found to contain 0.1 to 10 pCi. The mean age at time of death for all groups varied from 649 to 782 days. (Auth) (PHM)

<210>
Evans, R.D., A.T. Keane, and M.M. Shanahan, Massachusetts Institute of Technology, Department of Physics, Radioactivity Center, Cambridge, MA. 1972

Radiogenic Effects in Man of Long-Term Skeletal Alpha Irradiation. Part of Stover, B.J. and Jee, W.S.S. (Eds.), Radiobiology of Plutonium. J.W. Press, Salt Lake City, Utah, (p. 431-468), 552 p.

In the absence of human-injury data, some radiation protection guides for Pu 239, Sr 90, and other bone-seeking radionuclides are founded on the human radium base-line or reference standard of 0.1 uCi Ra residual burden, combined with radionuclide toxicity ratios determined from observations on long-lived experimental animals. In the M.I.T. series of human long-term radium cases, from a presently identified population of about 2200 individuals, some 600 have so far been studied (1970) while living plus about 60 after death through autopsy specimens, exhumations, or willed bodies, in addition to 120 matched control individuals. At average skeletal cumulative dosages above about 1000 rads marked radiobiological effects are seen. Among the epidemiologically suitable (unselected) high-dose cases, the cumulative incidence of bone sarcomas plus head carcinomas is about 0.28. The tumor appearance time in humans seems to increase with decreasing dosage, as it does in beagles, such that there would be a domain of dosages for which the required tumor appearance time exceeds the life span, thus defining a practical threshold dosage. The origin and proper use of UNSCEAR-ICRP linear nonthreshold models in formulating maximum-risk estimates for large-population exposures to low doses of radiation is reviewed. In humans undergoing long-term skeletal alpha-irradiation there is evidence for recovery processes and dose-rate dependence. Life-long observations are required before the response-vs-dosage relationships are certainly the final values. Vigorous and long-term efforts will be exerted by the AEC's Center for Human Radiobiology to obtain the maximum information from this unique, inadvertently exposed, and irreplaceable human population. (Auth)

The report deals with radium and mesothorium toxicity in man but can be used as a base line or reference standard for determination of the toxicity ratio of other bone-seeking radionuclides such as Pu.

<211>
Carpenter, B.S., National Bureau of Standards, Analytical Chemistry Division, Activation Analysis Section, Washington, DC. 1972

Quantitative Applications of the Nuclear Track Technique. Microscope, 20, 175-182

The nuclear track technique has been applied to the quantitative determination of several elements that emit charged particles. The detector sample "sandwich" is exposed to the desired radiation source, fast or thermal neutrons, or high energy photons, and the charged particles emitted are registered in plastic detectors. The elements boron, lithium, nitrogen, thorium and uranium have been determined in various matrices; e.g., liver, orchard leaves, tomato leaves, blood, glass, soil, steel and minerals. The amount of material in these matrices is determined in three different ways: the absolute method, the method of standard additions and the comparative method. All three of these methods require that the plastic detectors be chemically etched and the resulting optically visible tracks are then counted with the aid of an image analyzing microscope. (Auth)

<212>
Holzer, R.E., Institute of Geophysics and Planetary Physics, Los Angeles, CA. 1972, October 20

Atmospheric Electrical Effects of Nuclear Explosions. Journal of Geophysical Research, 77(30), 5845-5855

A series of electrostatic field measurements were made in the vicinity of nuclear explosions on the Nevada Proving Ground of the Atomic Energy Commission in 1952. The program was carried out during four tests of Operation Tumbler-Snapper. Detonations with energy yields in the 20-k range produced electric dipoles with the negative charge uppermost and with moments of a few coulomb kilometers. The electrical field produced by the nuclear cloud could be observed for several minutes after the explosion while the cloud moved upward through the troposphere to the vicinity of the tropopause. The estimated magnitude of the dipole moment of the cloud increased for several minutes as it moved upward. The results of the tests are in qualitative agreement with a gamma-ray-Compton electron model of charge separation. Difficulties associated with quantitative predictions of the model are discussed. The passage over the instruments of a weakly radioactive cloud from the stem of the mushroom cloud in one test produced results that are interpreted as a perturbation of the normal air-earth current system. (Auth)

<213>

<213>
Smith, V.H., J.F. Park, and D.K. Craig, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Radiolytic Effects on Chelatability of Plutonium Oxide. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 63-64), 103 p.

Ultrafiltration of Pu oxides, stored as aqueous suspensions, reveals increased solubility with time for the higher specific activity isotope Pu 238. Complexing by DTPA is facilitated by the radiolytic degradation of the oxide and by length of contact time. (Auth)

<214>
Sanders, C.L., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Phagocytosis and Translocation of Intraperitoneally Injected Plutonium 239 PuO2 and Plutonium 238 PuO2 Particles. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 6.13-6.17), 253 p.

Female rats were given intraperitoneal injections of either 1.4 uCi Pu 239 PuO2 or 1.8 uCi Pu 238 PuO2 particles of count median diameter 0.05 u suspended in 2 ml saline. Animals were selected at intervals following injection and the abdominal cavity washed twice with 10 ml saline. Peritoneal fluid cells from the wash were examined autoradiographically. Other animals were sacrificed for assay of tissues for plutonium. Particles of Pu 239 PuO2 and Pu 238 PuO2 were phagocytized by peritoneal mononuclear phagocytes at similar rates. The Pu 239 PuO2 was transported to the lymphatics of the omentum, resulting in necrosis of the omentum and subsequent release of Pu 239 back into the peritoneal cavity. The fate of the Pu 238 PuO2 particles was distinctly different and as yet not completely resolved. There was a substantially greater proportion of the Pu 238, as compared to Pu 239 that eventually deposited in the liver and other tissues. It was noted that the phagocyte played a vital role in the clearance of particulate Pu from the peritoneal cavity. (Auth) (PMM)

<215>
Sanders, C.L., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Cocarcinogenic Effect of Plutonium 239 PuO2 and Asbestos in the Lung. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 34), 103 p.

Four groups of rats were given intratracheal instillations of either Pu 239 PuO2, chrysotile asbestos, Pu 239 PuO2 plus chrysotile asbestos, or saline. Particulates were suspended in 0.3 ml saline prior to instillation. The coadministration of Pu 239 PuO2 with asbestos resulted in less excretion of Pu 239 than was the case with Pu 239 PuO2 only. Focal granulomatous lesions were common around bronchiolar areas of the lung in animals receiving asbestos. Plutonium oxide particles tended to concentrate in these asbestos-induced lesions forming "hot spots" of alpha activity. (PMM)

<216>
Sanders, C.L., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Effect of Fasting on Removal of Plutonium by DTPA. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 59-60), 103 p.

Metabolic alterations due to fasting had no effect on the biologic deposition of Pu 239 PuO2 injected intraperitoneally in rats or on decorporation of Pu with DTPA. (Auth)

<217>
Sanders, C.L., and R.R. Adee, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

The Ultrastructure of Peritoneal Mononuclear Phagocytes Exposed in Vivo to Plutonium 239 PuO2 Particles. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 6.20-6.21), 253 p.

Female rats given intraperitoneal injections of 1.4 uCi Pu 239 PuO2 (count median diameter, 0.12 u) were killed at 2, 6, 24, or 168 hr after injection and the peritoneal cavity was washed with saline. Peritoneal cell pellets were fixed and sectioned and autoradiograms of sections were prepared. Numerous electron-dense particles were found localized within cytoplasmic vacuoles of phagocytes. These were shown to be plutonium by electron microscopic autoradiography. Pu was also found in lysosomes in the cytoplasm of the phagocytes at 7 days. Only minimal alterations in phagocytes were observed during the first 6 hr but obvious necrosis was observed at 7 days. Lymphocytes were depleted after the first day. Necrosis of lymphocytes and their subsequent engulfment and digestion by phagocytes was frequently observed after the first day. It was concluded that peritoneal mononuclear phagocytes were more resistant to alpha irradiation than were other peritoneal cells. Phagocytosis of plutonium particles during the first few hours after deposition did not result in ultrastructural damage which would appear to impair their ability to transport particles to the visceral peritoneum. (PMM)

<218>
Stevens, W., D.R. Atherton, B.J. Stover, and P.W. Bruenger, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Comparison of the Intracellular Distribution of Plutonium 239, Americium 241 and Californium 249 in Livers After Intravenous Administration. COO-119-243; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 201-212), 400 p.

The intracellular distribution in livers of beagles injected intravenously with either Pu 239(+4), Am 241(+3), Cf 249(+3) or Cf 252(+3) in 0.08 M citrate, pH 3.5, was studied serially. Liver homogenates were fractionated by differential centrifugation. A mitochondrial fraction was obtained by centrifugation at 60,000 g-min, a lysosomal fraction at 8 x 10(E+5) g-min and a cytosol at 6 x 10(E+6) g-min. Initially all three nuclides were found in the cytosol and mostly associated with ferritin. Considerably higher concentrations of Am and Cf than Pu remained in the cytosol at progressively longer times after administration. The order of the rate of removal of nuclide from the cytosol was Pu >> Cf > Am. As the nuclide was removed from cytosol it became associated with subcellular organelles. No constant relationship was observed between concentration of nuclide and mitochondrial or lysosomal marker. The ratio of nuclide to lysosomal marker was consistently higher in the mitochondrial fraction than in the lysosomal fraction. However, significant contamination of the mitochondrial fraction with lysosomes was not demonstrated using electron microscopy. It is concluded that mitochondria and lysosomes and possibly other organelles are involved with nuclide binding in canine liver cells. (Auth)

<219>
Sanders, C.L., Jr., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1972

Carcinogenicity of Inhaled Plutonium 238 in the Rat. BNWL-SA-4659; CONF-730603-2; Part of Proceedings of the 18th Annual Health Physics Society Meeting held in Miami Beach, Florida, June 17-21, 1973, (40 p.)

Three groups of albino, female rats were exposed to an aerosol of soluble Pu derived from crushed Pu 238 PuO2 microspheres suspended in physiological saline. Initial alveolar burdens of Pu 238 were 5 nCi (Group 1), 18 nCi (Group 2), and 230 nCi (Group 3). Only 1% of the initial alveolar lung burden remained in the lung at one year, decreasing to 0.3% by 600 days after exposure. The Pu 238 body burden was 25% of initial alveolar burden at one year, decreasing to 12% by 1,000 days after exposure; about half of the body burden was found in the skeleton at these times. The cumulative radiation doses to the lung at two years after exposure were 9 rads (1), 32 rads (2), and 375 rads (3). Unexposed controls exhibited a median survival time of 825 days as compared to experimental survival times of 650 days (1), 675 days (2), and 550 days (3). The incidence of lung tumors in controls was 1.1% as compared to incidences in Pu 238 exposed rats of 6.6% (1), 23.3% (2), and 25.0% (3). The incidence of all tumors, other than mammary tumors, was 4.3% in unexposed controls, and in Pu 238 exposed rats, 26.7% (1), 36.6% (2), and 46.8% (3). It was concluded that exposure of rats to small amounts of inhaled Pu 239 resulted in a significant incidence of tumors in the lung and other tissues. (Auth)

<220>
Stewart, K., and R.H. Wilson, United Kingdom Atomic Energy Authority, Atomic Weapons Research Establishment, Aldermaston, Berkshire, England; University of Rochester, Rochester, NY. 1969, March

Final Evaluation of the Biological Measurements on Operation Roller Coaster (Joint US/UK Field Experiments). AWRE-0-76/67; 46 p.

The measured lung burdens of Pu for the three types of animal: burro (representing the horse), sheep and dog, are assessed in terms of the respirable aerosol determined from results obtained with cascade impactors. Consistent agreement between the two kinds of sampler is obtained. The observed changes in lung burdens with time are examined and relationships deduced by regression analysis. The statistical analysis of the results shows that those for each animal species form a self-consistent set. Methods of estimating the dose to man following exposure to aerosol clouds of the kind formed on the Double Tracks and Clean Slate 2 experiments are proposed. (Auth)

Table 5 shows lung deposition/retention of Pu in sheep. Table 6 shows lung deposition/retention of Pu in burros. Table 7 shows aerosol retention of Pu in dogs and sheep. Several other tables and figures are given including some on particle size distribution and radiation dose to lungs.

<221>

<221>
Smith, V.H., General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Prevention of Plutonium and Neptunium Deposition. HW-76000; Part of Hornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 143-148), 269 p.

Rats were injected with 1.5 nCi of Pu 239 as the pH 5.5 citrate. Ten minutes later ultrasonic irradiation of the right rear leg was started and continued for 30 minutes using a General Electric ultrasonic generator, with a frequency of 100 kc/s at 80 ma. Urethane was administered in separate experiments both before and after Pu injection. Several other chelating agents, such as 8-HQ (8-hydroxyquinoline) and UM (8-methylumbelliferone) were tested. The effect of DTPA on Np deposition was investigated. Rats were given 0.89 nCi Np 237 or 17.9 nCi Np 239 as the pH 5 citrate and treated with 4.5 and 1.5 umoles of DTPA respectively. The results showed that there was no statistically valid difference in Pu retention between the ultrasonically treated and untreated legs in either the DTPA treated or control animals. Urethane treatment before Pu injection decreased the liver Pu by half and increased bone Pu by a fourth as compared with untreated controls or post-Pu treatment with urethane. DTPA was the most effective agent studied, exercising greater effect on Pu than Np. Effects of these agents on toxicity are also noted. (FMM)

Table 1 shows the effect of urethane and ultrasonics on liver and bone deposition of Pu. Table 2 shows the effect of therapeutic treatment on retention of intravenously injected Pu.

<222>
Smith, V.H., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1965, January

Removal of Internally Deposited Plutonium from Rats. BNWL-122; Part of Thompson, R.C. and Woods, S.W. (Eds.), Hanford Biology Research Annual Report for 1964, (p. 118-121), 216 p.

Female, Sprague-Dawley rats were intravenously injected with 2 uCi Pu 239(+4) in 0.2 ml of pH 5 citrate buffer. One, 5 and 24 hr later they were treated with 0.1 mmol of deferoxamine (DFA) and diethylenetriaminepentaacetic acid (DTPA) (total treatment dose, 0.3 mmole). To prevent tetany, slightly less than an equivalent amount of calcium was given with all DTPA doses. Urine and feces were collected daily from each treatment group of 10 rats. Five days after injection of plutonium, the animals were killed and tissues analyzed. When administered to the same rat DTPA and DFA showed a cooperative action wherein the plutonium deposition in bone reflected the DFA effect and the soft tissue response was that of DTPA. A similar response was not shown for the removal of well-fixed plutonium. (Auth) (FMM)

Table 1 shows effects of treatments on Pu 239 content of tissues of rats and excreta five days after administration. Table 2 shows concentration of Pu 238 in liver, kidneys, spleen, femur, urine and feces for treated and control rats eight weeks after isotope administration.

<223>
Schubert, J., Argonne National Laboratory, Division of Biological and Medical Research, Lemont, IL. 1961

Internal Contamination and Its Treatment. Part of Rajewsky, B. (Ed.), Proceedings of the 9th International Congress of Radiology held in Munchen, Germany, July 23-30, 1959. Georg Thieme Verlag, Stuttgart, Germany, (p. 1251-1257), 1625 p.

The action of chelating agents in hastening the elimination of radioelements deposited in the body is described. Specifically, the effectiveness of the well-known chelating agent, ethylenediaminetetraacetic acid (EDTA) is compared to that of diethylenetriaminepentaacetic acid (DTPA) with respect to its ability to hasten the elimination of plutonium and thorium from rats. The data show that DTPA is more effective that EDTA against trivalent and tetravalent radioelements. Ultrafiltration studies of the radioelements deposited in tissues before and after treatment with a chelating agent prove that diffusible chelate is formed within the tissues, and that the diffusibility of the chelate remains well above the control levels for at least a week. This explains the observation that, following a single injection of chelating agent, the urinary excretion of the radioelement remains well above control levels for several days afterward. While a chelating agent may act efficiently against the nonpolymerized forms of hydrolyzable radioelements such as thorium, it is shown that when the polymerized form of the radioelement is injected, the chelating agent is much less effective. This is attributed to the slow rate at which the chelating agent depolymerizes the inorganic polymer. On the other hand, subsequent injections of the chelating agent cause the urinary excretion of the polymerized element to be greater than that following earlier injections--the opposite effect is observed with the nonpolymeric or ionic form of the same radioelement. The question of the possible effectiveness of chelating agents such as EDTA against Sr 90 is discussed. Calculations based on mass action equations show that it is highly improbable that these chelating agents can affect the excretion of Sr 90. Other calculations show that it is impractical to effect the removal of Sr 90 by the administration of the stable isotope. (Auth)

<224>
Scott, K., H. Fisher, D. Axelrod, J. Crowley, A.J. Barber, and J.G. Hamilton, Lawrence Radiation Laboratory, Livermore, CA. 1946, October 15

Metabolism of Plutonium in Rats. MDDC-1018; 27 p. (Declassified June 5, 1947)

The results of detailed metabolic studies of plutonium following oral, intramuscular, intravenous, subcutaneous and intrapulmonary administration to rats are presented. Plutonium is not absorbed from the digestive tract. The skeleton is the chief organ of deposition for plutonium absorbed by the body following parenteral administration. The digestive tract is the principal channel of elimination, and the degree of retention is very great. The rate of excretion is very slow, and the half-period of retention of plutonium by the skeleton is estimated to exceed 6 months. No significant differences in the metabolic properties of plutonium absorbed by the body were observed for its 3 valence states. Considerable retention of plutonium by the lungs following intrapulmonary administration was observed, and was found to be highest for the +4 state, less for +5 plutonium, and least for +6 plutonium. A significant degree of absorption of plutonium from the lungs with subsequent deposition in the skeleton took place following the intrapulmonary administration of solutions of this element in its 3 valence states. (Auth)

<225>
Scott, K.G., H.C. Lanz, D. Axelrod, J. Crowley, and J.G. Hamilton, Lawrence Radiation Laboratory, Livermore, CA. 1946, October 10

Studies on the Inhalation of Fissionable Materials and Fission Products and their Subsequent Fate in Rats and Man. MDDC-1276; 68 p. (Declassified August 28, 1947)

Experiments were done to ascertain the possible hazard resulting from inhalation of fissionable materials and fission products. Aerosols of plutonium, uranium plus fission products, protactinium, and short-lived fission products obtained from the cyclotron and the Clinton Pile were administered to rats. A Zr 89 aerosol was administered to one human subject and to rats. Aerosols of the above elements were almost totally retained by the head and lungs immediately after exposure. After four days the lungs contained the largest percentage of these elements. The elements deposited in the head were quickly eliminated via the gastrointestinal tract. The same avenue of elimination was used by the lungs, but at a slower rate. The small percentage absorbed into the body was primarily deposited in the skeleton after conditions of equilibrium had been established. Radioautographic studies indicate that the site of deposition in the lungs of these materials is in the bronchial passages and the alveolar structures. They are rapidly removed from the bronchial tree, presumably by ciliary action and are very slowly released from the alveoli. No accumulation of any of the radioelements was observed in either blood vessels or lymph nodes. (Auth)

<226>
Not given, Nevada Operations Office, Las Vegas, NV. 1973, January

Reports Available in Plowshare Open File. NVO-86 (Rev. 2); 30 p.

A significant compilation of scientific and technical information has resulted from Projects Gasbuggy, Rulison, Rio Blanco and Wagon Wheel, all of which are a part of the U.S. Atomic Energy Commission's Plowshare Program to develop peaceful uses for nuclear explosives. The fundamental concept in these underground engineering applications is to use the energy of a deeply buried nuclear explosive to increase the permeability and porosity of rock thereby stimulating the flow of natural gas. The publications concerning Gasbuggy, Rulison, Rio Blanco and Wagon Wheel, that have been placed in the Plowshare Open Files by the Nevada Operations Office, are listed in the document. All of these publications are available to the scientific, technical, and industrial communities. Also listed are certain other publications concerning the AEC's safety programs for underground nuclear detonations which may be of particular interest. Addresses where the documents may be inspected or purchased are given. (PHM)

<227>
Brown, G.W., Jr. (Ed.), University of Washington, College of Fisheries, Seattle, WA. 1968

Desert Biology, Special Topics on the Physical and Biological Aspects of Arid Regions. Academic Press, New York, New York, Vols. 1-2, 635 p.

Basic biological and physical information on the desert and arid regions of the world is presented. A desert community, the Merkhiyat Jebels near Khartoum is first described. Succeeding chapters are devoted to causes, climates distribution and geological aspects of deserts, biology of plants, amphibians, reptiles, birds and mammals in deserts, desert limnology, venoms of desert animals and human adaptation to arid environments. Chapters 1-11 have been abstracted individually for the data base. (PHM)

<228>

<228>
Cloudsley-Thompson, J.L., University of Khartoum, Department of Zoology, Khartoum, Sudan. 1968

The Merkhiyat Jebels: A Desert Community. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 1. Academic Press, New York, New York, (p. 1-20), 635 p.

The Merkhiyak Jebels are hills to the northwest of Khartoum and they rise to a height of about 100 meters above the general level of the surrounding plain. The vegetation of the area is classified as acacia desert scrub. Some plant species such as MAERUA CRASSIFOLIA extend upward from the desert plain but others such as HUBISCUS MICRANTHUS are restricted to the jebels because they are too selectively grazed elsewhere by camels. Life develops rapidly in the natural temporary pools that appear each year after rain and last from a few days to 5 or 6 weeks. TRIOPS GRANARIUS, T. CANCRIFORMIS, MOINA DUBIA and METACYCLOPS MINUTUS are some of rain fauna. The mammals common to the area are humped cattle, camels, foxes (VULPES PALLIDA), mongooses (ICHNEUMIA ALBICAUDA), ground squirrels, jerbcas, hares and bats. The reptiles include snakes (PHYTHON SEBAE and NAJA HAJE), tortoises and lizards. The peculiarities and behavior patterns of some of the arthropods are described such as the Buprestid beetles, (STERNOCERA CASTANEA), the bagworm (AUCHMOPHILA KORDOFENSIS), scorpion (LEIURIS QUINQUESTRIATUS), mantids, grasshoppers, ants, wasps, flies, and spiders. (FMM)

<229>
Logan, R.F., University of California, Department of Geography, Los Angeles, CA. 1968

Causes, Climates, and Distribution of Deserts. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 2. Academic Press, New York, New York, (p. 21-50), 635 p.

The sole common characteristic of all deserts is their aridity. The causes of aridity are several. For example, extremely porous soils allow water to percolate through them so rapidly that little is returned for the use of plants, thus creating an edaphic desert. Physiological deserts are present in the Arctic and Antarctic and at high altitudes on mountains in all latitudes because of the fact that water is present only in the solid form (ice) and hence is unavailable to plants. The world's deserts can be divided, climatically into five types, based on the causes of their aridity: (1) subtropical deserts, (2) cool coastal deserts, (3) rain shadow deserts, (4) continental interior deserts, and (5) polar deserts. The subtropical deserts include the Sahara of North Africa, the deserts of Arabia, Syria, Jordan, Iraq, Iran, Afghanistan, Baluchistan, West Pakistan, the Sonoran Desert of Mexico, Arizona and California, the Kalahari of South Africa, deserts of Australia and small areas of West Argentina. The cool coastal deserts are the Namib on the Coast of Southwest Africa, the Atacama, the coastal desert of Chile and Peru and the desert on the Pacific Coast of Baja California in Mexico. The Great Basin deserts of Nevada, Utah and adjacent states, owe their existence to their rain shadow position on the lee of the Sierra and Cascade Ranges to the west and the Rocky Mountains to the east. Examples of the other desert types are given and the climatic conditions of and causes of aridity, are discussed in detail for all the desert types. (FMM)

<230>
Smith, H.T.U., University of Massachusetts, Department of Geology, Amherst, MA. 1968

Geologic and Geomorphic Aspects of Deserts. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 3. Academic Press, New York, New York, (p. 51-100), 635 p.

Detailed characteristics of the desert environment are a function of the interaction of bedrock geology and surface processes through time. Bedrock geology sets the stage for various destructive processes and predetermines the size, shape and distribution of landscape such as the mountains and uplands, cliffs and escarpments, sand dunes and drainage features. The surficial deposits in desert lowlands, hydrologic aspects of desert basins, and desert soils are treated in detail. The surficial geological processes such as weathering, gravitational movement of detrital rock, work of surface water and wind, as well as the climatic changes in desert regions, are discussed. (FMM)

<231>
Johnson, A.W., San Diego State College, Department of Biology, Sand Diego, CA. 1968

The Evolution of Desert Vegetation in Western North America. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 4. Academic Press, New York, New York, (p. 101-140), 635 p.

The evolution of the vegetation of the Mojave and Colorado Deserts of the southwestern part of the United States is reviewed. By combining all information now available--paleobotanical records, paleogeographical concepts, modern distributional and ecological information, and cytological observations--it appears that the desert flora consists of species of diverse ages and origins, and the modern desert vegetation likewise can be characterized as a changing mosaic of species associations that together are arranged continuously in space and time. The Mojave and Colorado Desert floras include about 278 genera and 1084 species and about 156 of these species are endemic. Except for a few species (less than 1%), substantive information on the age, origin, or evolution of the California desert flora is lacking. To trace their evoluticnary roots to the tropics is reasonable in the sense of the proposed tropical origin of angiosperms per se, but the proximal origin of the majority of species and perhaps genera of desert angiosperms in California apparently lies in the western United States. (PMM)

Tables are present showing the genera of angiospermous desert plants in California giving the number of species occuring, number of endemic species, and the geographical affinity.

<232>
McCleary, J.A., California State College, Fullerton, CA. 1968

The Biology of Desert Plants. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 5. Academic Press, New York, New York, (p. 141-194), 635 p.

The flora of temperate, warm, coastal and Australian deserts is described and compared. For example, the flora of the Great Basin of North America is compared with that of central Asia where the species of Compositae and Chenopodiaceae, and more definitively those of the genera ARTEMESIA and ATRIPLEX, compose the bulk of the individuals along with other well-known genera such as EUROTIA, SALSOLA, ASTRAGALUS and EPHEDRA. The warm deserts are quite distinct, both in general aspect and in the actual families and genera that occur there. The greater abundance of trees in comparison with the temperate deserts along with the wider spacing of the individuals is very noticeable. Although many plant families are known, the Zygophyllaceae, Liliaceae, Leguminosae, and the Amaryllidaceae are outstanding. The two larger coastal fog deserts are dissimilar in plant constituents. In the South American deserts are located many outstanding members of the Leguminosae, Bromeliaceae, Cactaceae, Compositae, and Oxalidaceae. In South Africa the Leguminosae, Liliaceae, Asclepiadaceae, and Aizoaceae are most distinctive. The Australian deserts can be called grass deserts. Here TRIODIA is represented by many species, as is ASTREBLA and the ephemeral taxa of ARISTIDA and STIPA. In addition, the eucalypti as well as numerous species of the Protaceae and Chenopodiaceae are common. The adaptations of plants to arid environments are discussed with reference to morphology, time of germination and physiology. Studies on the lower plants, namely algae, fungi, slime molds, lichens, bryophytes and ferns are reported and some ecological studies of desert floras are presented. (PMM)

<233>
Mayhew, W.W., University of California, Department of Life Scieces, Riverside, CA. 1968

Biology of Desert Amphibians and Reptiles. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 6. Academic Press, New York, New York, (p. 195-355), 635 p.

Animals that succeed in deserts are those that have found a way to cope with or to evade the lean dry seasons. The amphibians, turtles, lizards and snakes are treated separately in respect to distribution, behavior, food habits, water balance, temperature preferences, reproduction and adaptations to deserts. (PMM)

<234>

<234>
Dawson, W.R., and G.A. Bartholomew, University of Michigan, Department of Zoology, Ann Arbor, MI; University of California, Department of Zoology, Los Angeles, CA. 1968

Temperature Regulation and Water Economy of Desert Birds. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 7. Academic Press, New York, New York, (p. 387-394), 635 p.

Birds are well represented in the desert regions of the world, where they exist despite some physiological handicaps and in certain instances because of the special advantage of extreme mobility. Most of the North American species apparently have not developed special means for contending with heat and aridity, even though the failure of the majority to utilize underground shelter limits their opportunities for evading the extreme conditions of their environment. Survival on hot days in deserts relies in part upon a general avian capacity for tolerating elevations of body temperature to as much as 4 degrees C above normal levels and upon behavioral patterns that serve to reduce heat stress. Water loss by desert birds generally exceeds oxidative water production and, like species from more mesic environments, they require preformed water. This requirement forces certain species to remain close to surface water. Others with stronger powers of flight may forage widely, moving to water every day or so. Tolerance of dehydration may be important to such birds. Many species appear virtually independent of surface water, obtaining their fluid from food such as succulent plants, fruits, insects, or vertebrate prey. A number of the deserts of the eastern hemisphere may be of considerable antiquity, and the avifauna associated with them appear more distinctive than those of the deserts of the western hemisphere. Birds indigenous to these eastern deserts might well show more conspicuous physiological adjustments to heat and aridity than the majority of the North American species that have been studied. The keying of reproduction to rain or its consequences and the nomadic tendencies of birds from dry parts of Australia or Africa are probably indications of this. (Auth) (FHM)

<235>
Bartholomew, G.A., and W.R. Dawson, University of California, Department of Zoology, Los Angeles, CA; University of Michigan, Department of Zoology, Ann Arbor, MI. 1968

Temperature Regulation in Desert Mammals. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 8. Academic Press, New York, New York, (p. 395-422), 635 p.

The combination of heat and aridity characteristics of low latitude deserts presents an unusually acute thermoregulatory challenge to homeotherms because it poses the problem of losing heat to a hot environment while at the same time keeping water loss at a minimum. The adaptative complexes that allow mammals to live in deserts are diverse and varied and involve an interplay between physiology, behavior, and morphology in which temporal patterning on both a daily and a seasonal basis is of key importance. For most mammals and for all those weighing less than a few kilograms, the primary adaptation to the desert is one of evading the challenge of heat by going underground or by being nocturnal or both. Where behavioral avoidance is impractical, a frequently observed adjustment involves the relaxation of limits for thermoregulatory homeostasis and the behavioral acceptance of hyperthermia. A number of desert mammals have basal metabolic rates lower than would be expected on the basis of size. Both seasonal and daily torpidity have been demonstrated in several kinds of rodents. Prolonged periods of summer dormancy (estivation) allow the animals to avoid the most stringent time of the year, while the daily periods of facultative hypothermia appear to be an adaptation to long-term food shortages. (Auth) (FHM)

<236>
Cole, G.A., Arizona State University, Department of Biology, Tempe, AR. 1968

Desert Limnology. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 9. Academic Press, New York, New York, (p. 423-486), 635 p.

The climatic distribution and origins of desert waters is first discussed. There is great diversity in desert waters but they share a number of features. Continental arid-land waters are markedly influenced by climatic fluctuations. A result is the high incidence of astatic lakes and their precarious existence. In drier regions, complete desiccation of lakes may follow a decline in precipitation or a temperature rise. In endorheic or arheic zones, waters are typically concentrated, are high in electrolytes and are quite different from the dilute standard type of humid, exorheic areas. Figures showing the anionic composition and concentration trends of various lakes are given. The productivity in desert waters is discussed. For example the mean annual gross photosynthesis in Pina Blanca Lake, Arizona was estimated at 1.6 kg O2/m2. Other aspects treated are plankton populations, benthos, fish production, biota of temporary waters and saline waters, endemism and relictism. (FHM)

<237>
Minton, S.A., Jr., Indiana University, Medical Center, Indiannapolis, IN. 1968

Venoms of Desert Animals. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 10. Academic Press, New York, New York, (p. 487-516), 635 p.

Venom to kill or immobilize prey is particularly useful to the desert predator that must rely upon sparse and often seasonal food supply, because it permits the animal to overcome prey that would otherwise be too large, too active, or too well defended to be taken. The venoms are described for scorpions, spiders, insects, centipedes, millipedes, amphibians, lizards and snakes. In some cases the chemical formula is given and the effects of the poison on man and animals, the venom apparatus and yield and toxicity of venoms are described. (FHM)

Table 2 gives the yield and toxicity of some medically important spider venoms. Table 3 gives the yield and toxicity of some representative desert snake venoms. Table 4 gives the enzymes of some representative snake venoms.

<238>
Lee, D.H.K., U.S. Public Health Service, Division of Environmental Health Sciences, Triangle Park, NC. 1968

Human Adaptations to Arid Environments. Part of Brown, G.W., Jr. (Ed.), Desert Biology, Vol. 1, Chapter 11. Academic Press, New York, New York, (p. 517-556), 635 p.

The criterion of man's adaptation to living conditions, residence and work in hot arid zones is his ability to satisfy his needs in regard to comfort, activity and motivation. The five desert forces, heat, sun, aridity, lack of resources, and isolation, are the basic threats. Given food, water, and health, man is able, physiologically, to cope with almost all natural desert conditions. The factors that add to or subtract from the heat content of the body, namely environmental temperature, radiant heat, humidity, air movement and metabolic rate are discussed. The body's regulatory responses are examined and the disturbances of bodily function that may ensue are noted. The thermoregulatory processes described are dilatation of skin blood vessels, sweating, reduced activity and increased surface area by relaxed posture. Some technological adaptations, such as housing, air conditioning and clothing are described. Two other aspects entering into man's adaptability to unaccustomed conditions, one in the psychological (attitude) and one in the cultural (enculturation) sphere are discussed. (PHH)

<239>
Jones, Y.E., and P.O. Jackson, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1968, May

The Determination of Plutonium to Americium Ratios in Biological Specimens. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 3.11-3.12), 253 p.

Techniques were developed to determine the plutonium-to-americium ratios in organs of animals that had inhaled a mixed plutonium-americium oxide. These methods employed alpha pulse height or photon spectrometry techniques. Where samples were analyzed by both of these methods, good agreement was obtained. The photon spectrometric method is preferred because it can be applied directly to wet-ashed samples. However, because present silicon diode detectors are small and the x ray fluorescence yields for Pu 239 are low, the overall counting efficiency is lower than that which can be achieved with alpha analysis. (Auth)

<240>
Buldakov, L.A., Z.I. Kalaykova, Yu.I. Moskalev, and V.N. Strel'tsova, Not given. 1969

On the Role of the Time Factor in Separate and Combined Infection with Cerium 144 and Plutonium 239. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radioactive Isotopes and the Body, (p. 329-346), 458 p.

Experiments were conducted on 1585 rats weighing from 140 to 200 g. A HCl solution of Ce 144 and a citric acid solution of Pu 239 were administered intraperitoneally at pH 3.0 and 6.5, respectively. The results show that under all versions of the administration of Ce 144 and Pu 239 the life span of the rats was reliably lower than in intact animals. The more considerable shortening of life span under the dosages used is caused by Ce 144. If in a single administration of Pu 239 in doses of 0.30 and 0.60 uCi the average life span of the rats is shortened to 505 plus or minus 17.5 and 414 plus or minus 15.0 days from 682 plus or minus 10.4 days in the clean control, under the administration of 100 and 200 uCi of Ce 144 the life span is shortened to 375 plus or minus 13.6 and 165 plus or minus 21.5 days. Simultaneous administration of 0.30 uCi of Pu 239 plus 100 uCi of Ce 144 or 0.15 uCi of Pu 239 plus 50 uCi of Ce 144 is accompanied by the shortening of the life span from 582 plus or minus 10.4 days in the clean control to 342 plus or minus 14.0 and 385 plus or minus 12.6 days, respectively. Under a double administration of 50 uCi of Ce 144 and 15 uCi of Pu 239 with an increase in the interval between injections, the average life span of the rats increased as compared with a single administration if Ce was used for the second injection and decreased or remained unchanged if Pu was used. Under a single administration of 0.30 uCi of Pu 239 or 100 uCi of Ce 144 or 50 uCi of Ce 144 plus 0.15 uCi of Pu 239 and also under the administration of the isotopes in double quantities, the percent of the occurrence of osteosarcoma was 6minus17.3% and under a double administration of the emitters with different intervals between injections, the occurrence of osteoma decreases to 3minus24%. The results also show shifts in the cellular composition of peripheral blood following administration of isotopes. It was shown that quadruple administration of Ce 144 in a total dosage of 200 uCi causes expressed early and prolonged leukopenia and moderate late anemia Plutonium 239 in a total dosage of 0.60 uCi does not affect the number of leukocytes but causes greater anemia at the end of the experiment. (PHH)

<241>

<241>
Buldakov, L.A., and Yu.I. Moskalev, Not given. 1961

Distribution of Plutonium 239 in the Skeleton and Liver of Rats and Kinetics of Its Elimination Depending on the Dose and Rhythm of the Isotope. AEC-tr-5425; Part of Radiobiology, (p. 37-45); Radiobiologiya, 1(4), 487-492

Upon intraperitoneal administration of plutonium in an amount of 0.25 to 4 uCi per rat, the character of distribution of the citrate complex of plutonium does not depend on the dose. The basic quantities of isotope are detected in the skeleton (up to 58%) and in the liver (up to 5.2%) within two months following a single administration. After a single and a prolonged uptake, the elimination of plutonium from the skeleton upon its introduction in the form of a citrate complex obeys the exponential law. The biological period of semi-elimination of plutonium from the skeleton upon single administration is equal to approximately 530 days, upon divided introduction to 410 days, and the elimination constants (Lambda) are 0.0013 and 0.0017, respectively. Upon prolonged administration, the value of plutonium deposition in bone tissue decreases. After a single administration, the elimination of plutonium from the liver obeys the exponential law and after divided doses that of the power function. Upon single administration, the biological period of semi-elimination of plutonium from the liver is equal to 195 days. (Auth)

<242>
Antonchenko, G.P., M.A. Koshurnikova, and E.R. Lyubchanskii, Ministry of Public Health, Institute of Biophysics, Moscow, USSR. 1969

Morphological Changes in the Lungs of Rats After Inhalation of Large Doses of Soluble Plutonium 239 Compounds. AEC-tr-7024; Part of Radiobiology, (p. 97-104), 220p.; Radiobiologiya, 9(1), 75-80

The inhalation of plutonium 239 citrate and ammonium plutonium pentacarbonate in amounts producing an initial deposition of approximately 0.5-1.5 uCi of the isotope in the lungs shortens the average lifetime of rats by 10-15 fold in comparison with the control. The pathological anatomical changes in the lungs of the experimental rats after the intake of large quantities of plutonium citrate and ammonium plutonium pentacarbonate (in an excess of ammonium carbonate) do not depend on the chemical form of the inhaled compound and are determined chiefly by the amount of original deposition of the isotope in the lungs. Among the animals that died before the hundredth day, the leading thanatogenic factor was fibrinous-suppurative inflammation of the lungs; among the rats that died after the hundredth day, the leading cause of death was pneumosclerosis. (Auth)

<243>
Bukhtoyarova, Z.M., and A.P. Nifatov, Not given. 1969

Microdistribution of Plutonium 239 and the Histopathology of the Liver and Skeleton of Dogs to Intravenous Administration of the Isotope. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radioactive Isotopes and the Body, (p. 364-375), 458 p.

The study was conducted on 36 dogs weighing from 7-29 kg and 2-5 years of age. Plutonium 239 was administered intravenously in the form of a nitrate solution at pH 3.0 in the quantity of 2 uCi/kg. The results show that the microdistribution of plutonium in the liver was not uniform. The greater portion of the isotope was distributed in the form of aggregates in the reticuloendothelial elements of the liver, preferentially in the peripheral sections of the liver lobules and the smaller part in the form of diffusely positioned tracks in liver cells and other structural elements of liver tissue. In early periods after administration of plutonium, dystrophic changes were noted preferentially in the peripheral parts of the lobules, sections of aggregation of the isotope were seen and in later periods there was a rise of annular atrophic cirrhosis of the liver. In the bones of dogs, plutonium is localized in all structural elements of the bone tissue and bone marrow even in late periods following administration. The greatest content of the isotopes was noted in the metaphysis of the tubular bones with preferential concentration in the bone marrow, endosteum, periosteum and to a smaller degree in the bone tissue itself. Dystrophic changes in the bone structure and vessels were observed in early periods in the bone tissue, basically in the region of the metaphysis. There was a breakdown in normal osteogenesis and as a result the newly formed bone structure was a disorganized form. Pretumorous changes were noted after 6 months and typical osteogenic sarcoma after 2-4 years. (Auth) (PHM)

<244>
Grove, D.B., U.S. Geological Survey Reston, VA; Sandia Laboratories, Albuquerque, NM. 1969, October

The Development of Theoretical Equations to Describe the Flow of a Radioactive Ion in Groundwater, Annual Report, December 1, 1966 to November 30, 1967. SC-CR-68-3637; 58 p.

A mathematical modeling study of the flow of trace concentration of ions through a porous media is described. The theoretical work in the report was performed as an aid in evaluating possible hazard resulting from the earth burial of a SNAP device containing radioactive fuel material. Ion-exchange processes examined included instantaneous equilibrium, the use of theoretical plates, and the assumption of a second-order kinetic-rate reaction. (Auth)

<245>
Buldakov, L.A., Ministry of Public Health, Institute of Biophysics, Moscow, USSR. 1968

The Behavior of Plutonium (Pu 239) in Young Pigs. AEC-tr-6950; Part of Radiobiologiya, (p. 101-106), 306 p.; Radiobiology, 8(1), 62-69

The distribution of 1% citric acid solution of Pu 239 (pH equals 6.5) was investigated after administration of 3 uCi intravenously to 15 young pigs and 33 uCi perorally to 3 young pigs, each pig being 2.5 months old and weighing 10-12 kg. Animals from the first group (intravenous injection) were killed in groups of three on 1, 9, 65, 330 and 640 days after injection and those of the second group (peroral administration) on the day after administration. The absorption of plutonium citrate was 0.19 percent in the intestines and 87 percent of the resorbed portion of the Pu was retained in the skeleton. The maximum content in the spongy bones was only three times (after intravenous injection, 3-10 times) as much as in the compact parts of the skeleton. The Pu concentration in the bones was 3-10 times as large as in the soft tissues (excluding muscles) after peroral and 20-100 times as large after intravenous administration. (Auth)

The distribution of Pu 239 in the organs of suckling pigs 24 hrs after IV and peroral administration is shown in tabular form.

<246>
Galkin, G.P., P.A. Vlasov, and L.A. Fedoseyeva, Not given. 1971

Remote Aftereffects of Killing Rats Using Ammonium Diuranate. AEC-tr-7387; Part of Moskalev, Yu.I. (Ed.), Remote Aftereffects of Radiation Damage, (p. 218-224), 574 p.

Rats were subjected to daily inhalation of an ammonium diuranate aerosol at a concentration of 8 mg/m3 or 1 mg/m3. The results show that ammonium diuranate in a concentration of 8.1 mg/m3 is toxic for rats while a concentration of ammonium diuranate of 1.0 mg/m3 is close to the minimum effective concentration. In the case of chronic daily poisoning of rats with ammonium diuranate, one of the early indicators of damage is an impairment in functioning of the liver and kidneys (Proteinuria, glucosuria, increase in the quantity of residual nitrogen in the blood, decrease in the quantity of hippuric acid eliminated in the urine, positive test with a bromphenol blue dye). Changes in the morphological composition of the peripheral blood in the case of damage with ammonium diuranate are characterized by a decrease in hemoglobin content, a decrease in the number of erythrocytes, reticulocytosis, relative lymphopenia and eosinophilia. At latent periods (after 2-20 months) following cessation of ammonium diuranate administration, indicators of body damage are an increase in the number of blood cells with a modified hue when a fluorescent microscope is used and eosinophilia. Ammonium diurnate, in the case of chronic inhalation in a concentration of 8 mg/m3, shortens the life of the animals, whereas a concentration of 1 mg/m3 under these same conditions exerts no influence on lifetime. Pathomorphological changes in the case of chronic inhalation of ammonium diuranate at latent periods are characterized by interstitial pneumonia and evidence of pneumosclerosis in the lungs, nephrotoxic focal sclerosis in the kidneys and the appearance of parenchymatous dystrophy in the liver with different degrees of expression in different animals. (Auth)

<247>
Campbell, E., and J.F. McInroy, Los Alamos Scientific Laboratory, Los Alamos, NM. 1973, November

Plutonium and Environmental Metals in Man, Interlaboratory Meeting, May 9, 1973. LA-5445-C; CONF-730577-1; Part of Proceedings of a Symposium on Plutonium and Environmental Metals in Man held in Albuquerque, New Mexico, May 9, 1973, (10p.)

An interlaboratory meeting was held in Albuquerque, New Mexico, to coordinate the efforts of the Los Alamos Scientific Laboratory, Battelle Northwest Laboratories, and Dow Chemical Company in carrying out a tissue analysis program. Various aspects of the analytical procedures and handling of human autopsy tissues for plutonium analysis were discussed. The purpose of the tissue analysis program is to establish the level of plutonium in the general population and detect any trend or changes in the plutonium concentration. The meeting was concluded with a summary of the analytical methods used at the three laboratories. (ST)

<248>

<248>
Ballou, J.E., D.K. Craig, J.F. Park, E.A. Ragan, and C.L. Sanders, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

Dose-Effect Studies with Inhaled Plutonium in Rats and Dogs. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 21-27), 103 p.

Eighteen month old beagle dogs exposed to Pu 239 PuO2 aerosols and sacrificed 7 to 30 days later had more than 98% of the final Pu body burden in the lungs. One dog with a low total body burden of 11 nCi showed more translocation to muscle, skeleton, and other tissues. During the first postexposure year, 11 to 29% of the Pu was translocated from the lung to the thoracic lymph nodes with little translocation to other tissues. About 75% of the total excreted Pu was excreted during the first 8 postexposure days, with 99% of this in the feces. The mean whole body retention half-time of the alveolar deposited Pu was 4900 plus or minus 3800 days, and the lung retention half-time was 1500 plus or minus 700 days. In the same manner dogs were exposed to freshly prepared and aged preparations of Pu 238 PuO2. Dogs exposed to the freshwater suspensions showed more than 96% of the Pu body burden in the lungs and thoracic lymph nodes 30 to 70 days postexposure. Those exposed to the aged preparations had 17 to 45% of the Pu body burden in the skeleton, 4 to 11% in the liver, and 30 to 75% in the lungs and thoracic lymph nodes. The much greater translocation of the Pu 238 suggested that solubilization of the Pu 238 PuO2 occurred to a significant degree within the dog, as well as in the water suspension. Life span dose effect experiments are continuing and new experiments using a more pure form of PuO2 in dogs and Pu 238 and Pu 239 exposures on rats have been started. (ST)

Tables 2, 3, and 4 show tissue distribution of inhaled Pu in dogs after inhalation of: Pu 239 PuO2 aerosols; fresh and aged Pu 238 PuO2 aerosols; and Pu 239 PuO2 and Pu 238 PuO2 aerosols two to three years postexposure, respectively.

<249>
Dougherty, T.F., University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, March 31

Californium 252 Pilot Studies in Beagles. COO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 287-288), 380 p.

A pilot study was initiated at the University of Utah to study the delayed biological effects of Cf 252 using beagle dogs. Comparison of the biological effects of Cf 249, an alpha emitter, and Cf 252, which decays by alpha emission and spontaneous fission, can provide a method of identifying the separate effects of alpha and fission fragments. The experimental design is described and predictions of the incidence of tumors are made. (ST)

<250>
Schell, W.R., and A.I.C. Yang, University of Washington, College of Fisheries, Laboratory of Radiation Ecology, Seattle, WA. 1973, April 30

Long-Lived Radionuclides Produced at Bikini and Eniwetok Atolls, I.. RLO-2225-T18-3; 29 p.

The report describes the early results of the investigation on the identification and measurement of long-lived radionuclides in samples collected from Bikini and Eniwetok Atolls. A description is given of the chemical procedures used to separate and measure several radioelements (Be 10, Al 26, C 14, Fe 55, Mn 53, Am 241, and Pu 238-239) in samples collected inside and near nuclear detonation craters. In 1972 concentrations of Fe 55 in Bravo crater had an activity of 1500 dps/g. Americium 241 and Pu 239 were found in concentrations of 1 to 60 pCi/g in sediment and soil samples. Americium 241 measured in biota was less than 0.[illegible] pCi/g dry wt. The particulate Am 241 in water samples was found to be 5 to 70 pCi/m3, depending on location, indicating significant redistribution. It is possible that certain radionuclides may enter into the North Equatorial Current away from Bikini Atoll. However, the amounts are generally very low and large volumes of water are required to measure the concentration present. (Auth) (ST)

Table 1 lists the radionuclides measured in Bravo crater sediment after chemical separation. Table 2 lists the measurements of Am 241, Pu 238, and Pu 239-240 in sediment, water, and biota of Bikini and Eniwetok Atolls. Table 3 lists radionuclides with half-lives of more than 200 days in samples from Bikini Atoll.

<251>
Dougherty, T.F., and C.W. Mays, University of Utah, Salt Lake City, UT. 1969

Bone Cancer Induced by Internally-Deposited Emitters in Beagles. CONF-690804; IAEA-SM-118/3; Part of Proceedings of a Symposium on Radiation-Induced Cancer held in Athens, Greece, April 28-May 2, 1969, (p. 361-367)

Osteosarcomas were the chief cause of death in adult beagles injected intravenously with bone-seeking radionuclides in citrate solution. The effectiveness of each nuclide depends on the type of radiation emitted and where this radiation is absorbed. Alpha-radiation is more effective than beta radiation, and the alpha emitters which deposit on bone surfaces are more effective those which deposit throughout bone volume. For death with osteosarcomas 8 years after injection, values for RBE (relative biological effectiveness) based on average skeletal dose at 1 year before death and relative to Ra 226 equals 1 are: Pu 239 equals 6; Th 228 equals 8; Ra 228 (Msth) equals 2.5; and Sr 9 equals 0.07 to 0.24. In humans Ra 226 was observed to induce bone cancers above a skeletal dose of about 1200 rads. Adjusting by the RMBE factors established in dogs, the predicted life-time doses above which bone cancers may occur in adult humans are: Pu 239 equals 200 rads; Th 228 equals 150 rads; Ra 226 equals 1200 rads; and Sr 90 equals 5000 to 17000 rads.

<252>
Stuber, C.E., U.S. Atomic Energy Commission, Technical Information Center, Science and Technology Branch, Oak Ridge, TN. 1970, January

Transplutonium Elements, A Bibliography. TID-3317-S-4; 174 p.

The bibliography comprises 835 references on the transplutonium elements compiled through the period ending June 30, 1973. The references were retrieved from the Nuclear Science Abstracts (NSA) data base using the computerized RESPONSA search system and were formatted for publication with indexes by the generalized output program GENOUT. The NSA subject indexing is displayed under each citation to provide information on the contents of the document. Part 1 includes 811 references dealing with the production, chemical, nuclear, physical, and biological properties and health and safety aspects of elements with Z>95. The actinides group includes references dealing with the actinide elements in general or treating the actinides collectively. References dealing with Z>104 are included in the transactinide group. Part 2 includes 28 references dealing with the natural occurrence of the transplutonium elements. This collection of references is concerned with attempts to locate or prove the existence of the transplutonium elements in nature. Author and subject indexes are included. (Auth)

<253>
Mc, T., A.D. Suttle, and W.M. Sackett, Texas A & M University, College Station, TX. 1973

Uranium Concentrations in Marine Sediments. Geochimica et Cosmochimica Acta, 37, 35-51

Uranium concentrations in a large number of marine sediment samples of different types with world-wide spatial distribution have been determined using the rapid, precise and nondestructive technique of counting the delayed neutrons emitted during U 235 fission induced with thermal neutrons. A direct proportionality was observed between percentage of organic carbon and uranium in sediments deposited in an anoxic environment in the Pettaquamscutt River in Rhode Island with concentrations ranging from 7 percent organic carbon and 7 ppm uranium to 14 percent organic carbon and 30 ppm uranium. A similar relationship was found in cores of sediments deposited on the Sigsbee Knolls in the Gulf of Mexico. For manganese nodules a direct relationship can be seen between uranium and calcium concentrations and both decrease with increasing depth of deposition. For nodules from 4500 m in the Pacific, concentrations are 3 ppm uranium and 0.3 percent calcium compared with 14 ppm uranium and 1.5 percent calcium at 1000 m. Relatively high uranium concentrations were observed in carbonates deposited in the deepest parts of the Gulf of Mexico, with the >88 u carbonate fraction in Sigsbee Knoll cores having as much as 1.30 ppm. A model to explain the observed variations must include uranium enrichment in near shore environments via an anoxic pathway, followed by redeposition in a deep ocean environment with dilution either by low-uranium-bearing foraminiferal or silicious oozes or, along the continental margins, dilution with high-uranium bearing carbonate sands. (Auth)

Tables 3 and 5 give uranium concentrations (ppm) in river and deep sea sediments, respectively.

<254>
Payne, D.E., and R.F. Grossman, National Environmental Research Center, Environmental Surveillance, Las Vegas, NV. 1972, November

Offsite Radiological Safety Program for Project Rulison Re-entry Portion of Phase 3. NERC-LV-539-14; 260 p.

The report presents the operational procedures and results of the off-site radiological surveillance activities conducted by the National Environmental Research Center-Las Vegas (NERC-LV) from April 1970 to October 3, 1970, during the re-entry phase of the Project Rulison Production Testing Program. No release of radioactivity occurred during re-entry operations, however, gas flaring operations during August released natural gas containing some radioactivity to the atmosphere. The only activity detected in the off-site area was tritium in atmospheric moisture samples collected at two remote, unpopulated locations near the test well during a flaring operation. All other environmental samples indicated no change in off-site radioactivity levels as a result of the re-entry program. (Auth)

<255>
Romney, E.M., A.J. Steen, R.A. Wood, and W.A. Rhoads, University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA. 1966

Concentration of Radionuclides by Plants Grown on Ejecta from the Sedan Thermonuclear Cratering Detonation. CONF-660405; Part of Aberg, B. and Hungate, F.P. (Eds.), Proceedings of an International Symposium on Radiocecological Concentration Processes held in Stockholm, Sweden, April 25-29, 1966, (p. 391-398), 1051 p.

Native and domestic plants grown on ejecta from the Sedan thermonuclear cratering detonation, July 6, 1962, concentrated very high levels of radiotungsten through their roots. Smaller, yet significant amounts of Sc 46, Mn 54, Co 60, Y 88, Sr 89, Sr 90, Zr 95, Ru 106, Sb 125, Cs 134, Cs 137, and Ce 144 also were concentrated through roots. Uptake of these radionuclides persisted through the 3-year cropping period of this study following the Sedan event; and the gamma spectrum continued to be dominated by Y 88, Zr 95, Ru 106, Ce 144, W 181 and W 185. Plant foliage contaminated by Sedan fallout also showed Rb 86, Y 91, Rh 102, Ru 103, I 131, Cs 136, Ba 140, Ce 141, Eu 152 and Eu 154; but these radionuclides were not concentrated through roots in later cropping experiments. Radioactive dust continued to be deposited on the foliage of plants re-established on Sedan ejecta after the detonation occurred. (Auth)

Table 1 lists the radionuclides identified in Sedan ejecta and in plants grown on ejecta during a three year cropping period following the detonation.

<256>
Perov, V.S., I.P. Tregubenko, D.I. Semenov, A.Z. Kach, and V.N. Strel'tsova; Akademiya Nauk SSSR, Trudy Instituta Biologii, Ural'skii Filial., Sverdlovsk, USSR. 1966

Administration of Unseparated Solution of Uranium Fission Products to Rats by Inhalation. AEC-tr-7169; Part of Metabolism of Radioisotopes in the Animal Organism, (p. 55-66), 220p.

An inhalation chamber is described that provides a continuous delivery of radioactive aerosol in the form of mist to small laboratory animals without contamination of the pelt. Tests involving inhalation by rats of unseparated solution of uranium fission products (Sr 90-Y 90 and Ru 106-Rh 106) with a mean particle diameter of one to four microns, showed reproducible results. A preliminary experiment resulted in deposition of 16.5% of the initially retained radioactivity in the respiratory tract. Immediately after inhalation, a significant amount of retained radioactivity was found in the trachea and large bronchi. Absorption from the lungs resulted in high radioactivity in the liver, bones and residual carcass. A high radioactivity in the gastrointestinal tract was indicative of swallowing of large particles initially retained in the upper respiratory tract. Within a month, total radioactivity of the entire rat dropped from 50 to 5%. (ST)

Table 3 gives the radioactivity in rat tissues at different intervals following inhalation of uranium fission products.

<257>
Dougherty, J.H., and L.S. Rosenblatt, University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy and Pathology, Salt Lake City, UT. 1970

The Comparative Toxicity of Radium 226, Plutonium 239, Thorium 228, Radium 228, and Strontium 90 to Leukocytes of Beagles. Radiation Research, 43, 56-70

The effectiveness of five internal emitters in depressing blood leukocytes in young adult beagles was studied during the first year postinjection. The radionuclides, Ra 226, Pu 239, Th 228, Ra 228, and Sr 90, were given as a single intravenous injection at dose ranges of 58.4 to 10,350, 15.8 to 2,877, 15.8 to 2,877, 49.5 to 8,470, and 571.2 to 97,483 nCi/kg, respectively. The occurrence of dose-dependent depressions in leukocytes has been previously established. The greatest depression was found in polymorphonuclear leukocytes (pmns), monocytes, and eosinophils while lymphocytes were depressed to a lesser extent. The probit transform was used to linearly relate response to the logarithm of the injected activity. Injected activities required to produce a 50% leukocyte depression (ED 50) were computed for eight time periods. Toxicity indices were also computed for four radionuclides relative to Ra 226 as a standard and converted to hematological relative biological effectiveness (RBE), again relative to Ra 226. For pmns and lymphocytes median values of RBE estimated over the eight time periods were: Th 228 approximately 4; Pu 239 approximatley 4; Ra 228 approximately 1.5; and Sr 90 approximately 0.5. Alpha emitters depositing on bone surfaces were more effective in reducing leukocytes than those which are volume seekers. The beta emitter, Sr 90, was less effective than the alpha emitters rad for rad. (Auth)

<258>
Asato, A.J., Norfolk State College, Norfolk, VA. 1973

Wind Effect Redistribution of Surface Contamination. ORO-4304-1; Progress Report for September 1972-August 1973; 5 p.

Progress is reported on the formation and programming of a model of the wind effected redistribution of surface contamination. Modifications and extensions of the model are explained. Surface contamination and air concentrations are computed with given computer programs. Planned studies, to be finished within the contract period, are listed. (ST)

<259>
Goates, M.A., Brigham Young University, Provo, UT. 1963, October

Mites on Kangaroo Rats at the Nevada Test Site. Brigham Young University Science Bulletin, Biological Series, 7(4), 18p.

A systematic study of parasitic mites on kangaroo rats of two species at the Nevada Test Site was conducted from August 1959 to December 1961. The intent was to determine the kinds, numbers, seasonal occurrences and ecological relationships of mites in nuclear disturbed and contiguous undisturbed areas. A total of 1,256 rats from nine plant communities was examined. The 6,208 mites collected represented 16 species including four undescribed. Fourteen were found on both kinds of rats. Considerably more rats were infested with chiggers than with mesostigmatids. Seasonal peaks in numbers of mites occurred during the three periods of February-March, July, and October-November. Forty percent fewer rats in the nuclear disturbed areas were infested than in undisturbed areas, and only one-third as many mites were found on rats in the disturbed as in the undisturbed areas. (Auth)

<260>
Beck, D.E., D.M. Allred, and E.F. Brinton, Brigham Young University, Provo, UT. 1963, October

Ticks of the Nevada Test Site. Brigham Young University Science Bulletin, Biological Series, 4(1), 12p.

As part of a study to determine kinds, population, seasonal occurrence, and geographical and ecological distribution of ticks in areas where nuclear detonations have taken place compared with undisturbed areas, the tick fauna of the Nevada Test Site is reported. Twenty four species of animals (primarily rodents and leporids) were found infested with eleven species of ticks. Collections were confined to the valleys and lower elevations of the mesas and mountains. Each type of tick was discussed in relation to its host, seasonal incidence, and associated plant community type. Comments on abundance, presence on unusual hosts, and stage of development are included. Results indicated that the nature of the habitat was influential on survival of the ticks when not on a host. (ST)

<261>
Barton, C.J., Oak Ridge National Laboratory, Nuclear Safety Information Center, Oak Ridge, TN. 1966, Summer

The Hazard of Dispersed Plutonium Particles. Nuclear Safety, 7(4), 468-473

Increasing usage of plutonium as a fuel material in nuclear reactors, together with the well-established inhalation hazard of this man-made element, has resulted in a need for information on particle production by overheated plutonium and plutonium-containing fuel materials. Ignition of metallic plutonium occurs under most conditions at 300 degrees C or higher. The higher the temperature of oxidation, the smaller the fraction of total oxide that needs to be taken into account as significant from the inhalation hazard or aerosol dispersion aspects. Recent publications on the production of particulate material by oxidation of plutonium and the effects of particle size and composition on retention in the human respiratory system are discussed. Further studies are needed to develop similar information for PuO2 and mixtures of PuO2 with other oxides. (Auth) (ST)

<262>
Dougherty, T.F., B.J. Stover, J.H. Dougherty, W.S.S. Jee, C.W. Mays, C.E. Rehfeld, W.R. Christensen, and H.C. Goldthorpe, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1962

Studies of the Biological Effects of Radium 226, Plutonium 239, Radium 228 (Mesothorium I), Thorium 228 (Radiothorium), and Strontium 90. Radiation Research, 17, 625-681

The design of a long-term experiment to compare the biological effects of five radionuclides, Ra 226, Pu 239, Ra 228, Th 228, and Sr 90, in adult beagles is presented. Results of the first ten years of the study are briefly summarized. Injected dose (uCi/kg), time elapsed since injection, skeletal dose in rads, bone tumor incidence, and reasons for death are given in tabular form. Results are presented under the following headings: metabolism and dosimetry; clinical observations; hematology findings; blood chemistry findings; radiological findings; autoradiographic and histological findings in mineralized tissues; soft tissue, histopathologic and autoradiographic findings; and incidence of tumors. (ST)

Table 3 gives the summary of the experiment as of September 30, 1960, and includes injected dose, days since injection, dose to skeleton, bone tumor incidence, and reason for euthanasia or death.

<263>
Stuart, B.O., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1973, January

Deposition of Inhaled Aerosols. Archives of Internal Medicine, 131, 60-73

Theoretical models and experimental studies of aerosol deposition in the respiratory tract as a function of particle size and respiration patterns are reviewed. In general, there is good agreement between the two. Models were developed based on the anatomical structure of the respiratory tract, air flows, and physical mechanisms of particle deposition by impaction, sedimentation, and diffusion. Particle deposition is influenced by particle density, shape, hygroscopicity, and pathology. Particle size distribution and deposition site of the inhaled aerosol influence the resultant biological response. (Auth) (ST)

<264>

<264>
Marley, W.G., National Radiological Protection Board, Harwell, Didcot, Berkshire, England. 1973

Radiological Hazards Associated with Internal Contamination of the Body by Radionuclides. CONF-720503; Part of Proceedings of the IRPA 2nd European Congress on Radiation Protection Bujdoso, E. (Ed.), Health Physics Problems of Internal Contamination, held in Budapest, Hungary, May 3-5, 1972, (p. 21-29), 655p.

Current evaluations of the hazards from external radiation and internal radioactivity, are summarized. Human experience with radium still provides a sound basis for fixing permissible levels for bone-seeking nuclides, but the importance is stressed of identifying the precise tissues at risk and determining the dose in those tissues from the various "bone-seeking" nuclides from their detailed metabolism. It is not sufficient for instance, to know that certain radionuclides are "bone seekers" but it is important to distinguish whether they are distributed widely in mineral bone like Sr 90 and Ra 226, or located on the surfaces of bone like Pu 239 and Ra 224. It is important also to take into account the respective sensitivities to malignant disease induced by radiation in the various tissues and also to include doses from nuclides not necessarily concentrated in the tissue of interest. It seems likely that malignancy is the somatic effect of greatest importance since there is evidence from the Japanese cities that morbidity from other causes has not been materially affected by the radiation doses. Tissue doses in fallout studies show that potential hazard from Cs 137 is some 7-15 times greater than from Sr 90. Fallout studies have provided the basis for greatly improved knowledge of the metabolism in humans and the agricultural behavior of sr and now enable the dose committment to persons of all ages to be reliably calculated. This information is especially valuable in regard to the protection of the public in the event of accidents to nuclear reactors and also shows that the potential hazards from Sr 90 are now found to be much less than was hitherto thought. (Auth)

<265>
Kunzle-Lutz, M., R. Metiveer, D. Nolibe, A. Simon-Vermot, J.L. Grimbert, and P. Jockey, Commissariat a l'Energie Atomique,, Centre d'Etudes de Bruyeres-le-Chatel, Laboratoire de Radiotoxicologie, France; Centre d'Etudes de l'Energie Nucleaire, Section Medicale, Saclay, France. 1971, January-February

Pulmonary Lavage: Therapy of Pulmonary Contamination by Plutonium Oxide. Journal of European de Toxicologie, 4(1), 53-59

The pulmonary lavage in vivo by saline solutons was tested with monkeys previously dusted over with plutonium oxide. The animals underwent 1, 3 or 5 series of washings of the lower right lobe; each session consisted of 5 to 10 repeated irrigations. The results obtained indicate the following: it is useless to carry out more than six irrigations during any one session; maximum efficiency is obtained when the treatment is carried out within the first few days immediately following the dusting; and whereas one session eliminates 10% of the dust particles in the area treated, several sessions lower the pulmonary amount in the treated area from 45 to 55%. Repeated treatment is therefore recommended. (Auth)

<266>
Hakonson, T.E., and L.J. Johnson, Los Alamos Scientific Laboratory, Los Alamos, NM. 1973

Distribution of Environmental Plutonium in the Trinity Site Ecosystem After 27 Years. LA-UR-73-1291; CONF-730907; Part of Proceedings of the IRPA 3rd International Congress on Radiation Protection Symposium held in Washington, D.C., September 9-14, 1973, (6 p.)

The results are presented for a radioecology survey of the Trinity Site environs, where the world's first (July 1945) atomic bomb was detonated. The temporal behavior of the low environmental levels of the plutonium produced by this detonation are discussed. The data from this study were compared with similar data obtained in the Trinity Site environs nearly 20 years ago. The major change which was observed was an increased migration of Pu into the soils. Concentrations of Pu in vegetation and rodents were too low to make valid comparisons. (Auth)

<267>
Morin, M., W. Skupinski, J.C. Menot, and J. Lafuma, French Atomic Energy Commission, Fontenay-aux-Roses, France. 1973

Experimental Research on the Treatment of Contaminations by Actinide Solutions. CONF-720503; CEA-CONF-2070; Part of Buidoso, E. (Ed.), Proceedings of the IRPA 2nd European Congress on Radiation Protection Health Physics of Internal Contamination, held in Budapest, Hungary, May 3-5, 1972, (p. 317-320), 655p.

Adult Sprague Dawley SPF rats were administered the actinides, U 235, Pa 233, Np 237, Pu 238, Pu 239, Am 241, Cm 242, and Cf 252, in nitrate form either intramuscularly or by inhalation, to study the effect of DTPA therapy. DPTA therapy was most effective on the removal of elements with a valence of +3 (Am, Cm, and Cf). Its effect on Pu 238 was similar, but the effect on Pu 239 was difficult to evaluate because of the slower migration of this isotope. DTPA therapy proved to be ineffective on U, Pa, and Np contaminations. In the case of U contamination, increased migration rate combined with precipitation in the kidneys resulted in dangerous renal deposits. (Auth) (ST)

Table 1 gives the distribution in rats of U 233, Pa 233, Np 237, and Am 241 injected intramuscularly as nitrates. Table 2 gives distribution of DTPA complexes, following intramuscular injection to rats sacrificed one day after contamination. Table 3 shows distribution of the actinides after twice weekly treatment with DTPA for three months. Table 4 shows distribution after inhalation of the actinides and effect of DTPA treatment. Table 5 shows effects of delayed DTPA treatment.

<268>
Abrams, R., H.C. Seibert, L. Forker, D. Greenberg, H. Lisco, L.O. Jacobson, and E.L. Simmons, University of Chicago, Metallurgical Laboratory, Biology Division, Chicago, IL. 1946, June

Acute Toxicity of Intubated Plutonium. CH-3875; 35 p.

Doses ranging from 7.5 to 500 ug of Pu(+4) nitrate with a specific activity of 0.062 uCi/ug were administered to the lungs of rats by tracheal intubation. All doses were lethal; mean survival time ranged from 203 days for the lowest dose to 26 days for the highest. Lung retention was 25% after 210 days. Approximately 15% of the initial dose was deposited in the skeleton. Pathological changes in the lungs were characterized by severe inflammation, necrosis, and abscess formation. Animals surviving a month or longer showed widespread scarring of the lung, emphysema, and squamous metaplasia of the bronchial epithelium. In hematological studies, rats given 500 ug showed an initial rise in hemoglobin, erythrocytes, and neutrophils followed by a sustained anemia, lymphopenia, and reduction in neutrophils until death within 28 days. Hematological changes appeared to be dose dependent. The gross pathological changes in the lungs appeared to be due to the high retention of plutonium in the lung. The hematological effects were due to the general redistribution of plutonium. (Auth) (ST)

Table 1 lists the median lethal dose of Pu for various periods after administration by both intravenous and intrapulmonary routes.

<269>
Albert, R.E., New York University, College of Medicine, Department of Environmental Medicine, New York, NY. 1972

The Tumorigenic Action of Beta, Proton, Alpha and Electron Radiation on the Rat Skin. CCO-3380-1; Progress Report of August 1, 1971 through July 31, 1972, 20 p.

Progress is reported on studies aimed at elucidating the various determinants of the dose-response relationships in radiation carcinogenesis using the rat skin as the experimental model. Progress is reported in the following areas: effects of protons in a sieve pattern on the incidence of skin tumors, tumor incidence in mouse skin, effects of fractionation of dose on tumor incidence and hair follicle atrophy, induction of tumors during the phase of hair growth, tumor induction in a resistant strain of rats, carcinogenic effect of radiation and methotrexate combined, effect of tumor growth rate on tumor incidence curve, the kinetics of recovery from carcinogenic damage, the critical depth for tumor induction in the growing phase, the dose-response curve for growing phase at 1.0 mm penetration, the effect of postirradiation proliferative stimuli on tumor incidence, effect of a sieve pattern on tumor induction for Grenz Rays, cell death and regeneration in the hair follicles and surface epidermis, properties of the G sub 0 phase in rat epidermis, and the treatment of radiation induced skin tumors with methotrexate. (ST)

<270>

<270>
Goldthorpe, H.C., University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1962

The Effects of Aging and Internal Emitters on Blood Chemistry. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held in The Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 117-129), 529 p.

The blood chemistry of normal beagle dogs and those given a single intravenous injection of Pu 239, Ra 228, Th 228, or Ra 226 was studied over a large period of their lifespan. In the normal aging controls, inorganic phosphates, total proteins, globulins, fibrinogen and glycoproteins all appeared to have a slight increase in value throughout life. Calcium, serum albumin, urea chlorides and carbon dioxide capacity tended to show a slight decline throughout life. Alkaline phosphatase tended to remain fairly constant throughout life. Cholesterol appeared to decrease in value in early life and at about midlife started to climb to above normal values. Special emphasis was given those groups in which a large number of the dogs had bone tumors at the time the measurements were made. The most striking change was the elevation of the mean values of alkaline phosphatase for almost all the groups in which bone tumor incidence is high. Pu 239 dogs showed a slight decrease in calcium with a slight increase of inorganic phosphates. The latter change appeared in some of the Th 228 dogs also. An interesting finding in the study of the serum proteins was an advancement in time of the normal reversal of the albumin-globulin ratio. Pu 239 dogs with bone tumors showed a slight decrease in serum urea nitrogen. Some increase in cholesterol values was noted. Both fibrinogen and serum glycoproteins showed an increase in the case of most of the groups of dogs with bone tumors. Terminal values for the various serum constituents of the injected dogs are given in graphical form. (ST)

<271>
Elkina, N.I., and I.A. Tseveleva, Not given. 1961, March

Mineral and Protein Metabolism in Bone Tissues of Rats in Plutonium Injury. JPRS-11242; Part of Medical Radiology, (p. 126-134), 190 p.; Meditsinskaya Radiologiya, 6(3), 58-63

The mineral and nitrogen metabolism of bones was studied in rats following administration of 20 x 10(E-3) and 1.9 x 10(E-3) uCi/g of plutonium in the form of nitrate or citrate solutions. The content of calcium, phosphorus, and nitrogen in the bones of the plutonium poisoned rats was not significantly different from the amounts in the control groups. The activity of acid and alkaline phosphatase activity in the chronic group was reduced by 25% after one year. The intensity of incorporation of P 32 and Ca 45 in the epiphyseal portion of the bones was considerably lower than in the control animals. In the chronic group the incorporation of glycine-1-C 14 in the proteins of the epiphyses was reduced one and a half to two times as compared with the normal. In all rats the metabolic activity in the epiphyseal part of bones was greater than in the diaphysis. It was concluded that the changes in the bones after external irradiation and upon exposure to deposited plutonium are similar. (ST)

<272>
Dushauskene-Duzh, N.P.P., E.D.P. Marchyulenene, V.B. Nyanishkene, R.I. Shuliene, and G.G. Pelikarpov, Institute of Botany, Vilnyus, USSR. 1972

Radionuclide Uptake by Some Freshwater Hydrobionts. Lietuvos TSR Mokslu Akademijos Darbai, Serija C, 3(59), 201-212 (Russian, English Summary)

Environmental sampling studies in 1967-1968 showed that the accumulation coefficients of Sr 90 and Pb 210 were the same in fish and mollusks, whereas that of Pb 210 in plants was an order lower than that of Sr 90. There appeared to be a positive correlation between Sr 90 and Pb 210 in fish. Accumulation coefficients depended on the ash content of aquatic organisms. Experimental results showed that Sr 90, Ce 144, Cs 137, and Ru 106 accumulated in phytoplankton and silt with maximum coefficients. Cerium 144 exhibited the greatest accumulation in aquatic organisms, while the accumulation of Cs 137 and Sr 90 was relatively low. The intense uptake of Cs 137, Ce 144, and Ru 106 by silt protected chironomid larvae from uptake of these radionuclides. The larvae accumulated the following percentages: Sr 90, 10%; Cs 137, 9%; Ce 144, 11%; and Ru 106, 6%. Year old carp assimilated 10% of the Ce 144 ingested with chironomid larvae. Fish of different trophic levels accumulated the same amount of Sr 90 and Pb 210. Uptake appeared to be primarily from the water if food was readily available. (ST)

<273>
Moskalev, Yu.I., L.A. Buldakov, N.A. Koshurnikova, A.P. Nifatov, and G.N. Reshetov, Not given. 1965

Combined Influence of Strontium 90, Cerium 144, and Plutonium 239 on the Rat Organism. AEC-tr-6603; Part of Radiobiology, (p. 85-93), 238 p.; Radiobiologiya, 5(6), 785-936

Rats were injected with the isotopes plutonium, strontium, and cerium separately and in pairs to study the biological effects of two isotopes with the same and different decay emissions and distribution within the organism. The elimination of strontium, cerium, and plutonium from the skeleton and liver within the time interval, for 16 to 918 days of observation, obeyed an exponential dependence, independent of whether the isotopes were introduced separately or in combination. In the case of joint administration of a pair of isotopes with the same and different types of distribution, the injuries not only were summed (cerium plus plutonium), but in a number of cases they also appeared earlier or in a larger percentage of cases (strontium plus cerium and strontium plus plutonium) than in the case of separate administration of the isotopes. The relative biological effectiveness of plutonium in comparison with beta emitters varied for various criteria, and, moreover, depended on the amounts of the isotopes incorporated. (Auth) (ST)

Table 2 shows the deposition and rate of elimination of strontium, cerium and plutonium in from the skeleton and liver. Table 3 shows the LD 50's for various periods and frequency of appearance of various injuries in rats after separate and combined administration of the isotopes.

<274>
Not given, E.I. du Pont de Nemours and Company, Savannah River Laboratory, Aiken, SC. 1973, September

Environmental Activities and Programs at the Savannah River Plant. DPST-73-436; 23 p.

The report briefly describes the purpose and operation of the Savannah River Plant activities and the funded programs to modify the impact of potential or actual releases to the environment. General descriptions of the results of the various emission controls, environmental research, and environmental monitoring programs, are given. For 1974 the operating budget for the plant site is about $125 million; about 10% of this amount is spent for environmentally oriented activities. Activities of the plant are described under the headings: emission reduction activities in Savannah River Plant processes, monitoring, administrative process controls, and environmental research activities. Present controls and efforts to minimize the losses or inefficient uses of raw materials, intermediates, and final products at the nuclear fuel fabrication, nuclear reactor, chemical separations and supporting facilities are briefly described. Routine environmental monitoring includes continuous measurement of radionuclides in effluents at the points of release and systematic sampling of the environment. All operations are carried out within limitations established by extensive administrative controls. A number of research programs are underway to predict the fate and impact of pollutants on the environment. These include research on heated water effluents, transport studies of radioactive and nonradioactive effluents to aqueous and gaseous routes, and forest production. (ST)

<275>
Isaacson, R.E., and L.E. Brownell, Atlantic Richfield Hanford Company, Chemical Processing Division, Research and Development, Advanced Technology Development Section, Richland, WA. 1972, August 19

Ultimate Storage of Radioactive Wastes in Terrestrial Environments. ARH-SA-126; CONF-721107-4; Part of Proceedings of a Symposium on the Management of Radioactive Wastes from Fuel Reprocessing held in Paris, France, November 27-December 1, 1972, (33 p.)

New avenues are opened for the ultimate storage of radioactive wastes, Ce 137, Sr 90, and Pu 239, via the STOPPER and Thermalt processes. STOPPER is the Stone Process for Permanent Encapsulation of Radionuclides, a hydrothermal process. Thermalt is a pyrochemical process for fixing radionuclides in a basalt-like product. The products contain analogs of silicate and aluminosilicate minerals such as pollucite, strontium feldspar and plutonite--a structural analog of zircon. Ultimate storage will have been effected if these product forms are secured in geochemically compatible media where the authigenic precipitation of cation aluminosilicates will provide additional protection from transport by groundwater movements. (Auth)

<276>

<276>
Eakins, J.D., and A. Morgan, Atomic Energy Research Establishment, Health Physics and Medical Division, Harwell, Didcot, England. 1964, October

The Role of Fecal Analysis in a Bioassay Program. CONF-648-9; STI/PUB/84; Part of Proceedings of a Symposium on the Assessment of Radioactive Body Burdens in Man held in Heidelberg, Germany, May 11-16, 1964, Vol. 1, (p. 231-244), 1067 p.

The role of fecal sampling and analysis in a bioassay program is discussed, with particular reference to the estimation of retained lung burdens of insoluble radioactive materials. Experience has shown that urine analysis alone cannot always be relied upon to give an adequate indication of exposure by inhalation of insoluble radioactive materials. The results obtained are affected by so many variables that they defy interpretation. The analysis of fecal samples, collected after an incident involving airborne contamination, can confirm whether or not a significant intake has occurred and will enable an initial estimate of the retained lung burden to be made by reference to one of the models describing the retention and elimination of inhaled particles. The subsequent fecal excretion pattern and particle size measurements on air filter samples representing the inhaled aerosol (if available) can be used to modify the initial estimate. At the Atomic Energy Research Establishment (AERE), Harwell, England, the sampling and analysis of fecal samples is used as a complement to urine analysis following cases of known or suspected exposure by inhalation. This method is considered to be the only satisfactory way of detecting and assessing lung burdens of insoluble compounds of Pu 239, which cannot be detected with adequate sensitivity by in vivo counting. Some examples of excretion patterns obtained from cases of accidental inhalation of insoluble compounds of plutonium and thulium are described. (Auth)

<277>
Jee, W.S.S., R.B. Dell, and E. Hashimoto, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, March 31

Quantitative Morphology of Vertebral Trabecular Bone in Beagles Injected with Plutonium. CCO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (199-217), 380 p.

As part of a study on histopathological lesions in bones induced by a single intravenous injection of plutonium citrate, results are reported on changes contributing to the alteration in percentage of the lumbar vertebral body occupied by trabecular bone and frequency distribution of trabecular widths in lumbar vertebral bodies. The percentage of trabecular bone within the cortical bone envelope of lumbar vertebral bodies of beagles diminished with age from a value of 25% at 500 days to a value of 16% at about 6000 days of age. Beagles injected with 2.7, 0.909, 0.301, 0.096, and 0.0485 uCi of Pu 239/kg exhibited elevated percent trabecular bone values, but were within normal range for their respective age groups in the beagles injected with 0.0157 uCi/kg. The dogs injected with 0.0157 to 2.7 uCi Pu 239/kg showed increased trabecular widths. In general, the effect of a single intravenous dose of plutonium resulted in the inhibition of bone resorption leading to thicker or mosaic trabeculae. (Auth)(ST)

<278>
Jee, W.S.S., and J.S. Arnold, University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1961

The Toxicity of Plutonium Deposited in Skeletal Tissues of Beagles. 1. The Relation of the Distribution of Plutonium to the Sequence of Histopathologic Bone Changes. Laboratory Investigation, 10(4), 797-825

The relation of the distribution of plutonium to the sequence of histopathologic bone changes was studied using autoradiographic, microradiographic, histopathologic and vascular injection techniques in 5 control beagles and 20 others that died or were sacrified from 1 to 1576 days following a single intravenous administration of 2.7 uCi/kg of plutonium (+4) citrate given at ages 14-19 months. The plutonium induced bone lesions by direct and indirect mechanisms: Early changes occurred in trabecular bone, resulting in transverse plates in spongiosa, acellular marrow cavities, peritrabecular fibroses, abnormal bone resorption, and endosteal bone growth. The late changes affected cortical bone and were manifested by plugging of haversian canals, resulting in death of osteocytes, followed by disturbance in bone remodeling (large resorption cavities, bizarre-shaped and abnormally mineralized osteones) eroded periosteal surfaces, and fibroses and spontaneous fractures. The late effect was the induction of osteogenic sarcomas. (Auth)

<279>
Jee, W.S.S., and J.S. Arnold, University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1960

Effect of Internally Deposited Radioisotopes Upon Blood Vessels of Cortical Bones. Proceedings of the Society for Experimental Biology and Medicine, 105, 351-356

Adult beagle dogs were injected with Pu 239 (3.0 uCi/kg), Ra 226 (10.0 uCi/kg), and Th 228 (0.9 uCi/kg) to study the effect of internally deposited radioisotopes upon blood vessels of cortical bones. After an extensive latent period following acquisition of plutonium, radiothorium and radium in cortical bone, plugging of the haversian canals occurred which in turn resulted in bone necrosis. Investigation of this phenomenon with a vascular injection technique and a bone-seeking alpha emitter (plutonium) which deposits on surfaces of haversian canals and allows the remainder of the osteones and adjacent interstitial lamellae to be free of activity, showed that death of osteocytes was principally the result of disrupted blood supply rather than direct alpha ray killing. With radiothorium, concentration of alpha particles about haversian canals was sufficient to result in total plugging of the vascular tree within the haversian canals resulting in complete bone necrosis and inhibition of internal reconstruction of cortical bone. With radium and plutonium only about half of the canals were plugged, which allowed internal construction to proceed; however, the nature of the remodeling in this environment was abnormal (formation of large cavities and abnormal osteones). It is suggested that both devitalization of bone and occurrence of large cavities weakens the bone which in turn results in spontaneous fracturing of long bones. (Auth) (ST)

<280>
Mays, C.W., University of Utah, Radiobiology Division, Salt Lake City, UT. 1968, August 23

Bone-Seeking Radionuclides. CONF-670938; Part of Proceedings of a Symposium on Delayed Effects of Bone-Seeking Radionuclides held at Sun Valley, Idaho, September 12-14, 1967. Published in Science, 161, 814

Papers presented at the international symposium on delayed effects of bone seeking radionuclides are summarized. The incidence of tumors (primarily bone sarcomas), in humans and animals subjected to various doses of Ra 224, Ra 226, Ra 228, Sr 90, Pu 239 was discussed. In most cases tumor incidence was correlated with dose rate. The papers included studies of humans exposed to Ra; similarity of dose required to produce a given incidence of bone cancer in a variety of mammals including man; a review of the neoplasms induced by high doses of Sr 90; incidence of squamous cell carcinomas, liver tumors and eye melanomas in Ra, Pu, and Sr injected beagles; and the delayed effects of internally deposited radionuclides in rats. (ST)

<281>
Andrews, H.L., National Cancer Institute, Bethesda, MD. 1955, September 9

Radioactive Fallout from Bomb Clouds. Science, 122(3167), 453-456

The mechanisms by which fallout particles are produced and the biological implications of the radioactivity associated with the particles are discussed. During test operations at the Nevada Proving Ground an off-site monitoring program is maintained by the U.S. Public Health Service. Criteria laid down by the Atomic Energy Commission have been met. The fate of radioactive fallout from all test shots and its effect on the human population are discussed. (ST)

<282>
Bowen, V.T., and V.E. Noshkin, Woods Hole Oceanographic Institution, Woods Hole, MA. 1973

General Summary of Progress, 1972-1973, Plutonium Concentration Along Freshwater Food Chains of the Great Lakes, USA. COO-3568-3; 35 p.

The report summarizes sample collections made in Lake Ontario during the summer of 1972; analyses completed, since writing the 1971-1972 progress report, on the samples collected in 1971; analyses completed on the 1972 samples; and some preliminary attempts to compare and contrast the analytical data from the two years of sampling. Analyses of water, sediment, and biological samples for plutonium, strontium, and cesium are given in tabular form. Analyses and comparisons between years are discussed under the following headings: quality of data, water samples, sediment cores, and biological materials. (ST)

<283>

<283>
Kelly, J.M., Oak Ridge National Laboratory, Oak Ridge, TN. 1973, July

Dynamics of Litter Decomposition, Microbiota Populations, and Nutrient Movement Following Nitrogen and Phosphorus Additions to a Deciduous Forest Stand. ORNL-4893; Ph.D. Thesis, University of Tennessee, 191 p.

The objective of the study was quantification of the dynamics of litter decomposition, microbiota populations, and nutrient movement in response to nitrogen and phosphorus additions to a deciduous forest stand. Nitrogen (urea) was applied at rates of 0, 550, and 1100 kg/ha in combination with phosphorus (concentrated superphosphate) at rates of 0, 275, and 550 kg/ha. Total loss of organic material from white oak, red maple, and black gum litter bags over a 16-month period was 34, 35, and 45%, respectively. Phosphorus treatment retarded weight loss from litter bags of all species. Weight loss for the 0, 275, and 550 kg/ha levels of phosphorus averaged 23, 20, and 19% for white oak; 26, 25, and 25% for red maple; and 29, 27, and 26% for black gum. Weight losses were increased by a small amount (1 to 2%) or not at all by nitrogen treatment. The NP interaction weight loss means were intermediate to the main treatment means. The increase in decomposition associated with nitrogen was offset by the decrease associated with phosphorus. Litter and soil bacterial populations were significantly increased by nitrogen additions, while litter and soil fungi did not respond to nitrogen. Soil fungal populations were increased by phosphorus addition, while litter bacterial populations were reduced. Litter fungi and soil bacteria did not respond to phosphorus. Combined additions of nitrogen and phosphorus increased bacterial populations, though not as much as nitrogen alone. There was a good correlation (r equals 0.70) between bacterial population and litter weight loss. Invertebrate populations in white oak and red maple litter were reduced by nitrogen treatment; however, phosphorus treatment increased only the red maple invertebrate population. Invertebrates inhabiting black gum litter were not affected by fertilization. The change in invertebrate population appears to be in response to pH changes following fertilization. The shifts in invertebrate populations did not correlate with weight loss as well as the shifts in microbial populations did (r equals 0.35). The nitrogen content of the litter exhibited the same response pattern regardless of fertilizer treatment, although there were differences in the magnitudes of the responses. The dynamics of nitrogen in the litter correlated well with microbial population (r equals0.85), while nitrogen loss from the litter and top 10 cm of the soil via the soil solution appeared to be controlled by chemical rather than biological factors. The formation of insoluble calcium ammonium phosphate was the primary chemical regulator. Significantly less nitrogen was lost at the 550 kg/ha level of phosphorus in combination with nitrogen than at the 275 kg/ha level. Phosphorus and calcium losses in the soil solution support the calcium ammonium phospate fixation hypothesis. Solubilized organic matter was estimated as contributing 25 g/m2 of nitrogen loss. Volatilization losses were estimated to be as high as 26 g/m2. Nitrogen treatment increased the amount of potassium, calcium, magnesium, and sodium in white oak litter, while phosphorus content was not altered. Phosphorus treatment increased the weight of phosphorus, calcium, and sodium, while reducing the weight of magnesium. Potassium content was not affected by phosphorus treatment. The alteration of microfloral populations by fertilization was the primary factor controlling nutrient dynamics in the decomposing litter. Nitrogen treatment significantly increased nitrogen and potassium losses from the litter and top 10 cm of the mineral soil via the soil solution. Phosphorus and calcium losses were unaltered. Phosphorus treatment increased the loss of all elements except nitrogen. (Auth)

<284>
Kisieleski, W., and L. Woodruff, Not given. 1947, November 1

Studies on the Distribution of Plutonium in the Rat. AECD-2009P; Part of Brues, A.M. (Ed.), Quarterly Report for August 1947-November 1947, (p. 86-93), 177 p. (Declassified May 12, 1948)

Adult male Sprague-Dawley rats were injected intramuscularly with the citrate and nitrate salts of plutonium in the +6 state at a dose level of 0.1 ug/g to study the distribution of plutonium over a period of one year. Most rats showed varying degrees of bronchopneumonia with abscesses at the time of autopsy. Animals were sacrificed at intervals from 7 to 420 days and the plutonium of the various tissues determined. The citrate salt was absorbed from the site of injection to a greater degree than the nitrate. The skeleton was the principal site of deposition regardless of the form. Liver was next and other soft tissues contained insignificant amounts. All of the tissues in the citrate injected rats showed a higher initial uptake than in the nitrate injected rats. The spleen contained a smaller percent of the injected dose, but in specific activity it was as high as liver or bone. (ST)

<285>
Jee, W.S.S., University of Utah, College of Medicine, Department of Anatomy, Salt Lake City, UT. 1962

Histopathological Endpoints in Compact Bones Receiving Alpha Irradiation. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at the Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 95-116), 529 p.

As part of a study of histopathological changes in bone as a consequence of long term effects of bone seeking alpha emitters, tibial diaphyses from controls and beagle dogs receiving a single intravenous injection of Pu 239, Ra 226, Ra 228, and Th 228 were studied. The results indicated that the turnover rate of the compacta of dogs between three and ten years old was slow and constant. Structural changes in compacta containing internally deposited alpha emitters appeared to be dose dependent. High radiation dosus altered the circulation, produced bone necrosis and bizarre osteones, stimulated bone resorption and inhibited bone formation. The increased accumulations of these structures indicated a more rapid turnover rate for the radionuclide bearing dogs when compared to controls. The ratio of canal plugs to blocked vascular channels in damaged compacta was as high as 1:35 as compared to 1:9 for controls. The high ratio was due to damage to main arterial channels supplying cortical bone in the marrow cavities. Time played an important role in that many of the changes were cumulative. Two groups of dogs showed nearly identical damage, although the radiation doses and burden times of radionuclides were 1711 days, 760 rads and 1178 days, 1645 rads, respectively. The circulation factor was mainly responsible for the altered remodeling. The response of compact bone to partial ischemia was massive resorption and endosteal and periosteal bone proliferation resembling changes induced by internally deposited radionuclides in bone. (ST)

<286>
Nickson, J.J. (Ed.), University of Chicago, Chicago, IL. 1945, July 23

Report of Conference on Plutonium, May 14th and 15th. CN-3167; 62 p. (Declassified December 22, 1952)

The distribution, retention, metabolism, toxicity, and excretion of plutonium following administration by different routes in humans and animals were discussed. The toxicity of plutonium as compared to polonium and radium was studied and the best method for decontamination of wounds was outlined. All of the nine papers presented at the conference were abstracted separately for the data base. (ST)

<287>
Hempelmann, L.H., S.T. Cantril, J.E. Wirth, J.J. Nickson, and S.G. English, University of Chicago, Chicago, IL. 1945, July 23

Summary of Requests for Information Desired Concerning Plutonium. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 1-4), 62 p. (Declassified December 22, 1952)

Requests for information on plutonium contamination and metabolism were listed under the following headings: diagnosis and estimation of the amount of plutonium in the human body; absorption rate through the skin, gastrointestinal tract, wounds, and lung; permissible levels of plutonium in different parts of the body; metabolism as influenced by rate of intake and diet and rate of elimination from bone; pathology; therapy; protection; and plutonium-radium ratios. (ST)

<288>
Finkle, R.D., University of Chicago, Chicago, IL. 1945, July 23

Distribution of Injected Plutonium. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 5-9), 62 p. (Declassified December 22, 1952)

The general biological reaction to administered plutonium appeared to be a deposition of 50% in the skeleton and early retention of 20-40% by the liver. In most cases the amount in the liver decreased to 5-10% within 60 days. The distribution in a dog 16 days after injection of a lethal dose of plutonyl nitrate was 44% in the skeleton, 31% in the liver, 8% in the muscle, and 3.5% in the spleen; 10% was excreted. Bone marrow was 13 times more active than an equal weight of compact bone. Plasma contained 80% of the plutonium in blood. In mice the liver retained 27% of the injected dose of plutonyl nitrate after 60 days, but only 7% of plutonyl citrate under the same conditions. Plutonium nitrates administered intramuscularly to rats resulted in small concentrations in the liver. Plutonyl nitrate and citrate injected intraperitoneally behaved similarly, with plutonyl nitrate being absorbed more slowly. (ST)

<289>

<289>
Abrams, R., University of Chicago, Chicago, IL. 1945, July 23

Retention of Inhaled Plutonium. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 10-11), 62 p. (Declassified December 22, 1952)

Data on the fate of inhaled and intubated plutonium particles in the form of nitrates (+3, +4, +6), oxide, cupferride, and citrates (+4 and +6) are summarized in tabular form. Greatest deposition was in the liver and skeleton. Deposition in the liver reached a maximum in one day, decreasing somewhat thereafter, especially with intubated citrate. Citrate accelerated the rate of transfer from the lung to the skeleton. (ST)

Lung retention, lung elimination half time, and liver and skeletal deposition of several plutonium compounds and valence states are given in tables 10 and 11.

<290>
Barron, E.S.G., University of Chicago, Chicago, IL. 1945, July 23

The Metabolism of Tissues of Plutonium Treated Rats. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 12-15), 62 p. (Declassified December 22, 1952)

Rats administered intravenous injections of plutonium (2mg/kg) showed reduction in the size of the spleen and thymus after one week, accompanied by diminished O2 uptake. The adrenal glands showed an increase in O2 uptake followed by very low values after the fifth day postinjection. Thirty percent of the treated rats had elevated blood non protein bound nitrogen. Kidney damage was confirmed by lower measured rates of oxidation of glutamate and NH3 formation. The liver appeared yellow and friable. Results were variable, but liver metabolic processes were generally inhibited to some degree. (ST)

<291>
Murray, R., University of Chicago, Chicago, IL. 1945, July 23

Gross and Histopathology of Animals Treated with Plutonium. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 16-18), 62 p. (Declassified December 22, 1952)

Results of several studies on the gross and histopathologic changes in rats, mice, and dogs following treatment with plutonium are summarized. The following gross pathological changes were reported: rats inhaling plutonium showed lung changes characteristic of pneumonia; a dog treated intravenously with 0.36 ug/gm died after 16 days and showed pale bone marrow and hemorrhagic lymph nodes; mice and rats treated intramuscularly with plutonium citrate (2-12 ug/gm) showed degenerated and hemorrhagic areas in the kidneys and ulcerated local legions; and mice and rats treated intravenously (1.0 ug/gm) had smaller spleens and showed liver changes. At lower doses tumors and a bone fracture were observed. Histology studies made 6 hr to 6 weeks following injection of 1.25 ug/gm showed changes in the bone and bone marrow, lymph nodes, spleen, testes, and gastrointestinal tract. Following intravenous injection, rats showed damage earlier than in mice and at lower dose levels. Results within all groups of animals were variable. (ST)

<292>
Brues, A.M., University of Chicago, Chicago, IL. 1945, July 23

Clinical Picture Following Plutonium Administration. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 19-26), 62 p. (Declassified December 22, 1952)

Clinical observations following intravenous injection of acute (0.36 mg/kg), subacute (0.286 mg/kg), and chronic (0.4 mg/kg intramuscularly) doses of plutonium nitrate (+6) were made on the dog. The most marked finding was a drop in white blood cell count involving heterophiles and lymphocytes. A progressive anemia was observed throughout the course of the experiment. Other clinical findings are listed in tabular form. Symptoms were similar but decreasingly less severe in dogs administered the subacute and chronic doses. These doses to dogs and rodents produced damage to the erythropoietic system, liver, spleen, kidneys, and bone. There was great variability of effects between groups of animals and results within a group were difficult to reproduce. Mice receiving plutonium nitrate (+6) intramuscularly and subcutaneously showed local greying of hair and skin ulceration. (ST)

<293>
Langham, W., and E.R. Russell, University of Chicago, Chicago, IL. 1945, July 23

Excretion Studies. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 27-45), 62 p. (Declassified December 22, 1952)

Attempts to establish a method of sampling and analyzing urine for small amounts of plutonium and establish a relationship between the amount of plutonium in urine and the total body burden are summarized. A method for collecting and analyzing samples is given. Results of personnel monitoring and human excretion following injection of 4.7 ug of plutonium citrate (+4) are given in tabular form. Results of rat studies showed that the percent of the total injected dose excreted in urine was independent of the size of the dose administered. The excretion of plutonium by humans, dogs, rats, rabbits, and mice are shown in tabular form. The minimum amount of plutonium excreted daily was 0.01% of the retained amount. No comparisons between concentration in the blood and urinary excretion could be made. (ST)

Tables 18-25 contain plutonium excretion data for man and several animals.

<294>
Fink, R.M., and K.S. Cole, University of Chicago, Chicago, IL. 1945, July 23

Radium-Plutonium, Polonium-Plutonium Ratios. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 46-56), 62 p. (Declassified December 22, 1952)

To study the relative toxicities of radium, polonium and plutonium these radionuclides were administered to rats at dose levels of 20-8000, 50-170, and 19-190 uCi/kg body weight, respectively. Results are presented in the form of dosage-survival time charts. In terms of uCi, polonium was three times as toxic as plutonium and plutonium was thirty times as toxic as radium for short survival periods. On the basis of equivalent alpha ray energy polonium was about twice as toxic as plutonium during a ten day survival period and increased in relative toxicity during longer survival periods. Plutonium to radium toxicity ratios were the same as those based on uCi. The relation of deposition site to toxicity was discussed. The toxicity of plutonium as related to route of administration, physicochemical form, experimental animal used, and specific organ effects is given in tabular form. (ST)

<295>
Nickson, J.J., University of Chicago, Chicago, IL. 1945, July 23

Therapeutic Experiments and Suggestions. CN-3167; Part of Nickson, J.J. (Ed.), Report of Conference on Plutonium, May 14th and 15th, (p. 57-62), 62 p. (Declassified December 22, 1952)

In preliminary experiments plutonium nitrate (+6) was introduced into skin lacerations on rats to study the rate of absorption of plutonium from the site of injury. The resultant data indicated that time after introduction of plutonium into a wound was the single most important condition affecting removal. Water was an effective washing agent. Administration of intravenous citrate increased urine plutonium excretion rate. (ST)

<296>
Ballou, J.E., General Electric Company, Hanford Laboratories, Biology Laboratory, Richland, WA. 1960

Distribution and Retention of Plutonium 239 and Neptunium 237 in the Rat Adrenal. Radiation Research, 22, 81-94

Sprague-Dawley rats were administered massive doses of plutonium or neptunium citrate intravenously to determine distribution and retention of these radionuclides in the adrenal gland. Tissue analyses at autopsy showed that the amount of plutonium or neptunium in the adrenal was always small compared to that retained in the total rat. Deposition in the adrenal cortex was characterized by discrete zonal concentrations in areas of the zona glomerulosa and zona reticularis. Localized deposition in these areas was apparent by the third day postinjection and appeared to be more pronounced at later time intervals. Prolonged retention in the adrenal may be explained by the phagocytic capacity of this organ and/or metabolic reutilization of biological components containing these radionuclides. Estimated local radiation doses to the portion of the adrenal containing the majority of plutonium or neptunium were about five times as high as the average adrenal dose. (ST)

<297>
, International Atomic Energy Agency, Vienna, Austria. 1973

Regulations for the Safe Transport of Radioactive Materials. STI/PUB/323; Safety Series No. 6; 146p.

Standards of safety are set forth which provide an acceptable level of control of the radiation hazards to persons, property, and the environment that are associated with the transport of radioactive material. The regulations are described for packaging and package design requirements, low level solid radioactive material, activity limits for various types of packages, controls for transport and storage in transit, fissile materials such as U 233, U 235, Pu 238, Pu 239, and Pu 241, and test and inspection procedures. The administrative requirements are discussed such as occasions when approval by competent authorities is required. (PHM)

<298>
Not given, International Atomic Energy Agency, Vienna, Austria. 1973

Safe Handling of Radionuclides. STI/PUB/319; Safety Series No. 1; 91 p.

The Code of Practice is provided as a guide to the safe handling of radionuclides. The code contains a series of recommendations which should be interpreted with scientific judgement in their application to a particular problem. Basic safety standards are set forth which prescribe maximum permissible levels of exposure to radiation and fundamental operation principles. The manual covers monitoring of personnel and work areas, sealed and unsealed sources and their storage, transportation of radioactive material, accidents, decontamination, and radioactive waste control and disposal. In the appendices there are tables of derived concentration limits of radionuclides (including Pu 239, Am 241, Pu 238, U 235, and U 238) in air and water for occupational exposure and for maximum permissible levels for surface contamination. (PHM)

<299>

<299>
Rancitelli, L.A., R.W. Perkins, and A.D. Renzetti, Jr., Battelle Memorial Institute, Pacific Northwest Laboratories, Environmental and Life Sciences Division, Radiological Sciences Department, Richland, WA. 1969, June

The Multielement Analysis of Human Lung Tissue. BNWL-1051 (Part 2); Part of Pearce, D.W. (Ed.), Annual Report for 1968, (p. 6-9), 234 p.

Human lung tissue obtained from individuals with experience in copper ore processing, uranium mining, uranium processing, and heavy metals processing were analyzed by instrumental neutron activation analysis. The concentrations of 19 elements are reported in the lungs of these individuals and are compared with the concentrations measured in a normal individual. The uranium miner was found to have 2 ppm U and the uranium processor 27 ppm U, compared to 0.001 ppm U in the normal individual. The lung from the subject with a heavy element exposure had a normal uranium concentration but contained 8 times the normal Th. (Auth)

Table 1 shows trace element content of normal lung tissue. Table 2 shows trace element content of lung tissue of individuals with heavy element exposure.

<300>
Goldman, M.I., NUS Corporation, Environmental Safeguards Division, Rockville, MD. 1972, September

Nuclear Power and a Protected Environment. ORP/SID-72-4; Part of Proceedings of the Southern Conference on Environmental Radiation Protection from Nuclear Power Plants, April 21-22, 1971, (p. 221-233), 246 p.

The future role of nuclear power in a protected environment is discussed. Two areas of concern to environmentalists, low level wastes from nuclear facilities and thermal effects, are given particular attention. The author suggests that present Atomic Energy Commission regulations are adequate, that the public is misinformed about radiation hazards, and that while more stringent regulations will be beneficial in some areas, they will in general result in little reduction of radiation dose to the public, increase the average radiation exposure of plant workers, and in some cases indirectly produce other hazardous conditions. (ST)

<301>
Bates, T.H., T.H. Boyd, and J.P. Clarke, British Nuclear Fuels Limited, Windscale and Calder Works, Technical Department, Risley, England. 1971

Rapid Determination of Plutonium in Urine: Separation from Baked Urine Residues Using Ion-Exchange. BNFL-Report-1(W); 21 p.

A method is given for the determination of plutonium in urine within 4 hours of receipt of a sample, excluding counting time. The method consists of evaporating 250 ml of sample to dryness with nitric acid and baking at 550 degrees C to remove organic matter, dissolution of the residue and removal of interfering condensed phosphates by boiling with a catalyst, isolation of the plutonium using an anion-exchange column and finally counting the plutonium on a tray in a low background counter. The method can be scaled up to cope with 1 l samples of urine. The interference of condensed phosphates with the ion-exchange process is studied. It has been shown that the presence of iron in the analytical process promotes good recovery of plutonium. (Auth)

<302>
Young, R.A., U.S. Geological Survey, Federal Center, Denver, CO. 1972

Water Supply for the Nuclear Rocket Development Station, at the U.S. Atomic Energy Commission's Nevada Test Site. Geological Survey Water-Supply Paper No. 1938; 19 p.

The Nuclear Rocket Development Station, in Jackass Flats, occupies about 123 square miles in the southwestern part of the U.S. Atomic Energy Commission's Nevada Test Site. Jackass Flats, an intermontane valley bordered by highlands on all sides except for a drainage outlet in the southwestern corner, has an average annual rainfall of 4 inches. Jackass Flats is underlain by alluvium, colluvium, and volcanic rocks of Cenozoic age and, at greater depth, by sedimentary rocks of Paleozoic age. The alluvium and the colluvium lie above the saturated zone throughout nearly all of Jackass Flats. The Paleozoic sedimentary rocks contain limestone and dolomite units that are excellent water producers elsewhere; however, these units are too deep in Jackass Flats to be economic sources of water. The only important water-producing unit known in the vicinity of the Nuclear Rocket Development Station is a welded-tuff aquifer, the Topopah Spring Member of the Paintbrush Tuff, which receives no significant recharge. This member contains about 500 feet of highly fractured rock underlying an area 11 miles long and 3 miles wide in western Jackass Flats. Permeability of the aquifer is derived mostly from joints and fractures, however, some permeability may be derived from gas bubbles in the upper part of the unit. Transmissivity, obtained from pumping tests, ranges from 68,000 to 488,000 gallons per day per foot. Volume of the saturated part of the aquifer is about 3.5 cubic miles, and the average specific yield probably ranges from 1 to 5 percent. The volume of groundwater in storage is probably within the range of 37-187 billion gallons. This large amount of water should be sufficient to supply the needs of the Nuclear Rocket Development Station for many years. Water at the Nuclear Rocket Development Station is used for public supply, construction, test-cell coolant, exhaust cooling, and thermal shielding during nuclear reactor and engine testing, and washdown. Present (1967) average consumption of water is 520,000 gallons per day--all supplied by one well. This supply well and a standby well have a production capability of 1.6 million gallons per day--adequate for present needs. Water in the welded-tuff aquifer is of the sodium bicarbonate type. Dissolved-solids content of the water in Jackass Flats is in the general range 230 milligrams per liter in the western part to 890 milligrams per liter in the eastern part. Personal communication from the author dated March 16, 1973 relates the following: As the report was written in 1968, the data is not quite up-to-date. Well J-12 was deepended in August 1968 to 1,000 ft and will now produce 1,000 gallons per minute with less than 20 ft of drawdown. Further, when the pump was pulled in 1968, it was found that the water level was the same as in 1952 when the well was drilled, therefore, there is no decrease in storage as indicated in the report. Because the wells have been on stand-by since the National Rocket Development Station has been deactivated, a maximum amount of storage should be anticipated at this time. (Auth)

<303>
Michels, D.E., Dow Chemical Company, Rocky Flats Division, Golden, CO. 1973, April 27

Diagnosis of Plutonium Reentrained in Air. RFP-1927; 16 p.

A method (a posteriori) of combining diverse environmental data has been developed to estimate the absolute amount of plutonium reentrained into the air from contaminated soil. Measured concentrations of plutonium in air and soil, and wind data are used to compute the fraction of the soil inventory which became reentrained during a 14-month period at Rocky Flats Plant. (Auth)

<304>
Michels, D.E., Dow Chemical Company, Rocky Flats Division, Golden, CO. 1972

Plutonium Resuspension from Soil: How Measurable. RFP-1927; CONF-721076-1; Part of Proceedings of the National Industrial Hygiene Association Symposium held in Denver, Colorado, October 5-6, 1972, (24 p.)

During a 14-month period approximately 3 millicuries of plutonium were resuspended by wind from the Rocky Flats strewnfield (120 km2). The estimate is based on diverse data taken routinely. Of the several technical difficulties in making this estimate, the most important concerned the correlations required between different kinds of measurements and the techniques used to interpret numerical data that are broadly distributed. The greatest current need relative to environmental studies concerns how the numbers can be related to concepts of public health in a valid and convincing way. (Auth)

<305>
Not given, National Environmental Research Center, Environmental Surveillance, Las Vegas, NV. 1973, February

Selected Census Information Around the Nevada Test Site. NERC-LV-539-8; 11 p.

The National Environmental Research Center-Las Vegas (NERC-LV), Environmental Protection Agency, conducts a comprehensive off-site radiological safety program in support of nuclear testing at the Nevada Test Site (NTS). To facilitate the planning and management of required surveillance and monitoring operations, and to assess potential and actual population exposures resulting from radioactive releases into the areas beyond the boundaries of the NTS, the NERC-LV collects and maintains census information in the area around the NTS. This census information, which includes the number and distribution of resident adults and children, family milk cows, and Grade A dairy cows located by azimuth and distance within a radius of 450 miles of Control Point 1 at approximately the center of the NTS, 36 degrees 15' N, 116 degrees 04' W is summarized. (Auth)

<306>

<306>
Zalmanzon, Yu.E., and O.A. Chutkin, Scientific Research Institute of Instrument Construction, Moscow, USSR. 1972, July

Distribution of Absorbed Dose from Alpha-Active Aerosol Particles by Tissue Depth. Meditsinskaya Radiologiya, 17(7), 69-72 (Russian)

Calculations of tissue absorbed dose dependence upon the distance from alpha-active isotope aerosol particle considering irregularity of linear losses of alpha radiation along the path and real energetic spectra of aerosol particles were carried out. The calculated results for Pu 239 are presented. It is shown that dose distribution by tissue depth is a highly variable function; this must be considered in assessment of alpha-active aerosol hazards for personnel. (Auth)

<307>
Zalmanzon, Yu.E., and O.A. Chutkin, Union Scientific Research Instrument Engineering Institute, USSR. 1971, July 12

Radiation Absorbed Dose in the Lungs from Radioactive Aerosols. RFP-Trans-130; 10 p.; Meditsinskaya Radiologiya, 17(4), 63-68

The variation in radiation dose in the lungs of personnel depending on the particle size of inhaled radioactive aerosols was studied. Calculations were made for the parameters of the distribution of aerosol particles according to measurements which are within the limits actually existing in practice, using recent international recommendations. Using Pu 239 as an example, it was indicated that with the same concentration of radioactive aerosols, the absorbed dose in the lungs can vary by a factor of several hundred. (Auth)

<308>
Tregubenko, I.P., Akademiya Nauk SSSR, Trudy Instituta Biologii, Ural'skii Filial., Sverdlovsk, USSR. 1966

Experiments on the Effect of Some Substances on the Behavior of Plutonium in the Organism. AEC-tr-7169; Part of Metabolism of Radioisotopes in the Animal Organism, (p. 199-204), 220 p.

A study was made of the effects of different types of colloids as well as of a number of complex-forming substances on the behavior of plutonium in rats. Albino rats received intraperitoneal injections of plutonium citrate in a dose of 1 uCi, and ten to twenty minutes later one of the substances tested was injected. The animals were sacrificed by the fourth day and an assay was made of Pu levels in the tissues by radiometry. It was established that negatively charged colloids of zirconium and yttrium have a pronounced effect on deposition of Pu in the skeleton and soft tissues. Finely dispersed colloid zirconium elicits a significant increase in excretion of plutonium with urine; the larger particled zirconium citrate and particularly yttrium causes a marked increase in deposition of Pu in the liver as well as in the spleen. Of the complex-forming substances, it was found that a reliable decrease in deposition of Pu in the skeleton was induced only by cupferron, which also elicited a visible increase in plutonium content in the spleen. Sodium arsenate doubled deposition of the emitter in the liver. All the other preparations had no effect. Complex-forming substances whose stability constants for the complexes produced are not too high have practically no effect on the behavior of plutonium, even when administered early. (Auth) (PMM)

Tables 1 and 2 show the effects of colloids and complex-forming substances on Pu levels in rat tissues on the 4th day after IP injection.

<309>
Yelkina, N.I., Not given. 1971

Metabolic Processes in the Bone Tissue of Animals Damaged by Plutonium 239. AEC-tr-7387; Part of Moskalev, Yu.I. (Ed.), Remote Aftereffects of Radiation Damage, (p. 406-415), 574 p.

Bone tissue damage by Pu was compared in rabbits, dogs and rats. Plutonium citrate at pH 2 was administered to rabbits IV at 7 and 2 uCi/kg, to dogs IV at 2 uCi/kg and to rats IP at 1.9 uCi/kg. Calcium and phosphorus metabolism were investigated using Ca 45 and P 32. The results show that in the bones of rabbits 3-3.5 months old that were administered 7 uCi/kg of Pu, the Ca and P content was 11-13% higher during the first 30 days than in the controls. There were considerable changes in the activity of enzymes and the quantity of nucleic acids. With a greater dose, the changes in metabolic processes in the bones developed earlier. The greatest impairments were noted in the spongy matter of the bones. The degree of change in metabolism of bone tissue was dependent on the age of the animals at time of entry of the radioelement. Some experimental animals later developed osteosarcomas and the biochemical indices in tumorous tissues were compared with those of similar parts of the bones without tumors. It was shown that osteosarcomas arising under the influence of Pu are characterized by a considerable increase in the content of nucleic acids and the activity of phosphatases and also an increased rate of incorporation of Ca 45 and P 32 in comparison with similar regions of the bones. (PMM)

<310>
Zlobin, V.S., and O.V. Mokanu, Polar Scientific Research Institute of Marine Fish Farming and Oceanography, Murmansk, USSR. 1970

Mechanisms of the Accumulation of Plutonium 239 and Polonium 210 by the Brown Alga ASCOPHYLLUM NODOSUM and Marine Phytoplankton. AEC-tr-7205; Part of Radiobiology, (p. 160-169); Radiobiologiya, 10(4), 584-589

The accumulation of Pu 239 by ASCOPHYLLUM NODOSUM and marine phytoplankton, as well as that of Po 210 by macrophytes under the influence of inhibitors of cellular respiration, was investigated. It was established that Pu and Po exist in seawater in the form of colloidal particles. Sodium cyanide induces uniform suppression of the accumulation of Pu 239 and Po 210 in plant cells, while ammonium chloride briefly stimulates accumulation. It is demonstrated that the accumulation of Pu 239 by marine algae is an active process, and it involves an energy expenditure by the cell. (Auth)

<311>
Beach, S.A., National Radiological Protection Board, Research Division, Harwell, Didcot, Berkshire, England. 1973, January

SEBEACH, A Digital Computer Program for the Estimation of Body Content of Plutonium from Urine Data. Health Physics, 24, 9-16

The digital computer program SEBEACH allows estimation of the retained body content of plutonium from urine data. A function is given which relates the amount of plutonium found in a 24 hr urine sample at a time after intake, to the amount retained in the body. The method is based upon the trend of urine values. Two types of computation are carried out: first, as an upper bound, the calculated trend value is assumed to result from a single intake during the earliest possible period indicated by the urine record; second, the trend value is assumed to result from a constant and continuous intake over the whole exposed period. Two different clearance rates from the lung or wound to the blood are considered. The difficulties encountered in estimating the body content of plutonium are discussed in the light of the method of estimation programmed in SEBEACH. Comparison is made with other digital programs undertaking the same type of computation. A flow chart of the program is included. (Auth) (ST)

<312>
Risik, N.S., Academy of Sciences, Institute of Biology of Southern Seas, Ukranian SSR. 1970

Uranium in Organism of Animals from the Adriatic Sea. Vestnik Zoologii, 4(2), 12-15 (Russian, English Summary)

To study the role of uranium on radioecological processes and its effect as an alpha emitter on living organisms, accumulation coefficients of some animals in the Adriatic Sea were determined. MYTILUS GALLOPROVINCIALIS concentrated uranium by factors of units and tens and ARBACIA sp. by a factor of hundreds. In VERONGIA AEROPHORA microaggregations of uranium were found in which its concentration was higher by a factor of two-thirds as compared with the rest of the organism. (ST)

<313>
Fuqua, P.A., General Electric Company, Hanford Atomic Products Operation, Occupational Medical Operation, Richland, WA. 1965, April

Plutonium Absorption, Evaluation and Treatment. Industrial Medicine and Surgery, 34, 335-337; HW-SA-3730 (Rev.); 3p.

Possible methods of entry of plutonium into the body--wounds, skin contamination, inhalation, and ingestion; evaluation of the amount absorbed; and the most effective method of removal are discussed. The most common known absorption source is from contaminated wounds. These are treated by early excision of the entire wound if possible. DTPA is the most effective agent that binds and mobilizes plutonium for urinary excretion. Some of the most urgent diagnostic and evaluation needs that would facilitate treatment are described. (ST)

<314>
Dougherty, T.F., University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Research in Radiobiology: Annual Report of Work in Progress in the Internal Irradiation Program. CCO-119-248; 400 p.

Progress on work begun in 1950 on the predictive toxicity of radionuclides, particularly plutonium, to man using effects observed in beagle dogs is reported. Studies on Ra 226, Pu 239, Ra 228, Th 228, Sr 90, and Am 241 are partially or fully completed, and work is continuing on Ra 226 and Pu 239 at low dose levels, Cf 249 and Cf 252, and other animals receiving various radionuclides of current interest. Fourteen papers were selected for separate abstracts. (ST)

<315>
Jee, W.S.S., R.B. Dell, D. Kimmel, J.J. O'Toole, and L. Clark, Jr., University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Jee-Miller Detailed Neutron-Induced Autoradiography of Plutonium 239 Bones. CCO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 244-254), 400 p.

Neutron induced autoradiography (NIAR) of bones from beagle dogs injected with as little as 0.0006 uCi of Pu 239/kg body weight is being used to characterize the local deposition of Pu 239 in hard and soft tissues. Undecalcified 7 u thick bone sections are affixed to Lexan film and irradiated with thermal neutrons for about one month. Recent improvements in developing techniques have given reproducible films showing fission fragment tracks upon a bone image. This method allows rapid, accurate localization of the Pu 239 in bones from animals receiving very small amounts of Pu 239. This is a pilot study that will be used to gain information on bone tumor production by radiation. (Auth) (ST)

<316>

<316>
Bruenger, F.W., B.J. Grube, D.R. Atherton, and W. Stevens, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

The Early Subcellular Distribution of Curium in Canine Livers. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 186-200), 400 p.

Previous studies of the subcellular distribution of Pu 239, Am 241 and Cf 249-252 in canine livers were extended to include Cm 243-244. Beagles were injected with 3 uCi of the nuclide in citrate solution of pH 3.5. Following injection, liver specimens were obtained at 0.092 and 47 days by surgical liver biopsy and at 6, 13 and 30 days at autopsy. As observed with other nuclides, curium in the liver was first associated with soluble liver proteins, mainly ferritin, and was found later in increasing concentrations in subcellular organelles. The highest concentration was found in the crude mitochondrial fraction and somewhat less in the crude lysosomal fraction. A considerable part of the nuclide remained in the cytosol. Sucrose density gradients showed a variable relation between the lysosomal enzyme marker activity and the nuclide concentration. Heavy subcellular organelles other than lysosomes (probably mitochondria) must, therefore, be involved in the binding of the nuclide. With respect to liver retention and subcellular distribution, curium occupies a position between Am(+3) and Cf(+3), but resembles Am(+3) more closely than Cf(+3). (Auth)

<317>
Dougherty, T.F., University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Injection Tables. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 9-109), 400 p.

Injection tables for adult beagles injected with one of the radionuclides, Ra 226, Pu 239, Ra 228, Th 228, Sr 90, and Am 241, in a single intravenous injection at 17 months of age, are given. Injection level 1 is the basis of the scheme and is 10 times the maximum permissible concentration of Ra 226 in man. Actual injection levels differ, but the desired retained activities are the same for all radionuclides except Sr 90, in which case they are greater by a factor of 10. Present measurements indicate that: average Ra 226 retention is 0.25 at about 271 days; average Pu 239 retention is 0.90 at about 6 days; average Ra 228 retention is 0.25 at about 214 days; average Th 228 retention is 0.90 at about 6 days; average Sr 90 retention is 0.25 at about 134 days; average Am 241 retention is 0.90 at about 6 days; average Cf 249 retention is 0.90 at about 1 day; average Cf 252 retention is 0.90 at about 1 day; and average Cm 243-244 retention is 0.90 at about 1 day. The injection tables include the calculated average dose in rads to the skeleton at death. (ST)

Tables 1 and 2 list the toxicity (animals maintained until sacrifice becomes a clinical necessity) and test animals (animals sacrificed as needed for special studies), respectively.

<318>
Atherton, D.R., and B.J. Stover, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Retention of Plutonium 239 in the Ulna of the Beagle Compared with Retention in the Humerus and the Third Lumbar Vertebra. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 299-243), 400 p.

The initial deposition of Pu 239 and the rate of decrease in retention are both higher in bones which have a relatively greater amount of trabecular bone. For this reason the ulna, which has relatively less trabecular bone, was chosen for an extensive comparison with the humerus and third lumbar vertebra. These three bones were obtained from 40 beagles at dose levels from 0.00064 to 0.095 uCi Pu 239/kg (P0.1 to P2) and at times from 35 to 4549 days after injection. Analyses showed that the initial concentration of Pu 239 in the ulna was about 25% that in the other two bones. Retention of Pu 239 in the ulna was approximately constant over the 12.5 year period. In contrast, retention in both the humerus and third lumbar vertebra decreased during the first several years and then approached approximately constant values. A kinetic model for the observed retention has been formulated. (Auth)

<319>
Bruenger, F.W., B.J. Grube, D.R. Atherton, and W. Stevens, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Binding of Americium 241 by Bone Protein. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 213-228), 400 p.

A study to characterize some details involved in the binding of actinide elements to skeletal tissue has been initiated. The present studies have been limited to Am 241 as a model representative of the actinide series. Experiments were carried out first with mature skeletal tissue obtained from a beagle which had been injected with Am 241. A protein fraction of high but as yet undetermined molecular weight which was associated with Am 241 was extracted from the whole bone homogenate. Extracts were also prepared from embryonic or neonatal skeletal tissue of rats and beagles. These extracts were incubated in vitro with Am 241 and Sr 90. These experiments showed that beginning with the onset of ossification, a protein with a molecular weight of approximately 500,000 emerged which had a high affinity for Am 241. With increasing time after conception, another protein of very high molecular weight emerged to which the nuclide had an affinity which was even higher than the affinity for the protein of molecular weight of approximatley 500,000. Sr 90 exhibited a much lower affinity for both of these proteins. Qualitative similarities existed between the uptake of Am 241 and Sr 90 by both of these proteins. The protein with a molecular weight of approximately 500,000 and the very high molecular weight protein both gave positive tests for glycoprotein and sialic acid. (Auth)

<320>
Casey, H.W., R.O. McClellan, W.J. Clarke, and L.K. Bustad, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1973, January 15

Iodine 131 Labeled Rose Bengal Dye Blood Clearance as a Liver Function Test in Sheep. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 174-177), 269 p.

Blood clearance of I 131 labeled rose bengal dye was used to measure liver function in sheep. Two hepatotoxic agents, CCl sub 4 and Np 237, were used to determine the sensitivity of the test. Clearance rates differed only slightly for sheep of different age groups and in those placed in different body positions. (Auth)

<321>
Casey, H.W., R.O. McClellan, W.J. Clarke, and L.K. Bustad, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Acute Toxicity of Neptunium 237 and Its Relationship to Liver Function in Sheep. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 31-35), 269 p.

Deaths with lesions resembling heavy metal poisoning were observed in all sheep intravenously administered 12 mg of Np 237/kg body weight and in four out of five animals that received 6 mg/kg. Liver function was impaired in animals which received doses as low as 1.5 mg (1 uCi) per kg body weight. The LD 50 appeared to be slightly less than 6 mg/kg of body weight. (Auth)

<322>
Dougherty, J.H., and L.A. Woodbury, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Hematologic Changes Following Plutonium 239 Injection in Adult St. Bernards and Immature Beagles. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 317-335), 400 p.

The hematologic changes following a single intravenous injection of Pu 239 in young adult St. Bernards and 3 month old beagles are reported for the first year following injection. The amounts of Pu 239 injected ranged from 0.005 to 0.3 uCi/kg in the 12 St. Bernards and from 0.3 to 3.0 uCi/kg in the 20 beagle pups. The dose levels selected were comparable to those in the adult beagles injected in our laboratory. There were no significant alterations in erythrocytes in any of the dose levels in either the St. Bernards or beagle pups. A dose-dependent leukopenia was found in St. Bernards receiving the two highest dose levels (0.1 and 0.3 uCi/kg) which was sustained over the first year. The pattern and degree of cell depression was quite similar to that found in adult beagles. The beagle pups given the highest dose level (3.0 uCi/kg) had a leukopenia and lymphopenia which was not as marked as that found in adult beagles receiving the same amount of Pu 239. The increase in skeletal mass of the pups during growth, a more rapid burial of Pu 239 within bone volume, and perhaps, a greater capacity of the immature hematopoietic system to recover may be possible reasons for this difference in hematologic toxicity of the injected plutonium. (Auth)

<323>

<323>
Dougherty, T.F., University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1962

Incidence of Bone Cancer in Internally Irradiated Dogs. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at The Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 47-61), 529 p.

As part of a study to compare the toxicity of internally deposited Ra 226, Pu 239, Ra 228, Th 228, and Sr 90, the incidence of bone tumors in beagles given a single intravenous injection was studied. Among the various types of cancers produced by these radionuclides, bone cancer (osteosarcoma) appeared to be most common. Injected doses ranged from 1.1 to 10 uCi/kg for Ra 226 and Ra 228, 0.096 to 2.8 uCi/kg for Pu 239, 0.096 to 0.90 uCi/kg for Th 228, and 100 uCi/kg for Sr 90. At the same radionuclide dose level there were differences in survival times and in the absorbed skeletal dose. Survival time decreased with increasing dose. The earliest incidence of cancer occurred with Th 228. (ST)

Table 1 lists the incidence of osteosarcomas, number of days from injection to death, and the average absorbed skeletal dose of adult beagles injected with radium, plutonium, mesothorium, radiothorium and strontium.

<324>
Christensen, W.R., C.C. Smith, C.E. Rehfeld, and G.N. Taylor, University of Utah, College of Medicine, Department of Radiology, Salt Lake City, UT. 1962

Radiographic Changes in Internally Irradiated Dogs. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at The Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 63-77), 529 p.

Diagnostic criteria established as evidence of radionuclide injury to skeletal structures of dogs receiving intravenous injections of radium (0.34 to 10 uCi/kg), thorium (0.096 to 0.90 uCi/kg), and plutonium (0.096 to 2.8 uCi/kg) were: structural changes in the mandible, destructive changes in the teeth, pathological fractures--with and without healing, distortion of cortex of long bones, disturbance of metaphyseal trabeculation, osteolytic rarefaction, rib end demarcation, aseptic necrosis, and tumor formation. Alternations in the mandible were the earliest detectable and most consistently visualized evidences of injury. Earliest changes occurred in animals receiving the highest doses. There was no specificity or consistency in the skeletal changes produced and it was impossible to identify a specific nuclide on the basis of radiological evidence. Th 228 and Ra 228 appeared to produce pathological changes somewhat more rapidly than Pu 239 and Ra 226. Osteolytic resorption and irregular bone overgrowth appeared to follow vascular injury. Tumor incidence at high levels of toxicity was low because of early death from general radiation injury. Experimental results are still accumulating. (ST)

<325>
Dougherty, J.H., University of Utah, College of Medicine, Division of Radiobiology, Departments of Pathology and Anatomy, Salt Lake City, UT. 1962

Some Hematological Responses to Internal Irradiation in the Beagle. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at The Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 79-93), 529 p.

The chronic hematological changes in beagles receiving intermediate and high level doses of Pu 239 (0.30 to 2.8 uCi/kg), Ra 226 (1.1 to 10 uCi/kg), Ra 228 (1.1 to 10 uCi/kg), Th 228 (0.30 to 2.8 uCi/kg), and Sr 90 (11 to 100 uCi/kg) were summarized. Dose levels were chosen so that retained amounts of radioactivity were closely related. A comparison of initial effects and recovery rate of blood cells indicated that Th 228 was the most toxic radionuclide. In general, there was a dose response effect on blood cells and particularly on polymorphonuclear neutrophils where the greatest initial effect was found. There was a lymphopenia in all dogs receiving high dose levels. Although there was a decrease in red cells and a reduced red cell volume with all nuclides, the pattern of change and dose level where changes occurred differed among them. Dogs receiving high level doses of plutonium and strontium showed transient anemia during the first months with plutonium dogs again developing progressive anemia after two years as they became terminal. The effects of metabolism of the radionuclides and its location in bone and soft tissues were discussed. A dose level effect on bone marrow myeloid to erythroid cell ratio was demonstrated. (ST)

<326>
Hess, J., and W.S.S. Jee, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Plutonium 239 and the Stimulated Peridontal Ligament Cells. COO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 308-316), 400 p.

Following a single intraperitoneal injection of 3.0 uCi Pu 239/kg body weight, the quantity of Pu 239 on the alveolar bone surface mesial to the periodontal ligament (PDL) of the maxillary first molar of male Sprague-Dawley rats increased from 1 to 9 days, then decreased by 15 days. At 15 days post-injection, the amount continued to decrease for 22 hours in both an orthodonticallystimulated area and a nonstimulated area in the opposite jaw of the same animal. However, the amount continued to fall in the stimulated PDL until 48 hours poststimulation while the nonstimulated side remained constant from 22 to 48 hours. The labeling index of the stimulated PDL fibroblasts of control and Pu 239 injected female Sprague-Dawley rats rose to a peak of 12% at both 22 and 27 hours poststimulation. Regional analysis of labeling index divided the PDL fibroblasts into "at risk" and "safe" groups. The "at risk" cells showed a labeling index of 10% at 22 hours compared to the cells of the same area in a control animal whose labeling index was 22%. The "safe" cells showed a labeling index of 15% vs a labeling index of 10% in corresponding controls. In stimulated controls, the number of osteoblasts increased by three-fold after 48 hours, while the number of osteoclasts decreased to zero. In stimulated Pu 239 treated animals, the number of osteoblasts doubled in 48 hours, while the number of osteoclasts doubled also. (Auth)

<327>
Kornberg, H.A. (Ed.), and E.G. Swezea (Ed.), General Electric Company, Hanford Atomic Products Operation, Biology Labcratory, Richland, WA. 1963, January 15

Hanford Biology Research Annual Report for 1962. HW-76000; 269 p.

Forty-three papers were included in the Hanford Biology Research Annual Report for 1962. Major topics covered were the toxicity and metabolism of radioelements including transuranium and rare earth elements, radioiodine, strontium, other elements, and inhalation studies; modification of radioelement deposition and radiation response; animal and cellular physiology; plant physiology; and ecology. Thirteen papers were selected for separate abstracts. (ST)

<328>
Dougherty, T.F., University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1962

Study of the Long Term Biological Effects of Internal Irradiation in Adult Beagles. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at The Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 3-6), 529 p.

In 1952 the Radiobiology Division of the Department of Anatomy, University of Utah, began a comparative study of the biological effects in adult beagles of the internal irradiation resulting from five different radionuclides, Ra 226, Pu 239, Ra 228, Th 228, and Sr 90. Eighteen month old beagles received a single intravenous injection of one radionuclide at a specific dose level related to the human maximum permissible level for Ra 226. Injected doses were selected so that the desired retained doses, with the exception of Sr 90, would be the same. Injected dose levels, designated 1 to 5, ranged from 0.057 to 10 uCi/kg for Ra 226 and Ra 228, 0.016 to 2.8 uCi/kg for Pu 239 and Th 228, and 0.57 to 100 uCi/kg for Sr 90. Incomplete results indicated that average Ra 226 retention is 0.25 after 330 days, average Pu 239 retention is 0.90 after 6 days, average Ra 228 retention is 0.25 after 235 days, average Th 228 retention is 0.90 after 6 days, and average Sr 90 retention is 0.25 after 150 days. (ST)

<329>
Mahlum, D.D., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1965, January

Chemical Carcinogens and Radionuclide Metabolism. BNWL-122; Part of Thompson, R.C. and Woods, S.W. (Eds.), Hanford Biology Research Annual Report for 1964, (p. 91-93), 216 p.

Female rats were injected intravenously with Ce 144-Pr 144 or Pu 238. They were then fed a diet containing hepatocarcinogens, or a control diet. At the end of the experimental period (11 months), the animals were killed and livers and femurs analyzed. The liver carcinogens, dimethylaminoazobenzene and diacetylaminofluorene were shown to increase the retention of Ce 144-Pr 144 and Pu 238 by the liver. These carcinogens appear to act by decreasing biliary excretion of the radionuclides. (Auth) (FMM)

<330>

<330>
Galibin, G.P., Not given. 1969

Distribution of Uranium in the Body of Rats Under a Single Administration of Ammonium Diuranate to the Stomach. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radioactive Isotopes and the Body, (p. 147-152), 458 p.

Experiments were conducted on male rats with an initial weight of 150 g. Ammonium diuranate in a dose of 120 mg/kg, which was 18 mg/rat was administered to the rats in the stomach using a metal probe. The results show that uranium is not retained in more than 0.5% of the administered quantity (0.48%) under a single administration of ammonium diuranate in the stomach of rats. The half-life for the elimination of uranium for tissues of the gastrointestinal tract is short, 1 day, and several days for the liver, kidneys, and spleen. Besides in the bone tissue, the greatest quantity of uranium is retained in the kidneys. Uranium accumulates in the bones up to 4 days and then is slowly eliminated with a half-life of about 150-200 days. (Auth) (PHM)

Table 2 shows strontium concentration in 1 g of tissue of rats after administration to the stomach. Table 1 shows uranium content in organs of rats after administration to the stomach.

<331>
Semenov, D.I., Not given. 1966

Behavior of Inseparated Solution of Uranium Fission Products in the Animal Organism. AEC-tr-7169; Part of Metabolism of Radioisotopes in the Animal Organism, (p. 15-32), 220 p.

An aged (2.5 year storage) solution of uranium fission products, with a pH of 3 was administered to albino rats in a dosage of 2.5 uCi/animal. It was shown that in the case of peroral administration, about 11% of the emitters contained in the solution was absorbed. Cesium making up 5% of the mixture was absorbed in its entirety, the radioactive pair of strontium 90 --yttrium 90 constituting 35% of the mixture was 25% absorbed, and cerium and ruthenium, constituting 55% and 5% of the mixture respectively, were practically not absorbed. In the case of intravenous administration of the mixture, most was deposited in the bones (30%) and in the liver (21%). In the bones there was mainly strontium-yttrium and cerium, in the liver--cerium, and in the muscles almost exclusively cesium. Excretion of the mixture with urine and feces was rather rapid, since about 75% of incorporated radioactivity left the organism by the 120th day. A comparison of the data obtained with the results of experiments on incorporation of individual radioisotopes indicated that in the case of both intravenous and peroral administration of unseparated mixture of uranium fission products each of the emitters behaved in the organism quite independently, regardless of the presence of other emitters. The animals age had a marked effect on the behavior of the solution, thus uranium fission products accumulated much more in the bones of young animals and less in the liver and kidneys. (Auth) (PHM)

<332>
Wallace, A., Soil Science and Agricultural Engineering, Riverside, CA 92507; University of California, Laboratory of Nuclear Medicine and Radiation Biology, Los Angeles, CA. 1972, May 15; 1972, December

Effect of Soil pH and Chelating Agent (DTPA) on Uptake by and Distribution of Americium 241 in Plant Parts of Bush Beans. Radiation Botany, 12(6), 433-435; UCLA-34-P-51-35; Part of Wallace, A., Annual Progress Report, Behavior of Certain Synthetic Chelating Agents in Biological Soil Systems, (p. 42-46), 99p.

Bush bean (PHASEOLUS VULGARIS L. var. Improved Tendergreen) plants were grown with and without the chelating agent diethylenetriaminepentaacetate (DTPA) in Yolo loam soil which had been amended to give a range of soil pH values. A level of 1.68 uCi Am 241 had been uniformly mixed with each 500 g quantity of soil. Highest amounts of Am 241 and highest leaf-stem ratios for the Am 241 were found in plant parts at soil pH around 7.7 with the DTPA. The results are interpreted as chelated Am 241 not only being available to the plants especially at pH 7.7 but also the Am 241 being transported through the plants as the metal chelate. (Auth)

Table 1 shows the Am 241 content of roots, stems and leaves of plants grown in contaminated soil in a glasshouse.

<333>
Smith, V.H., M.T. Karagianes, and C.R. Watson, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Gastrointestinal Passage Time and Absorption of Plutonium 238 PuO_2 and Plutonium 239 PuO_2. BNWL-714; Part of Thompson, R.C. et al (Eds.) Annual Report for 1967, (p. 412-415), 253 p.

Both Pu 238 PuO_2 and Pu 239 PuO_2 microspheres were delayed in their passage through the intestinal tract of miniature swine. Times for 50 or 99% elimination of the two radionuclides were similar, but the total excretion pattern was quite different. Absorption varied widely among different animals but was generally greater for Pu 239 than for Pu 238. The maximum figures obtained would suggest that no more than one millionth of the ingested material would be absorbed and deposited in liver and skeleton. (Auth) (PHM)

Table 1 shows Pu distribution in liver, kidneys and skeleton of miniature swine 14 days after the ingestion of Pu 239 PuO_2 microspheres.

<334>
Yuile, C.L., P.R. Gibb, and P.E. Morrow, University of Rochester, School of Medicine and Dentistry, Department of Radiation Biology and Biophysics, Rochester, NY. 1970

Dose Related Local and Systemic Effects of Inhaled Plutonium 238 and Plutonium 239 Dioxide in Dogs. Radiation Research, 44, 821-834

Pulmonary and lymph node lesions and leukopenia which developed in dogs after plutonium 239 and 238 dioxide inhalation, have been related to various radiation dose parameters, over a wide range of postexposure time intervals (16-468 days). The degree of radiation pathology in lungs was found to increase with increasing accumulated alpha doses above 1500-2000 rads and up to about 15,000 rads. In general no damage to tracheobronchial lymph nodes was evident unless radiation changes were also present in the lungs. The degree and extent of the lymph node changes did not correlate well with estimates of total lymph node dose, but there was a relatively good relationship with dose rate (rads per day) to the lymph nodes adjacent to trachea and main bronchi. Radiation changes in both types of tissue, and due to both plutonium isotopes, were unrelated to length of postexposure period except for increasing fibrosis with time. In contrast, the leukopenia which developed was related to mean, postexposure, fixed tissue burdens but not to rad dose except in experiments of similar duration. The findings indicate that the lung lesions reflect total accumulated pulmonary doses while lymph nodes are more sensitive to dose rate. It is suggested that the leukopenia developed as a result of irradiation of circulating cells by localized deposits of plutonium in lymph nodes and probably lungs, rather than to depression of hematopoiesis and/or lymphopoiesis. (Auth)

See also Report UR-49-1242.

<335>
Watson, G.M., Australian Atomic Energy Commission, Sydney, Australia. 1972

Environmental Monitoring Program at the AAEC Research Establishment, Lucas Heights. CONF-710901; A/CONF.49/P-300; STI/PUB/300; Part of Proceedings of the 4th International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971, Vol. II, (p. 341-353), 766 p.

The evolution, over the past ten years, of effluent discharge formulas, and the associated environmental monitoring at the Australia Atomic Energy Commission's Research Establishment near Sydney are described. The Establishment has a staff of 1200, and its major research facility is a 10 MW(th) heavy-water moderated and cooled materials testing reactor, which is also used for extensive radioisotope production. Possible sources of environmental contamination are (a) atmospheric, from isotope production facilities and reactor tritium, (b) estuarine, from the discharge of low-level liquid effluent to a tidal stream, and (c) leaching, from a burial ground for low-level solid wastes. Discharge authorizations derive from critical group studies, with oyster consumption being the most significant pathway. Expressed as a fraction of ICRP derived limits, the levels of environmental activity found are trivial. (Auth)

Table 5 shows possible doses to members of the local population as a result of exposure to measured concentrations.

<336>
Wheeler, H., B.L. Baker, and P. Hanchey, University of Kentucky, Department of Plant Pathology, Lexington, KY; Colorado State University, Department of Botany and Plant Pathology, Fort Collins, CO. 1972, September

Pinocytosis in Root Cap Cells Exposed to Uranyl Salts. American Journal of Botany, 59(8), 858-868

In cap cells of intact plant roots exposed to 1mM uranyl for 30 min or less, uranyl crystals were found only in cell walls and in secretory products which had been extruded from the protoplast. In roots exposed for 10-20 hr to 0.1 mM uranyl, packets of uranyl crystals bound to secretory products were found within the protoplasts of those exterior cells which contained accumulations of secretory products between the cell wall and protoplast. Although the evidence indicated that these packets of crystals entered the protoplast pinocytotically, results with these specialized exterior cells did not apply to the vast majority of root cap cells in which, after prolonged exposure to 0.1 mM uranyl, crystals were concentrated in vacuoles. In roots exposed to 1 or 5 mM uranyl for 1 hr, the plasmalemma of interior cap cells was much thicker (13.1 nm) than normal (8.2 nm), and many invaginations and vesicular structures were found near the protoplast surface. Crystals were confined to cell walls except for a few found in vesicles with thickened membranes. Serial sections indicated that most vesicular structures with thickened membranes were in contact with the cell wall, but a few, including some which contained uranyl crystals, were within the protoplast. These results provide evidence of pinocytotic activity in intact plant cells exposed to a toxic heavy metal. (Auth)

<337>
Wheeler, H., and P. Hanchey, University of Kentucky, Department of Pathology, Lexington, KY; Colorado State University, Department of Botany and Plant Pathology, Fort Collins, CO. 1971, January 8

Pinocytosis and Membrane Dilation in Uranyl-Treated Plant Roots. Science, 171, 68-71

Electron-dense crystals formed in plant roots exposed to uranyl acetate have been used to identify binding sites and to follow the pinocytotic uptake of uranyl in the oat rootcap. Before uranyl enters the protoplast, the plasmalemma is greatly dilated. After uranyl is sequestered in vacuoles, the tonoplast is similarly dilated. (Auth)

<338>

<338>
Kalistratova, V.S., G.S. Oksentyuk, and V.P. Kryuk, Not given. 1971

Change in Metabolism at Remote Times After Exposure to Radioactive Americium. AEC-tr-7387; Part of Moskalev, Yu.I. (Ed.), Remote Aftereffects of Radiation Damage, (p. 441-446), 574 p.

Several metabolic indices were studied in dogs receiving one intravenous injection of Am 241, in doses of 2.5 and 1 uCi/kg of weight. The results show a high effectiveness of the biological effect of americium, accompanied by impairments in fat and carbohydrate metabolism, which are characterized by hyperglycemia, hypercholesteremia, beta-lipoproteinemia, hyperlipemia, hypolacticacidemia, and a change in the activity of enzymes (alkaline phosphatase and diatase). All the changes had a wavelike character; periods of relative compensation were replaced by well-expressed pathological changes, evidence of a chronic course of the process. Only on the basis of individual indices was it possible to detect a dependence of effect on dose; this pertains primarily to enzymes. The impairments in metabolism caused by exposure to radioactive americium were not restored up to the 17th month of the investigation. (FMM)

<339>
Rudasheva, N.P., Ministry of Public Health, Institute of Biophysics, Moscow, USSR. 1967

The Dynamics of Changes of the Morphological Composition of the Peripheral Blood in Rats, Following Inhalation of Plutonium 239. AEC-tr-6891; Part of Radiobiology, (p. 169-177), 275 p.; Radiobiologiya, 7(6), 900-905

Female Wistar rats weighing 150-180 g received 0.0047-1.028 uCi of Pu 239 by inhalation of plutonium citrate and ammonium plutonium pentacarbonate aerosols. At 1.028 and 0.33 uCi of Pu 239 in plutonium citrate, moderate changes were observed in the blood system. With 1.028 uCi the number of leukocytes declined 44%; with 0.33 uCi moderate leukopenia (75-60% of the control) was maintained during the life of the rats (480 days). Mild leukopenia was caused by 0.72 uCi of Pu 239 in ammonium plutonium pentacarbonate; the number of leukocytes was reduced to 83-87% of the control. After inhalation of the minimum quantities present in the lungs (0.0096-0.058 uCi of Pu citrate and .0047--0.060 uCi of ammonium plutonium pentacarbonate) leukocytosis with neutrophilesis and lymphocytosis was observed in the rats. (Auth)

<340>
Sanders, C.L., and W.J. Bair, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Effect of DTPA and Calcium on Intraperitoneally Injected Plutonium 239 PuO2 Particles. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 6.17-6.19), 253 p.

Female rats were given intraperitoneal injections of 1.4 uCi Pu 239 PuO2 (count median diameter, 0.12 microns), with or without accompanying intraperitoneal injections of CaCl2 2H2O, MgCl2 6H2O, or DTPA. Smears of saline washes from the peritoneal cavity were evaluated microscopically and autoradiographically at intervals following injection. It was shown that phagocytosis of PuO2 particles and uptake by the peritoneal lymphatics were inhibited by DTPA and stimulated by calcium. It is suggested that the inhibitory action of DTPA is due to its chelation of calcium, and that the action of calcium in promoting phagocytosis of plutonium particles may be related to the known role of calcium ion in fibrin formation since the administration of fibrin also stimulated the uptake of plutonium by the peritoneal lymphatics. (FMM)

<341>
Korkisch, J., and I. Steffan, Analytisches Institut der Universitat Wien, Abteilung: Rohmaterialanalyse Nukleaver Brennstoffe, 1090 Wien, Wahringerstrabe 38, Vienna, Austria. 1973

Determination of Uranium in Urine Specimens Following their Separation through Anion Exchange. Mikrochimica Acta, 1973(2), 273-278 (German)

A separation method that is generally applicable for uranium in the analysis of urine specimens is described. This is based on the adsorption of the uranium on the strongly basic anion exchanger Dowex 1, X8 from human urine that has been strongly acidified with hydrochloric acid, whereby most of the organic components, phosphoric acid and most mineral urine components are removed. Thus it becomes possible to separate the uranium compounds rapidly and simply without prior evaporation of the urine and destruction of the organic compounds. If need be, the foreign ions that are adsorbed along with the uranium, such as iron and also adsorbed urine coloring materials, are removed through subsequent washing of the resin with a mixture of 50 volume percent tetrahydrofurane, 40 volume percent methylglycol and 10 volume percent 6 N hydrochloric acid, and the uranium is eluted with 1 N hydrochloric acid. The determination of the uranium in the eluate can then be conducted without interference by the fluorometric method. (Auth)

<342>
Dilley, J.V., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Heterophile Antibody Formation in Rats and Beagles After Plutonium 239 PuO2 Inhalation. BNWL-714; Part of Thompson, R.C. et al, (Eds.), Annual Report for 1967, (p. 3.17-3.20) 253 p.

Female rats were exposed to an aerosol of Pu 239 PuO2. They were injected with 10(E+6) sheep red cells, sacrificed a week later and blood was taken for cell counts, antibody titers, serum electrophoresis and Pu 239 analysis of lung tissues. Heterophile antibodies were measured in beagle dogs that showed respiratory distress after inhaling Pu 238 PuO2. The results show that the ability of rats and beagle dogs to form heterophile antibodies against sheep red blood cells was impaired following inhalation of Pu 239 PuO2 and Pu 238 PuO2. Impaired antibody formation occurred in rats prior to the onset of lymphopenia. This suggests that those lymphoid cells concerned with antibody formation may be the most sensitive to radiation damage. (Auth) (FMM)

<343>
Cable, J.W., B.J. McClanahan, V.G. Horstman, D.H. Wood, and L.K. Dustad, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Effects of Plutonium in Skin and Its Removal. HW-76000; Part of Romberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 149-155), 269 p.

One to two years after swine were intradermally injected with 0.0016 to 5 uCi of Pu 239, scabs and indurated areas characterized many of the sites injected with 0.04 uCi or more. Lesions caused by Pu 238 were less severe than those caused by Pu 239 and sites injected with 0.06 uCi Np 237 showed no visible lesions. Within one week after intradermal injection of 1 uCi Pu 239, regional lymph nodes contained up to 12% of the injected dose. Na3 Ca DTPA increased urinary excretion of Pu and reduced tissue deposition, but did not increase translocation of subcutaneously injected Pu. Surgical excision removed most of the Pu from the injection site. (Auth) (ST)

The distribution of Pu 239 in six tissues, one and seven days after intradermal injection of 1 uCi, is shown in Table 3.

<344>
Foreman, H., Los Alamos Scientific Laboratory, Los Alamos, NM. 1956, August

Clinical Experiences in Removal of Radioelements from the Body. ANL-5584; Part of Rosenthal, M.W. (Ed.), Therapy of Radioelement Poisoning, Transcription of a Meeting on Experimental and Clinical Approaches to the Treatment of Poisoning by Radioactive Substances held October 20-21, 1955, (p. 12-22), 175 p.

In three separate accidents at Los Alamos Scientific Laboratory, personnel accumulated a body burden of plutonium or other actinides in sufficient amounts to warrant EDTA treatment to hasten excretion of these radioelements. In all cases workers were immediately scrubbed and wounds, if present, were excised. Urinary excretion of radionuclides increased sharply with Ca EDTA treatment and decreased sharply when treatment was stopped. Body burdens were reduced by 25 and 90% in two of the cases. It was found that continuous high level doses of Ca EDTA produced kidney damage in the form of tubular nephrosis. This is a reversible lesion. It was concluded that the drug should be given in intermittent doses and daily urine analyses should be done on patients. (ST)

<345>
Eve, I.S., United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Health and Safety Branch, Radiological Protection Division, Harwell, Berkshire, England. 1964, February

An Outline of the Metabolism of Inhaled and Ingested Insoluble Radionuclides. Part of Proceedings of a Symposium on the Metabolism of Biologically Important Radionuclides held January 25, 1963. Published in British Journal of Radiology, 37(434), 115-120

The fate of insoluble radionuclides after inhalation is reviewed, with particular reference to the human case. The influence of deposition, clearance and translocation of particles in the lung is described. The clearance of radioactive particles from the lung by ciliary action leads to irradiation of the gastrointestinal tract, and this is also briefly discussed. (Auth)

<346>
Healy, J.W., General Electric Company, Hanford Laboratories, Richland, WA. 1957, September

Estimation of Plutonium Lung Burden by Urine Analysis. American Industrial Hygiene Quarterly, 18(1), 261-266

Inhaled insoluble plutonium compounds in the lung may be regarded as a pool of material isolated from the normal metabolism of the body but continually being transferred to the blood stream at a given rate over a period of time. A model is proposed that permits estimation by urine analysis of the quantity of material retained in the lung following initial clearance. Transfer to the gastrointestinal tract by ciliary action is about 10% of that removed to the blood stream. The equations derived should satisfy any condition wherein a slightly soluble compound exists as a pool in the body with slow transfer to the blood stream. (ST)

<347>

<347>
Ballou, J.E., General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Excretion of Plutonium Into the Perfused Rat Intestine. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 18-21), 269 p.

Starved adult female rats were catheterized to permit separate perfusion of the duodenum, jejunum, and ileum. Following injection of Pu citrate into the tail vein, perfusates were collected for one hour. Plutonium was excreted into the duodenum to a greater extent than into other segments of the small intestine and the highest level of excretion occurred 30 to 40 minutes after injection. Following DTPA treatment, Pu increased twenty fold in the duodenum compared to relatively small increases in the remainder of the small intestine. The significance of bile as a source of Pu in the duodenum was discussed. (Auth) (ST)

<348>
Bair, W.J., and R.W. Perkins, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Plutonium-Americium Ratios in Dogs After Inhalation of Plutonium 239 PuO2. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 312-314), 253 p.

The relative retention, translocation, and excretion of plutonium and americium were studied in dogs that inhaled Pu 239 aerosols containing Am 241 present as a contaminant. In dogs that inhaled the oxide prepared by heating the metal to 450 degrees C, there was a slightly increased Pu 239-Am 241 ratio in the lungs and the lymph nodes, suggesting a relatively greater clearance of Am 241. Dogs that inhaled Pu 239 Pu(NO3)4 showed an increased Pu 239-Am 241 ratio in lungs and lymph nodes and a decreased ratio in liver relative to the aerosol inhaled. Data obtained at much longer times following inhalation of Pu 239 PuO2 prepared by calcining the oxalate at 350 degrees C, show that the Pu 239-Am 241 ratios in the tissues were not greatly different from those in the inhaled aerosol. There is little indication that Pu 239 and Am 241 are significantly separated in the body after inhalation of PuO2 containing trace amounts of Am 241. However, since Am 241 was clearly translocated to the liver more rapidly than Pu 239 after inhalation of Pu(NO3)4, it cannot be concluded that americium is a valid tracer for Pu in all cases. (Auth) (PMM)

<349>
Stuart, B.O., and Y.M. Jones, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

In Vivo Separation of Uranium and Thorium After Inhalation of Uranium Ore by Beagles. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 323-334), 253 p.

Four beagle dogs were exposed to uranium ore dust aerosols (approximately 1 mg/liter, 26% U3O8) for 8 days. Two animals were sacrificed at 13 and 16 days following the last exposures and representative tissue and excreta samples were analyzed for U 238, Th 230 and Po 210. The results showed separation of U 238, Th 230, and Po 210 in the lungs, tracheobronchial lymph nodes, liver, kidneys, spleen, and urine and suggest that in vivo solubilization of uranium was greater than that of Th 230 and Po 210. (PMM)

Table 1 shows distribution of uranium 2 weeks after inhalation of uranium ore dust by beagle dogs. Table 2 shows concentrations of U 238, Th 230 and Po 210 in organs of beagle dogs 2 weeks after inhalation of uranium ore dust.

<350>
Semenov, D.I., and N.D. Borisova, Not given. 1966

Comparative Distribution of Aged Unseparated Solution of Uranium Fission Products in Dogs, Rabbits, Guinea Pigs and Rats. AEC-tr-7169; Part of Metabolism of Radioisotopes in the Animal Organism, (p. 33-54), 220p.

An aged unseparated solution of uranium fission products was administered intraperitoneally to dogs, rabbits, guinea pigs and rats. The solution contained 55-60% Ce 144-Pr 144, 25-30% Sr 90-Y 90, 5-10% Cs 137, about 5% Ru 106, and a significant quantity of inert admixtures. The animals were sacrificed at different intervals following administration of the solution, and radioactivity in the organs was analyzed. The results show that there was incomplete and uneven absorption of the components of the solution. While cesium, strontium and, to some extent, yttrium were well absorbed from the abdominal cavity, cerium was only partially absorbed. There was no appreciable difference in distribution of the unseparated solution in the organs in different species of animals. Dogs showed higher radioactivity in the bones and slower excretion from the liver. The fastest excretion of emitters from the organism in urine and feces was observed in rabbits, rats and guinea pigs, and it was much slower in dogs. There were rather substantial differences in radioactivity content, mainly in the liver and bones, in different breeds of dogs. Individual emitters behave very independently of one another in the organism of different animals, when incorporated in the form of an unseparated solution. (Auth) (PMM)

<351>
Stover, B.J., D.R. Atherton, and C.W. Mays, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1962

Studies of the Retention and Distribution of Radium 226, Plutonium 239, Radium 228 (Mesothorium I) Thorium 228 (Radiothorium) and Strontium 90 in Adult Beagles. Part of Dougherty, T.F., et al (Eds.), Proceedings of a Symposium on Some Aspects of Internal Irradiation held at the Homestead, Heber, Utah, May 8-11, 1961. Pergamon Press, Oxford, England, (p. 7-25), 529 p.

The biological behavior of Ra 226, Pu 239, Th 228, and Sr 90 in young adult beagles for the first 1000 days following a single intravenous injection was studied. Plasma concentration, excretion, fractional retention, distribution, metabolic fate of the decay products, if any, and the average radiation dose rate to the skeleton were determined. The results are considered in terms of the nuclear and chemical characteristics of the radionuclides and the biological organism. The results for the pair of alkaline earth radionuclides are, in general, similar with interesting small differences, and this pair differs markedly from the pair of actinide element radionuclides, which in turn show some interesting similarities and dissimilarities. The combined effect of nuclear and chemical properties and the biological organism result in markedly different average radiation dose rates to the skeleton when compared on the basis of equal injected activities. These empirical relations are presented as useful interpolation formulae to describe a specific case. (Auth)

Table 4 shows concentrations of radionuclides in eyes and plasma. Table 6 gives empirical equations for retention, skeletal retention, and skeletal dose for 20-1000 days after injection.

<352>
Dilley, J.V., and K.E. McDonald, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Removal of Inhaled Plutonium 239 PuF4 in Beagles. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 6.11), 253 p.

Six beagle dogs were exposed to dry aerosols of Pu 239 PuF4. Immediately after the exposure, each animal was counted in the whole body counter. Approximately 2 hr after the exposure each of three dogs was injected intraperitoneally with 0.5 g of DTPA. This treatment was repeated after 1, 2, 4, 7, 11, 16, 18, 23, 37, 44, 51, and 58 days. Whole body counts of treated and control animals were made at frequent intervals. It was observed that DTPA was not effective in removing Pu from the dogs. (FMM)

<353>
Stuart, B.O., and M.D. Snyder, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

A Constant Feed, Uniform Dispersion Device for Large Particle Inhalation Studies. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 47-48), 253 p.

A series of experiments to measure the inhalation, deposition, and clearance of large particles in beagle dogs required the development of an instrument to uniformly disperse these particles throughout an exposure chamber. It was necessary to evenly distribute a few milligrams of 50 micron diameter Pu 238 PuO2 spheres (density >10) over a 7 in. diameter cross-sectional area at a constant rate during a 10-15 min exposure period. The design of an instrument developed for this purpose is described and illustrated. (FMM)

<354>

<354>
Tadmor, J., and H. Galron, Israel Atomic Energy Commission, Soreq Nuclear Research Centre, Yavneh, Israel. 1966

Relative Hazards of Fission Products in the Environmental Hazards Evaluation of Nuclear Reactors. CONF-660920; Part of Snyder, W.S., et al (Eds.), Proceedings of the 1st International Congress of Radiation Protection held in Rome, Italy, September 5-10, 1966, Part 2. Pergamon Press, Oxford, England, (p. 929), 1623 p.

The fission products and their decay products which accumulate in the fuel during the operation of a nuclear reactor consist of about 300 isotopes of different physical, chemical and biological properties. However, only a relatively small number of these isotopes contribute significantly to the hazard to the population, in the event of an accidental release of fission products into the environment. The relative hazard of the fission products in the environmental hazards evaluation of nuclear reactors was calculated in order to ascertain which fission products must be taken into account. Consideration was given to (1) the various ways in which the population might be subjected to irradiation (external cloud radiation, external radiation from contaminated land, and internal irradiation due to inhalation); (2) the properties of the fission products (fission yield, percentage of release from the fuel in an accident, energy of radiation, physical and biological half-life, velocity of deposition); and (3) the critical organ in the human body in which the fission product concentrates. Although several studies deal with the relative hazards of various radioisotopes in general and of fission products in particular, no comprehensive study has been made so far concerning the specific aspect of environmental hazards evaluation of nuclear reactors. The relative hazards of the fission products were calculated for external cloud radiation, external radiation from contaminated land and internal radiation from inhalation, assuming a reactor power of 1 MW (th) and an accident occurring after 3 years of operation. The hazards were calculated for different times after the occurrence of the accident and for different distances from the point of release of the fission product. The importance of using the individual gamma energies rather than the average energy of all the fission products is shown and the contribution of the fission product daughters formed during the travel of the cloud is also evaluated. The study summarizes the sequence of importance of the different fission products in the framework of the hazards evaluation of nuclear reactors. (Auth) (Complete text)

<355>
Stuart, B.O., and W.J. Bair, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Comparative Toxicity of Inhaled Plutonium 238 PuO2 and Plutonium 239 PuO2 in Rats. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 411-412), 253 p.

Approximately 250 rats, in groups of 12, inhaled aerosols of either Pu 239 PuO2 or Pu 238 PuO2 to determine the relative acute lethal toxicities of these radionuclides. The count median diameter for both materials was 0.1 micron. It was shown that inhaled Pu 238 PuO2 and Pu 239 PuO2 were equally effective, on a radioactive basis, in causing acute lethality in the animals. (Auth) (PMM)

<356>
Stuart, B.O., and T.M. Beasley, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1965, January

Selective Tissue Accumulation of Uranium and Thorium in Rats After Inhalation of Uranium Ore Dust. BNWL-122; Part of Thompson, R.C. and Woods, S.W. (Eds.), Hanford Biology Research Annual Report for 1964, (p. 21-24), 216 p.

Groups of rats inhaled uranium ore aerosols semiweekly for two months. Th 230 activity levels in the lungs were twice those of U 238 by the end of exposures, increasing to nine times after four months due to selective removal of uranium. Levels of Th 230 in tracheobronchial lymph nodes were also higher than U 238. Uranium levels in the kidneys and femurs were initially higher than thorium, but by two months postexposure thorium activities were equal to or greater than those of uranium. This rapid in vivo separation of uranium and thorium is important for permissible limit considerations. (Auth)

<357>
Tombropoulos, E.G., and W.J. Bair, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Removal of Inhaled Radioactive Particles. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 136-142), 289 p.

Inhaled Ce 144 CeO2 was removed from the lungs and body organs of rats and dogs by administering diethylenetriaminepentaacetic acid (DTPA) and, to a lesser degree, Pluronics P68. Pluronics was more effective than DTPA in increasing the clearance rate and urinary and fecal excretion of inhaled PuO2, but neither decreased the body burden of PuO2 to any appreciable extent. Other therapy agents tested include sodium polystyrene sulfonate, triethylene-tetraminehexaacetic acid, sodium diethyldithiocarbamate, phenylephrine hydrochloride, and negative ions. (Auth) (PMM)

Table 2 shows distribution of Pu 239 in tissues of dogs 17 days after exposure to Pu 239 PuO2 aerosols. Table 1 shows effect of different aerosol treatments on removal of inhaled Ce 144-Pr 144 from rats.

<358>
Stannard, J.N., University of Rochester, School of Medicine and Dentistry, Rochester, NY. 1958

An Evaluation of Inhalation Hazards in the Nuclear Energy Industry. A/CONF.15/P-738; Part of Proceedings of the 2nd United Nations International Conference on the Peaceful Uses of Atomic Energy held in Geneva Switzerland, September 1-13, 1958, Vol. 23, (p. 306-312)

Power reactors present potentially a much greater inhalation hazard than weapons fallout. While the external radiation hazard is important, conditions can be easily imagined where deposition of I 131 in thyroid, Sr 89 or Sr 90 in bone or of mixed fission product insoluble oxides in lung or lymph nodes would be limiting. In normal operations, mining and processing of uranium ore may involve the largest number of individuals and be the most likely source of radioactive inhalation hazard in nuclear energy work. Ventilation of mines and mills or respiratory protective equipment can aid greatly in relieving this hazard. It is unsafe to extrapolate from aerosol data on chemically toxic materials to radioactive aerosols and also, to predict a minimum hazard from articles in the 0.2 to 0.3 u range. While the GI tract may at times contain more material than other organs, it is questionable if it should be made the critical organ on this basis alone. The accumulation of material in pulmonary lymph nodes, particularly after prolonged inhalation exposure, may greatly exceed that in the lungs. In fact, lymph nodes may limit exposure under many conditions. Requisite data for hazard evaluation are never available in toto. Approximations must be made. For example, a variety of assumptions can be made covering meteorological conditions, particle sizes, activity released, deposition, resuspension, pulmonary deposition, clearance, turnover to other organs and excretion. By making very conservative assumptions the maximal hazard can be estimated; by making less conservative assumptions an average hazard can be arrived at. (Auth) (PMM)

<359>
Gilbert, R.O., and L.L. Eberhardt, Battelle Memorial Institute, Pacific Northwest Laboratories, Environmental and Life Sciences Division, Ecosystems Department, Richland, WA. 1973, March

Plutonium Studies at the Nevada Test Site. BNWL-1750 (Part 2); Part of Vaughan, B.E., et al, Annual Report for 1972, (p. 2.2-2.4), 105 p.

The Plutonium Environmental Studies Program has provided statistical input relating to the design of soil and vegetation sampling. A discussion of the "double sampling" design is given. The basic idea is to estimate a linear calibration equation between an inexpensive method and an expensive method of determining plutonium concentration. In the case of sampling soil for estimating inventory, the "inexpensive" method being used is a hand held gamma counter commonly called the FIDLER which reads the 60 KeV gamma rays emitted from Am 241; the expensive but accurate method is the laboratory determination of concentrations of Pu 239-Pu 240 using "wet chemistry" techniques. Two locations on the Nevada Test Site, namely, Area 13 and Area 4 (GMX) have been thoroughly surveyed with the FIDLER and isopleth lines have been drawn to establish strata within which the levels of soil concentration are relatively homogeneous. The design of the soil sampling protocol for the Eniwetok atoll survey planned for October 1972 was discussed. (PMM)

<360>

<360>
Sullivan, M.F., P.L. Hackett, L.A. George, and R.C. Thompson, General Electric Company, Hanford Laboratories, Biology Operation, Richland, WA. 1960

Irradiation of the Intestine by Radioisotopes. Radiation Research, 13, 343-355

Experiments were done on rats weighing from 200 to 225 g. Radionuclides were administered by stomach tube to non-fasted rats in a single dose with Y 91 as the chloride at pH 3 (2 mCi/ml) and Pu 239 as the oxide suspended in water (6.2 mCi/ml). The results show that the LD 50 for orally adminsitered Y 91 in the rat is about 17 mCi/kg, and the average survival time is 8.4 days. The calculated radiation dose from this amount of yttrium to the various segments of the intestine is: small intestine--1150 rads; ascending colon--2800 rads; and descending colon--4760 rads. Blood counts showed that lymphocytopenia, granulocytosis, and a mild anemia occurred after oral doses of Y 91. Fluid loss and hemorrhage were contributing factors to these changes. Pathologic changes due to Y 91 were primarily present in the large intestine owing to longer retention of intestinal contents in that segment. Damage was qualitatively similar to that observed previously after x irradiation. Quantities as high as 230 mCi/kg of the alpha-emitting isotope Pu 239 were administered by gavage to rats without causing death. A series of rats sacrificed at 3, 6, and 9 days showed only superficial epithelial damage at 3 days. No other evidence of injury was noted. (Auth) (PMM)

<361>
Swinth, K.L., and W.J. Bair, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Use of In Vivo Counting to Determine Retention of Inhaled Plutonium 239 in Dogs. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 3.8-3.10), 253 p.

Dogs were given a single exposure to Pu 239 PuO2 aerosols. Whole body burdens of Pu 239 in dogs determined by in vivo counting of the 17 KeV x ray from Pu 239 and the 60 KeV gamma ray from Am 241 compared closely with values obtained by alpha analyses of the total tissues. (Auth)

Table 1 shows results of in vivo counting of inhaled Pu 239 PuO2 with a comparison of values based on x ray and gamma counting and tissue radioanalysis.

<362>
Sullivan, M.F., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1973, April

DTPA Enhanced Plutonium Excretion via the Bile. BNWL-1750 (Part 1); Part of Thompson, R.C. (Ed.), Annual Report for 1972, (p. 60-61), 103 p.

Rats were injected with either monomeric or polymeric Pu 239 and a complete collection of bile was made. On the third day, DTPA was injected and bile collection continued. It was shown that DTPA enhanced the biliary excretion of both monomeric and polymeric Pu 239 and was almost twice as effective for monomeric. (Auth) (PMM)

<363>
Zlobin, V.S., Not given. 1971

Active Phase of Assimilation of Plutonium 239 by the Marine Algae ASCOPHYLLUM NODOSUM. AEC-tr-7418; Part of Effect of Ionizing Radiation on the Organism, the Problem of the Effect of Radioactive Water Pollution on the Reproduction of Commercial Fishes, (p. 207-217), 217 p.

A study was made of the problem of accumulation of Pu 239 by the brown alga ASCOPHYLLUM NODOSUM during suppression of cell respiration. The inhibitors used were sodium cyanide in a concentration of 1 X 10(E-4) M, ammonium chloride 10 mM and 100 mM and cadmium chloride 2 mM. It was established that they cause a decrease in the Pu 239 accumulation factors in dependence on the substrate on which they act. A study was made of the mechanism of this phenomenon and it was possible to establish the dependence of the intensity of cell respiration and the accumulation factor. Hypotheses are given on the means and methods by which Pu 239 in a colloidal state penetrates through the cell membrane. (Auth)

<364>
Zlobin, V.S., and N.F. Perlyuk, Not given. 1971

Photosynthesis and the Mechanism of the Action of Cyanide on Cell Respiration and Plutonium 239 Accumulation by Marine Algae. AEC-tr-7418; Part of Effect of Ionizing Radiation on the Organism, the Problem of the Effect of Radioactive Water Pollution on the Reproduction of Commercial Fishes, (p. 195-206), 217 p.

Cultivation of the brown alga ASCOPHYLLUM NODOSUM in the control (addition of Pu 239 in a concentration n x 10(-6) uCi) and experimental aquaria (plutonium in the same concentration and cyanide in a quantity 1 x 10(E-4) M) revealed a stable suppression of accumulation of an alpha-emitter by algae in the presence of an inhibitor. As a result of chromatographic separation of amino acids in plant hydrolysates the greatest activity was registered in serine-glycine (34.66%), histidine (31.94%) and alpha-alanine (10.49%). Quantitatively these acids also predominate. In the samples investigated it was established by the electrophoretic method that the tag is incorporated into hypoxanthine and adenosine monophosphoric acid. The introduction of the cell respiration inhibitor cyanide into the energy system of algae caused a decrease in plutonium accumulation by the plant cells. It is postulated that assimilation of colloid particles of plutonium occurs as a result of ultraphagocytosis. (Auth)

<365>
Van As, D., and C.M. Vleygaar, Pelindaba Atomic Energy Board, Isotopes and Radiation Division, Pretoria, South Africa. 1972, December

Environmental Radioactivity at the National Nuclear Research Center, Pelindaba. PEL-209; 21 p.

A revised environmental survey program, with the emphasis on monitoring of the critical paths of exposure of the general public, was introduced during 1970. Results of determinations of both gross radioactivity and individual nuclides in samples of fish and water (which are critical materials for liquid effluent releases) from the Hartbeespoort Dam and from the Crocodile River, are given and discussed. Results of gamma-spectrometric, I 131 and Sr 90 analyses of milk, the critical material for releases to the atmosphere, are presented. Results are given of regular investigations of the composition of effluent releases. These investigations are performed in order to be able to detect other possible critical nuclides. Levels of deposited and airborne activity from nuclear bomb tests are reported. (Auth)

Table 14 shows monthly activity in deposited fallout for Sr 90, Cs 137, Ce 144, Ru 106, Ba 140, Zr 95, Ru 103, and Ce 141. Table 16 shows monthly activity in air for Cs 137, Ce 144, Ru 106, Ba 140, Zr 95, Ru 103, Ce 141, and I 131.

<366>
Taylor, D.M., and F.D. Sowby, Institute of Cancer Research, Royal Cancer Hospital, Department of Physics, London, England; Department of National Health and Welfare, Radiation Protection Division, Ottawa, Ontario, Canada. 1962, July

The Removal of Americium and Plutonium from the Rat by Chelating Agents. Physics in Medicine and Biology, 7(1), 83-91

The effect of treatment with a number of different chelating agents on the retention of plutonium or americium was studied in rats. Am 241 was administered as the trivalent citrate complex at pH 6. Pu 239 was given as a solution of Pu(NO3)4 which was brought to pH 4 to 5 by the addition of sodium carbonate solution immediately prior to injection. The nuclides were injected intravenously, except in one experiment where Pu 239 was given intramuscularly; the activity administered ranged from 0.05 to 0.4 uCi. The chelating agents were generally administered by intraperitoneal injection in doses ranging from 0.75 to 3.0 mM/kg body weight. The content of Am 241 or Pu 239 in the samples of bone and soft tissue was determined. Diethylenetriaminepentaacetic acid (DTPA) was found to be the most effective reagent for the removal of both plutonium and americium. The effects of different times and patterns of treatment were investigated and it was shown that for both elements the greatest reduction in retention occurred when treatment was commenced very shortly after exposure. (Auth) (PMM)

Table 1 shows the effect of treatment with various chelating agents on the retention of Pu 239 in rats 28 days after IV injection. Table 2 shows the effect of EDTA and DTPA on distribution of Am 241 in rats. Table 7 shows the effects of treatment by IP injection of DTPA in the retention of Pu 239 at various times after intramuscular injection.

<367>
Willard, D.H., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Acute Toxicity of Inhaled Crushed Plutonium 239 PuO2 Microspheres in Beagles. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 4.9-4.10), 253 p.

Six female, 33 month old beagle dogs were exposed for 10 min to Pu 238 PuO2 aerosols at concentrations of 0.016-0.039 uCi/cm3. The count median diameter of the aerosol was 0.52 u (sigma g equals 1.66). Alveolar deposition ranged from 30-160 uCi. Death occurred in the dogs 50-106 days after alveolar deposition of Pu 238 PuO2. Death was due to respiratory insufficiency and was preceded by lymphopenia and other changes similar to those seen after inhalation of acute lethal levels of Pu 238 PuO2. At time of death the lungs and trachebronchial lymph nodes contained about 98% of the body burden of Pu 238 which ranged from 33-160 uCi. The skeleton contained about 1% and the liver less than 1%. (Auth) (PMM)

Table 1 shows distribution of inhaled Pu 238 PuO2 in dogs.

<368>

<368>
Wood, D.H., J.L. Murray, and J.L. Palctay, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1965, January

Liver Damage from Neptunium 237 in Sheep. BNWL-122; Part of Thompson, R.C. and Woods, S.W. (Eds.), Hanford Biology Research Annual Report for 1964, (p. 75-78), 216 p.

There was a close correlation between rose bengal liver function tests and the histopathologic changes found in serial liver biopsies from sheep following the intravenous administration of the hepatotoxic agent, Np 237 (1.5 mg/kg). The most severe cellular damage and the slowest blood clearance of the dye occured the fourth day postinjection. Cellular repair was evident by the sixth day and was almost complete by the tenth day. (Auth)

<369>
Zalikin, G.A., Yu.I. Moskalev, and I.K. Petrovich, Ministry of Public Health, Institute of Biophysics, Moscow, USSR. 1968

Distribution and Biological Effects of Americium 241. AEC-tr-6950; Part of Radiobiology, (p. 107-118), 306 p.; Radiobiologiya, 8(1), 65-71

Americium 241 was administered in the form of the chloride intravenously and intratracheally (0.5 and 0.3 ml, respectively, 2 uCi/l) and perorally (1.0 ml, 2 and 19 uCi/l) to white rats weighing an average of 200 g. At certain intervals the rats were killed and samples taken from the organs and tissues for determination of gamma radiation as % of the introduced activity. After intravenous administration, Am 241 rapidly accumulated in the liver (about 57%) and skeleton (about 18%) and high accumulations were noted in the kidneys (1.1%), liver (7.1%), bones (1.4%), spleen (0.65%), thyroid gland (0.437%), adrenal glands (0.18%), and ovaries (0.13%). After intratracheal administration it was slowly absorbed from the lungs; the effective period of half-excretion of the excreted portion is 66 days. In peroral administration not more than 0.03% was absorbed from the gastrointestinal tract. For Am 241 administered intravenously in the form of the chloride, the acutely LD 50/15 and LD 50/30 and subacutely LD 50/120 are 0.14, 0.11 and 0.04 uCi, respectively. (Auth)

Table 1 shows content of Am 241 in the organs and tissues of rats at various periods after IV injection. Table 3 shows content of Am 241 in rat organs and tissues at various times after intratracheal injection.

<370>
Sailor, V.L., Brookhaven National Laboratory, Upton, Long Island, NY. 1972

Population Exposure to Radiation; Natural and Man Made. CONF-710716; Part of LeCam, L.M., et al (Eds.), Proceedings of the 6th Berkeley Symposium on Mathematical Statistics and Probability held at the Statistical Laboratory, University of California, April 9-12, June 16-21 and July 19 -22, 1971, Vol. 6. University of California Press, Berkeley, California, (p. 291-311) 599 p.

Statistical studies which might be capable of demonstrating relationships between health effects and low level radiation pollutants in the environment will be difficult to design, because: 1) the pollutants are small by comparison with natural background radiation and with variations in natural backgrounds, 2) the radiation burden of medical x rays are about as large as natural background and thus large compared with the pollutants, and medical x ray exposures for which no precise records are kept vary widely among individuals, and 3) the biological manifestations of radiation are not uniquely induced by radiation. Using a model, the population dose distribution in a 50-mile radius about a nuclear power plant is estimated. The care of 16 plants equally spaced on a 50 km radius surrounding a city, gives a maximum annual dose of approximately 0.27 mrem provided the 5 mrem fence post limit is observed thus commercial nuclear power would not contribute a significant increment to the radiation environment of the population. (Auth) (FMM)

Table 1 shows typical whole body doses to standard man from natural sources.

<371>
Tashiro, S., Y. Wadachi, and M. Muramatsu, Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken, Japan; Tokyo Metropolitan University, Setagaya, Tokyo, Japan. 1968, April

Skin Contamination by Radioisotopes, (5) Pig Skin Contamination by Plutonium 239. Journal of Nuclear Science and Technology, 5(4), 160-162

Samples of pig skin were prepared by cutting the hair, washing with synthetic detergent and cutting into pieces 2 cm X 2 cm. The contaminating solution was prepared by dissolving metallic Pu in hydrochloric acid to obtain a solution of 0.5 uCi/ml and solutions of various pH values were prepared therefrom by the addition of sodium hydroxide. Immediately, a 0.1 ml aliquot of the solution was applied to the center of the sample. It was found that the contaminability of Pu was affected by the formation of colloidal substances in the contaminating solution, as in the case of Pm, Sb, Po and U. It was also found that 0.05% of the Pu penetrated through the pig skin with pH 1 solution after 60 min. (Auth) (FMM)

<372>
Stuart, B.O., and P.J. Dionne, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Dynamic Simulation of Retention and Translocation of Inhaled Plutonium Oxide in Beagle Dogs. BNWL-714; Part of Thompson, R.C. et al (Eds.), Annual Report for 1967, (p. 3.5-3.8), 253 p.

A dynamic simulation model for inhaled plutonium oxide was constructed using hybrid computer facilities. Blood, tissue, and excretion data collected from more than 50 beagle dogs up to 7 years after inhaling Pu 239 PuO2 were incorporated into a program for predicting long-term retention and translocation of inhaled insoluble plutonium. The long-term model predicts that 15 and 60% of the amount deposited in the deep lung remains in the deep lung and lymph nodes, respectively, 15 years after exposure, and that the whole body burden decreases less than 10% after the inital rapid clearance which occurs during the first 2 weeks after exposure. (Auth) (PMM)

<373>
Blair, H.A., University of Rochester, School of Medicine and Dentistry, Department of Radiation Biology and Biophysics, Rochester, NY. 1968

Radiation Dose-Time Relations for Induction of Bone Tumors in the Dog and Skin Tumors in the Rat. Radiation Research, 34, 501-522

There are two mutually exclusive routes of tumor induction by radiation both in rat skin from brief doses of external beta radiation and in dog bone from Pu 239, Ra 226, or Th 228 injected at age 500 days. In the one process oncogenesis occurs directly on attainment of high radiation dose. In the other process oncogenesis follows a long latent period which is initiated by lower dose. Subsequent development time is the same in both cases. With protracted dosage the latent period is initiated at relatively low dose, but if exposure is continued the high-dose process will supersede the low if the high-dose threshold is exceeded during the latent period. Otherwise the low-dose process will govern. For those radioelements in the dog yielding relatively constant dose rates the data are represented by equations relating survival time, initiating high dose, development time and dose rate to the skeleton. The relative values of the initiating high dose provide a scale of toxicities. (Auth) (PMM)

<374>
Bogatov, L.V., Not given. 1963

Reaction of the Blood System in Dogs to Heavy Blood Loss in Remote Periods Following Chronic Irradiation. Meditsinskaya Radiologiya, 8(2), 28-35 (Russian)

Investigations were carried out on 3 groups of dogs: (1) 18 months after external gamma-irradiation, 10 R/day, total dose of 1,300 R; 2) after four-fold plutonium administration, 0.05 uCi/kg for a period of 4 months; 3) 4 years after external gamma-irradiation, 18 R/day, total dose of 954 R. In all three groups there took place, the same as in nonirradiated animals, a reaction of the blood system to acute blood loss (33-39% of blood). Peripheral blood restoration occurred at the same time or even earlier than in controls. In contrast to controls, the blood regeneration in experimental animals occurred against the background of marked hyperplasia of the red series, while in animals of the first group posthemorrhagic reticulocytosis was absent. (Auth)

<375>
Atherton, D.R., W. Stevens, and F.W. Bruenger, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1973, March 31

Early Retention and Distribution of Curium in Soft Tissues and Blood of the Beagle. CCO-119-248; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 178-185), 400 p.

Following intravenous administration of 2.6 uCi Cm/kg to beagle dogs, the concentration of the nuclide in circulating blood diminished very rapidly, and after 2 days the concentration was of the order of 0.4% per kg of blood. Soft tissue concentration was highest in the liver, followed by thyroid, kidney, dura mater, and lymph nodes. The concentration in other soft tissues was less by substantial factors. (Auth)

The retention and concentration of curium in soft tissues is shown in tables 1 and 2. Tables 3, 4, and 5 compare the retention concentrations of Th 228, Pu 239, Am 231, Cf 249, and Cm 243-Cm 248 at 1, 2, and 3 weeks in a variety of soft tissues.

<376>

<376>
Ballou, J.E., General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1963, January 15

Comparative Toxicity of Plutonium 239 and Plutonium 238. HW-76000; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1962, (p. 11-17), 269 p.

On an equivalent microcurie basis, Pu 239 was significanlty more toxic than Pu 238 when administered intravenously to rats over a dose range of approximately 80 to 140 uCi/kg. Toxicity was demonstrated by an abrupt loss of weight and early death following injection. Lower doses of Pu 238, Pu 239, and Np 237 followed by 500 R total body x radiation showed no difference in lethal effect between Pu 238 and Pu 239 combined with x radiation. The 520 ug/kg level of Np 237 combined with x radiation did not affect survival. Tissue distribution and retention of low doses (1 uCi/rat) of the two plutonium isotopes were similar but markedly different at higher doses (18 uCi/rat). The Pu 239 deposition pattern at the higher dose was characterized by a relatively high deposition in the liver, spleen, and other soft tissues and a correspondingly low relative deposition in bone. It was suggested that a five-fold greater deposition in the spleen of Pu 239 was sufficient to overcome the protective function of this organ and the result was an earlier death than that observed with Pu 238. Thus results indicated that the difference in toxicity was related to the mass levels of heavy metal administered. (Auth) (ST)

Tables 2 and 3 list the tissue distribution of Pu 238 and Pu 239 expressed as percent dose/tissue for 1, 3, and 8 days post injection.

<377>
Plasenbaum, W., J.S. McNeil, T.A. Kotchen, and A.J. Saladino, Walter Reed Army Institute of Research, Department of Nephrology, Washington, DC. 1972, November

Experimental Acute Renal Failure Induced by Uranyl Nitrate in the Dog. Circulation Research, 31, 682-698

Renal blood flow and renal function were studied serially for 96 hours after the administration of uranyl nitrate (10 mg/kg IV) in unanesthetized dogs. Acute renal failure was induced by the uranyl nitrate and was characterized by a diminished inulin clearance, a progressively falling urine voluse, an initial increase in urine sodium concentration, a decreased urine osmolality, rising blood urea nitrogen concentration, and altered renal hemodynamics. Inulin clearance and total renal blood flow decreased to 25 and 52% of control, by 6 hours and remained depressed. Plasma renin activity was elevated by 3 hours. Histological examination revealed minimal tubular change at 6 hours and widespread disruption at 96 hours. The decrease in renal blood flow prior to any significant tubular pathology suggested that alterations in renal hemodynamics, which may be mediated by the renin-angiotensin system, were responsible for the diminished renal function. (Auth) (ST)

<378>
Kahn, B., B. Shleien, and C. Weaver, U.S. Environmental Protection Agency, Cincinnati, OH. 1972

Environmental Experience with Radioactive Effluents from Operating Nuclear Power Plants. CONF-710901; A/CONF.49/P; STI/PUB/300; Part of Proceedings of the 4th International Conference on the Peaceful Uses of Atomic Energy held in Geneva, Switzerland, September 6-16, 1971, Vol. 11, (p. 559-573), 766 p.

Radiological surveillance activities at the eight nuclear power stations and the nuclear-fuel reprocessing plant under routine commercial operation in the USA are described, and current results are summarized. At each facility the operator or his contractor monitors the environment and presents findings in periodic reports to the USAEC. The appropriate state agency for public health or environmental protection also performs radiological measurements in the neighborhood of the plant, usually as part of a state-wide monitoring program. The USAEC sponsors a program of independent measurements at several stations and periodic aerial radiation surveillance of the environment. New York University and the Essex Marine Laboratory are evaluating possible thermal and radiological effects of liquid effluents from two of these plants on aquatic life in the Hudson and Connecticut rivers, respectively. Studies to develop environmental surveillance guidelines have been conducted at operating facilities since 1967 by the Division of Environmental Radiation (formerly of the Public Health Service, Bureau of Radiological Health). The field studies, which were initially undertaken at a fuel reprocessing plant, a boiling-water reactor, and a pressurized-water reactor that had been in operation for several years, have now been extended to include the newer and larger light-water nuclear power stations. Concurrent measurements of individual radionuclides are made within the station, at points of waste discharge, in the immediate environment, and at points of possible human exposure. Thus the magnitude of the source, the importance of paths to and through the environment, and the extent of radionuclide dispersion or concentration are indicated. Specific procedures have been suggested for collecting appropriate samples and measuring radiation and radionuclide concentrations in environmental media at the usual extremely low levels. The major observations have been the feasibility, given sufficiently sensitive techniques, of measuring directly the critical radiation exposure pathway and the desirability of basing environmental surveillance programs on release rates of individual radionuclides measured at the source. (Auth)

Table 5 gives the concentration of several radionuclides found in discharged water, clams, algae, fish, sediment and vegetables at various nuclear facilities. Table 6 shows several radionuclides including Pu 238 and Pu 239 found in environmental samples.

<379>
Lyubchanskii, E.R., Not given. 1966

Using Na3Ca DTPA (Pentacin) to Eliminate Plutonium 239 from the Organism of the Rat with Inhalation Poisoning. AEC-tr-6944; Part of Moskalev, Yu.I., Distribution and Biological Effects of Radioactive Isotopes, (p. 592-598), 718 p.

Male rats of the Wistar line were exposed to a single 20-minute inhalation of Pu 239 citrate (pH equals 6.5). Some of the animals were treated with aerosols of the trisodium calcium salt of DTPA obtained on atomizing a 10% solution in a special generator. Others were intravenously injected with DTPA (2.5 and 25 mg/rat) 30 minutes prior to inhalation of Pu. The rats of both series were killed five days after the administration of DTPA and the lungs, liver, femurs, and kidneys were analyzed. It was found that single-dose prophylactic inhalation of pentacin in the amount of 1.8 mg prevents to a large degree the deposition in rats of the inhaled plutonium. As the interval of time between the inhalation of plutonium and of pentacin increases, the effectiveness of the latter diminishes. Administration of small amounts of pentacin (1.8 and 3.6 mg) 40 days following the inhalation of plutonium does not affect the content of this isotope in the rat. By contrast with inhalation, prophylactic intravenous administration of pentacin in the amount of 2.5 mg does not reduce the activity in the lungs and skeleton following the penetration of Pu 239 into the respiratory pathways. (Auth)(FMM)

<380>
McClellan, R.O., U.S. Atomic Energy Commission, Division of Biology and Medicine, Medical Research Branch, Washington, DC. 1966

Use of Swine in Radionuclide Toxicity Studies. CONF-65-718; Part of Bustad, L.K., et al (Eds.), Proceedings of a Symposium on Swine in Biomedical Research held in Richland, Washington, July 19-22, 1965, (p. 447-462), 825 p.

Increased use has been made of swine as experimental animals in radionuclide toxicity studies. An important stimulus to their increased use has been the availability of strains of miniature swine. Their body and skeletal size, diet, gastrointestinal tract, skin characteristics, and relatively long lifespan have been pertinent factors favoring their use because of the importance of these criteria when experimental results are extrapolated to man. Three types of experiments are discussed that illustrate the current use of swine: (1) long-term chronic radionuclide ingestion studies with a significant fallout radionuclide (Sr 90), (2) short-term metabolism studies with radionuclides that predominate in nuclear industry operations and/or may have special applications as in "Systems for Nuclear Auxiliary Power," and (3) acute and chronic studies of the metabolism and effects of plutonium deposited on or in the skin. (Auth)

<381>
Menot, J.C., M. Morin, W. Sku[illegible] J. Lafuma, Commissariat a l'Ener[illegible]gie, Fontenay-aux-Roses, France.

Experimental Removal of Cerium 144, Americium 241, Curium 242 and Plutonium 238 from the Rat Skeleton. Health Physics, 23, 635-640

The therapeutic effectiveness of DTPA on bone deposits of lanthanide or transuranic elements can be appreciable when the greater part of the activity is to be found in bone. This was obtained after 3 weeks time following the administration by inhalation of Ce 144 and Am 241 and by intramuscular injection of Cm 242 and Pu 238. DTPA therapy starting after this delay decreased bone burdens by a factor from 1/2 to 1/3 in 3 months. There probably exist two different compartments which can be cleared, under the influence of DTPA, with a half-life of 2 months for the former and very slowly for the latter. The effectiveness of DTPA on the second compartment could not be estimated. (Auth)

Table 2 shows the distribution of Ce 144, Am 241, Cm 242 and Pu 238 salts in bone, liver, urine and feces of rats following IM injection or inhalation and DTPA treatment.

<382>
Rudasheva, N.P., Not given. 1969

On the State of the Blood System in Rats Under Inhalation Affection by Plutonium 239. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radicactive Isotopes and the Body, (p. 347-353), 458 p.

The morphological composition of the blood and bone marrow following single and chronic inhalation of Pu 239 was studied in rats. It was shown that with a single inhalation of a plutonium carbonate complex in the quantity 0.024 uCi/lung and also with chronic inhalation for 160 days with a daily deposition of 0.02 uCi/lung, no changes were found in the blood system. Under the action of a plutonium citrate complex in quantities shortening the natural life span of rats, moderately expressed changes in the blood system were found. After a single inhalation in the quantity 0.64 uCi/lung there was a tendency toward a certain lowering of the total number of leukocytes at the end of the life of the rats. During chronic inhalation for 60 days with daily deposition of 0.004 uCi/lung, a moderate depresssion of erythropoiesis, leukopoiesis and lymphopoiesis developed. The number of leukocytes dropped by a factor of 1 1/2-2. Restoration of the number of leukocytes in the peripheral blood was noted in the bone marrow under conditions of depressed leukopoiesis. (Auth)(FMM)

<383>

<383>
Koranda, J.J., J.R. Martin, and R.W. Wikkerink, Lawrence Radiation Laboratory, Biomedical Division, Livermore, CA. 1970

Leaching of Radionuclides at Sedan Crater. Part of Radionuclides in the Environment, Advances in Chemistry Series No. 93, (p. 97-117)

The distribution of tritium and long-lived gamma radioactivity was studied in crater ejecta from the Sedan detonation (July 1962). Tritium concentrations were determined in soil water extracted from crater ejecta samples collected from the surface to 6 feet, and at distances of 3000 feet from the crater from 1966-1968. Tritium distribution was very obviously modified by postshot environmental effects, especially rainfall leaching. Tritium maximum concentrations were found below the strata in which they were deposited. Gamma radionuclides exhibited limited movement in the crater ejecta strata or in preshot soil covered by sedan ejecta. A subtle leaching of Cs 137 was demonstrated by considering the Cs 137/Mn 54 ratios in the ejecta strata. (Auth)

<384>
Kalmon, B., and S.H. Hulett, Goodyear Atomic Corporation, Industrial Relations Division, Industrial Hygiene and Health Physics Department, Piketon, OH. 1970, September 10

Environmental Radiation Levels and Concentration, First Half 1970. GAT-628; 10 p.

The average environmental radiation levels for the Goodyear Atomic Corporation gaseous diffusion plant, for the first half of 1970, are summarized. For the first half of 1970, the water alpha and beta-gamma, and the air alpha decreased when compared with the 1969 calendar year values. For the first half of 1970, the air beta-gamma increased when compared with the 1969 calendar year values. It is assumed that the gross alpha activity is due to highly enriched uranium and the beta-gamma activity is from its daughter product, thorium 234. Penetrating background dose rates for the first half of 1970 remained essentially the same when compared with the 1969 calendar year values. Previously environmental radiation levels and concentration reports have reflected air sample results, for both alpha and beta-gamma, taken at twenty-one off-site locations. These samples were taken once per month at each location. In April 1970, the Atomic Energy Commission requested that Goodyear Atomic Corporation report only the results of air samples taken from a minimum of four off-site sampling locations. Sampling at these locations should be at a frequency of at least three, 1000 ft3 samples per week. In selecting sample locations, the prevailing wind direction and the locations with the highest concentrations should be considered as indicated in past reports. The air sample results in this report reflect this request. (Auth)

<385>
Buldakov, L.A., Z.I. Kalmykova, N.P. Kudasheva, E.R. Lyubchanskiy, and Ye.P. Ovcharenko, Not given. 1971

Biological Effect of Plutonium 239 Administered by Inhalation. AEC-tr-7387; Part of Moskalev, Yu.I. (Ed.), Remote Aftereffects of Radiation Damage, (p. 323-333), 574 p.

Experiments were done on rats of the Wistar line weighing 120-180 g. The animals inhaled aerosols of solutions of Pu citrate and ammonium Pu pentacarbonate and the initial Pu 239 content in the lungs varied from 0.0047-1.46 uCi. The results show that the differences in the biological effect of the two plutonium compounds are small. The LD 50 values differ insignificantly. A reliable decrease in lifetime in the rats occurs after inhalation administration of plutonium in a quantity of 0.11 uCi per animal or 0.00073 uCi/g; the "safe" plutonium quantities are 0.0001-0.00027 uCi/g. The shortening of lifetime of the rats by 1 rad of dose in the lungs increases linearly with an increase in dose intensity from 0.35-0.40 to 15-20 rad/day. A further increase in pulmonary dose intensity is not accompanied by an increase in shortening of lifetime per 1 rad of dose. A change in respiration rate of the rats occurs with deposition of 0.28 uCi of Pu 239 in the lungs; this is 0.0018 uCi/g of body weight; the respiration depth already changes with 0.047 uCi of Pu 239 in the lungs or 0.00003 uCi/g; hypoxemia is observed with 0.048 uCi/lungs, or 0.00032 uCi/g; the shifts in the acid erythrogram were noted with 0.066 uCi/lungs or 0.00044 uCi/g of body weight. (Auth) (FTM)

<386>
Becker, V.J., J.H. Bennett, and O.K. Manuel, University of Missouri, Department of Chemistry, Rolla, MO. 1972, April

Iodine and Uranium in Sedimentary Rocks. Chemical Geology, 9(2), 133-136

The abundance of iodine and uranium in sedimentary rocks was determined by neutron activation analyses. The iodine content is higher in the sediments than in igneous rocks and the iodine concentrations follow the same general pattern as chlorine and bromine in sedimentary rocks and deep-sea sediments. The uranium concentrations in these sediments are in good agreement with previous estimates, except for two uranium-rich sandstones. (Auth)

Table 1 gives a comparison of the iodine and uranium content of sedimentary rocks with previously estimated limits.

<387>
Koshecnikova, N.A., E.R. Lyubchanskiy, R.A. Yerchkin, and A.A. Puzyery, Not given. 1971

Effect of Some Drugs on the Remote Aftereffects of Inhalation of Soluble Plutonium 239 Compounds. AEC-tr-7387; Part of Moskalev, Yu.I.,(Ed.), Remote Aftereffects of Radiation Damage, (p. 416-424), 574 p.

The effects of pentazine, prednisolone and streptomycin on the latent effects of inhalation of plutonium 239 compounds were tested in rats. The results show that with inhalation damage by soluble plutonium compounds the prophylactic breathing of pentazine reduces content of the isotope in the organs where most deposition occurs and leads to a decrease in the dissemination of pneumosclerosis, and accordingly results in a lengthening of the lifespan. The value of streptomycin for treating plutonium-induced pneumosclerosis was proven in all cases of inhalation damage; there is a decrease in the degree of expression of pneumosclerosis and an increases in lifespan of the experimental animals. With damage by plutonium in quantities causing a chronic form of damage the administration of prednisolone decreases the degree of expression of the pathological processes in the lungs, the frequency of osteosarcomas and leukoses, but does not increase the lifetime of the experimental animals. There is an increased frequency of malignant pulmonary tumors and pathological changes characteristic of extreme old age. (Auth)

<388>
Taylor, G.N., and C.W. Mays, University of Utah, College of Medicine, Radiobiology Division, Salt Lake City, UT. 1972, March 31

Bone Sarcoma Induction in the St. Bernard, A Pilot Study in Dogs of High Natural Incidence. COO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 282-283), 380 p.

As part of a pilot study of dogs with a high natural incidence of bone sarcoma, young adult St. Bernard dogs were given a single intravenous injection of 0.3 uCi Pu 239/kg body weight. The appearance time of radiation induced osteosarcomas was approximately 1/2 of that observed in beagles injected at the same dose level. (ST)

<389>
Hamada, G.H., and P. Kruger, Hazleton-Nuclear Science Corporation, Palo Alto, CA; Stanford University, Civil Engineering Department, Stanford, CA. 1965

Methods of Assessing Fallout. Part of Fowler, E.B., (Ed.), Radioactive Fallout, Soils, Plants, Foods, Man. Elsevier Publishing Company, New York, New York, (p. 287-303)

Some of the analytical methods of assessing radioactivity in ecological systems are reviewed. Particular attention is given to the problems of radiochemical preparation for soils and vegetation. These problems include the precautions necessary for adequate and representative sampling, pretreatment of samples, chemical or physical preparations for radioactivity measurements, and choice of analytical methods for specific radiations or radionuclides. Under the headings soil and vegetation and foods, radiochemical analyses for Sr 90, Ce 144, Pu 239, Ru 106, and Cs 137 are described. Milk is discussed separately and radiochemical analyses for Sr 89 and I 131 are included here. Some of the more common techniques for analysis of stable elements are also described. (ST)

<390>
Not given, Hanford Laboratories, Facilities Engineering and Finished Products Technology Personnel, Hanford, WA. 1960, August 19

Predicted Z Plant Radiation Exposure Levels vs Plutonium Isotopic Concentration of Products. HW-66675; 22 p. (Declassified November 3, 1971)

The report contains seven charts that show the anticipated relationship between whole body exposure levels encountered in the Z plant of the Hanford Laboratories and the plutonium isotopic concentration of the product. The charts are based on gamma ray and neutron studies made in the Z plant in the course of normal plutonium production activities, basic decay characteristics of plutonium isotopes, and time and motion studies made throughout the plutonium processing and fabrication areas. The first three charts show the anticipated effect of high density shielding glass placed around all operating equipment. Charts, 1, 2, 3, and 7 show expected whole body doses due to neutrons as a function of Pu 240 concentration in the product. Charts 4 through 7 deal with anticipated experience associated with several operations. (ST)

<391>

<391>
Not given, Western Environmental Research Laboratory, Las Vegas, NV; U. S. Atomic Energy Commission, Nevada Operations Office, Las Vegas, NV. 1972, July

Offsite Surveillance Around the Nevada Test Site, January-June 1968. Radiation Data and Reports, 13(7), 417-419

During January through June 1968, 18 announced nuclear tests were conducted in Nevada by the U.S. Atomic Energy Commission. Radioactive material was released offsite following one underground nuclear event and after two plowshare cratering experiments. These were Hupmobile on January 18, Cabriolet on January 26, and Buggy I on March 12. Two power operations of the Phoetus 2A nuclear rocket reactor released radioactive material detected offsite on June 8 and June 26. The maximum concentration of gross beta in air was 33,000 pCi/m3 at Stone Cabin Ranch about 16 miles west and 5 miles north of Warm Springs, Nevada. This activity was released by the Cabriolet experiment. The maximum external gamma radiation level measured at a populated location during this period was 65 mR/h following Cabriolet on January 26. Surveillance did not indicate that any individual in an offsite area received an exposure which exceeded the guides established by the AEC and/or recommended by the Federal Radiation Council. (ST)

This is a summary of Report SWRHL-81r. Results of air and milk samplings and ground monitoring are given in tabular form.

<392>
Not given, Western Environmental Research Laboratory, Las Vegas, NV, Nevada Operations Office, Las Vegas, NV. 1972, April

Offsite Surveillance Around the Nevada Test Site, July-December 1966. Radiation Data and Reports, 13(4), 227-236

During July through December 1966, 10 announced underground nuclear tests were conducted by the U.S. Atomic Energy Commission at their Nevada Test Site as a part of Operation Latchkey. The Western Environmental Research Laboratory, EPA, conducted a program of radiological monitoring and environmental sampling in the offsite areas surrounding the restricted area enclosed within the Nevada Test Site, Nuclear Rocket Development Station, and the Nellis Air Force Range. This report describes the methods and equipment used and summarizes the data collected during the 6-month period. Operational procedures consisted of ground monitoring, aerial cloud tracking, air sampling, milk and water sampling, vegetation sampling, and dosimetry measurements of offsite residents. Only the Derringer Event of September 12, 1966 resulted in a release of radioactive effluent which was detected offsite. Ground monitoring showed two readings slightly above background in unpopulated areas. Results indicated that no individual in the offsite area received an exposure, resulting from Nevada Test Site operations, which exceeded the guides established by the AEC and/or recommended by the FRC and the NCRP. (ST)

This article is a summary of Report SWRHL-38r.

<393>
Wilson, R.H., and J.L. Terry, University of Rochester, Atomic Energy Project, Rochester, NY. 1968, September 26

Operation Roller Coaster, Project 4.1, Plutonium Uptake by Animals Exposed to a Non-Nuclear Detonation of a Plutonium Bearing Weapon Simulant. POR-2512; WT-2512; 161 p.

Eighty-four dogs, 132 sheep, and 84 burros were allowed to breathe from the cloud generated by the high-explosive detonation of a plutonium-bearing nuclear weapon simulant. No nuclear yield was present in the explosion. Animals were sacrificed serially from 1 hour to 2 1/2 years later to quantitate initial tissue burdens, to establish lung clearance kinetics, and to determine extent of translocation to other organs. Ten dogs and ten sheep were exposed in a similar trial in which more explosive was used and the weapon simulants were housed in a typical earth-covered high-explosive storage magazine, to establish in a limited way if the admixed earth in any way effected the clearance kinetics. Half of those animals were sacrificed on the third day, the remainder on the seventh. Calculated initial depositions in the animals were found to encompass the deposition postulated for man exposed to a similar aerosol, although the estimate of deposition in animals is somewhat sensitive to the mathematical treatment used in analyzing the data. Clearance in dogs and burros was found to be somewhat more rapid than similar measurements on laboratory dogs exposed to pure PuO2; clearance in sheep was much more rapid, and the usefulness of this species is questionable. No translocation was observed except in those animals exposed to the largest amounts of plutonium, and in these buildup occurred only in lymph nodes. In burros, the species for which results are most reliable, lymph node concentration reached twenty percent of initial lung concentration in 456 days. Initial lung concentrations were shown to be quite closely comparable among the three species if exposed to the same cloud integral of respirable aerosol, and it is proposed that these species in particular and probably other large animals can serve as monitors of exposure if sacrificed soon after an accident. The presence of large amounts of inert dust in the storage magazine trial resulted in a three-fold reduction in lung burden as compared to the dirt-free trial. This may be conservative, but the scarcity of data and the short duration of this phase of the studies preclude any more precise estimate of the benefit of earth-covered storage. It is believed that the altered clearance kinetics are those of the inert dust for which the plutonium serves as a tracer. (Auth)

Tables 3.4 show lung burdens of the various animals as percent of respirable fractions. Tables 3.5 through 3.7 show various tissue burdens. Table 3.8 gives median plutonium levels found in urine and feces of sheep sacrificed at 2 and 1/2 years. Table 3.9 shows median total deposition for the three species. Table 3.10 shows median lung burdens expressed as percent of respirable aerosol for Double Tracks and Clean Slate II dogs and sheep.

<394>
Benstead, J.P.M., D.M. Taylor, and F.D. Sowby, Institute of Cancer Research, Department of Biophysics, Sutton, Surrey, England. 1965, December

The Carcinogenic Effects of Americium 241 and Plutonium 239 in the Rat. British Journal of Radiology, 38(456), 920-925

A comparison was made of the relative radiotoxicities of Pu 239 and Am 241 in terms of tumor production and, in particular, of bone tumor production in rats. For approximately equivalent microcurie doses of the two nuclides, Am 241 is far less effective in producing bone tumors than Pu 239. Fractionation of a single dose of Pu 239 did not increase the number of tumors though there was a slight increase in the number of leukemias. The fact that fewer bone tumors appear for equivalent microcurie doses of the two nuclides suggests that maximum permissible levels for Am 241 might well be reconsidered. (Auth)

<395>
Balabukha, V.S., A.T. Ivannikov, L.I. Razbitnaya, N.O. Razumovsky, L.I. Tikhonova, and L.M. Baranovskaya, Ministry of Public Health, Institute of Biophysics, Moscow, USSR. 1973

Polyaminopolyalkylphosphonic Acids as Effective Ligands for Binding and Eliminating Uranium and Its Fission Products from the Body. CONF-720503; Part of Buldoso, E. (Ed.), Health Physics Problems of Internal Contamination, Proceedings of the IRPA 2nd European Congress on Radiation Protection held in Budapest, Hungary, May 3-8, 1972, (p. 293-298), 655p.

Chelating processes of various aminealkylphosphonic acids with uranium and Ca 45, Y 91, Ce 144, Zr 95, Nb 95, and Ru 106 radionuclides were studied by the methods of spectrometry, electrophoresis, potentiometry and ion exchange. It was established that the stability of the complex compounds with uranium, Zr 95, Nb 95 and Ru 106 is higher than that of polyaminepolycarbonic acids while the stability of compounds with Y 91, Ce 144 and particularly with Ca 45 is lower. All compounds tested on dogs and rats were shown to be efficient in accelerating elimination and decreasing deposition of Zr 95, Nb 95 and particularly uranium. They enhance animal survival and reduce the deleterious effect of uranium on the kidneys and on the animal as a whole. For the elimination of Y 91 and Ce 144, these acids are inferior to the corresponding polyaminepolycarbonic acids. (Auth)

Table 1 shows the effect of aminealkylphosphonic acids on elimination of uranium from rats.

<396>
Bcocock, G., and D.S. Popplewell, United Kingdom Atomic Energy Authority, Atomic Weapons Research Establishment, Aldermaston, Berkshire, England. 1965, October 16

Distribution of Plutonium in Serum Proteins Following Intravenous Injection into Rats. Nature, 203(5007), 282-283

The distribution of tetravalent Pu(NO3)4 in the blood serum of rats was measured 30 minutes after intravenous injection of 0.1 uCi. Following protein separation by gel filtration, the plutonium was found bound to the transferrin proteins. (ST)

See also Report AWRE-O-46/65, 17 p.

<397>
Bair, W.J., General Electric Company, Hanford Laboratories, Biology Operation, Richland, WA. 1960

Radioisotope Toxicity: From Pulmonary Absorption. Part of Caldecott, R.S. and Snyder, L.A. (Eds.), Proceedings of a Symposium on Radioisotopes in the Biosphere held at University of Minnesota, Minneapolis, Minnesota, 1959, (p. 431-448), 527 p.

The physiological behavior and biological effects of several radioisotopes following inhalation are described. Studies on deposition, retention, and translocation of various radionuclides in several animals and factors influencing these physiological processes are reviewed. Inhalation of strontium and iodine in rats and mice was generally followed by rapid lung clearance and translocation to tissues that accumulate the isotope after its entry to the body by other routes. Very insoluble compounds such as Pu 239 PuO2 were retained in the lung for a long period with slow translocation to other tissues and slow excretion. Pu 239 showed major translocation to tracheobrochical lymph nodes in both dogs and mice. Retention differed in dogs and mice. Mice surviving 500 days after inhalation of Pu 239 PuO2 or Ru 106 RuO2 showed lymphatic pathology and minor pulmonary pathology. Doses greater than 0.3 uCi of PuO2 resulted in early mortality. Histological examinations showed no malignant pulmonary tumors. Limited histologic studies of tracheobronchial lymph nodes from dogs after intratracheal deposition of 20 uCi of Pu 239 PuO2 showed characteristic radiation damage two years later. Autoradiograms confirmed a greater deposition of Pu 239 in tracheobrochial lymph nodes than in the lungs following inhalation of 2 uCi. Circulating lymphocyte count was decreased. Chronic inhalation by mice of 10(E-5) uCi Sr 90 SrSO4/cc of air and less, caused minor hematologic changes but no increase in leukemia after two years. (ST)

Table 1 gives the distribution of radioactive PuO2 and PuO2 in mice and dogs following inhalation. Table 2 reviews pulmonary retention of radioisotopes in several animals and man. Table 3 gives translocation of inhaled PuO2 and RuO2 to various tissues at various times. Table 5 gives the effects of inhaled radionuclides in mice. Tables 6 and 7 give hematological changes observed in mice after inhalation of SrSO4.

<398>

<398>
Alexander, L.T., E.P. Hardy, Jr., and H.L. Hollister, U. S. Department of Agriculture, Soil Survey Laboratory, Beltsville, MD; Health and Safety Laboratory, New York, NY; U.S. Atomic Energy Commission, Division of Biology and Medicine, Washington, DC. 1960

Radioisotopes in Soils: Particularly with Reference to Strontium 90. Part of Caldecott, R.S. and Snyder, L.A. (Eds.), Proceedings of a Symposium on Radioisotopes in the Biosphere held at University of Minnesota, Minneapolis, Minnesota, 1959. (p. 3-22), 597 p.

The distribution of Sr 90 on a global basis from the standpoint of soil measurements and in relation to latitude and rainfall was studied. A detailed picture of Sr 90 distribution along two approximately constant rainfall lines in the United States was obtained along with information on some "hot spots" in the United States. The contribution of rainfall, world wide fallout and fallout from the Nevada Test Site to these values is discussed. Other fission products in soils measured by gamma spectrometry were discussed with regard to isotope ratios. (ST)

Tables 3-7 give Sr 90 soil sampling data at various global latitudes between 1953 and 1958. Table A in the appendix contains global Sr 90 soil sampling in relation to rainfall (1959); table B lists Sr 90 in United States soils at various locations.

<399>
Kalani, D.K., Industrial Toxicology Research Center, Lucknow, India. 1972, October

Analysis of Indian Monozite Sand in Animal Tissues, Part 2. Indian Medical Journal, 66(10), 191-195

The feasibility of using a direct colorimetric method for the analysis of mineral samples for uranium content was investigated. The method is based on the yellow color produced by uranyl ions and NH_4SCN in dilute mineral acid solution. Results of monozite sand analysis for rare earths, thorium, cerium, phosphorus and uranium are given. (ST)

<400>
Not given, Argonne National Laboratory, Argonne, IL. 1963, October

Biological and Medical Research Division Semiannual Report, July through December 1962. ANL-6790; 236 p.

Thirty-eight papers are included in the ANL Biological and Medical Research Division semiannual report. Two articles concerning plutonium removal were abstracted separately for the data base. The types of studies done concern gamma and x radiation effects, immune mechanisms, radionuclide toxicity, carcinogenesis, biochemistry, cell fractionation, genetics, microscopy techniques, metabolism, and physiology. The studies cover plants, microorganisms and laboratory animals. (ST)

<401>
Atherton, D.R., and R.D. Lloyd, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, March 31

The Distribution and Retention of Californium 249 in Beagle Soft Tissue. COO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 299-305), 380 p.

Beagles injected intravenously with Cf 249 (2.8 uCi/kg) in citrate buffer of pH 3.5 were sacrificed 7 days and 3 weeks after injection. As with americium, the concentration of californium in the liver was highest of all soft tissue but the total was about 15 to 20%, whereas the beagle liver retains about 50% of injected americium at comparable times. Concentrations in other soft tissue ranged from 70% of that in the liver downward. The thyroid, kidney, spleen, lymphatic tissue and dura mater showed significant concentrations. The presence of californium was ubiquitious but in very low concentrations throughout all other soft parts; the brain, lungs, heart, gastrointestinal tract, pancreas, gonads, thymus, pituitary, and adrenals being measured specifically, as were large samples of fat, muscle and pelt. From these initial studies it is seen that of the soft tissues, liver, thyroid, and kidneys will be at greatest risk following administration of Cf 249. (Auth)

See also Health Physics, 22(6), 675-677

<402>
Atherton, D.R., B.J. Stover, W.S.S. Joe, W. Stevens, and F.W. Bruenger, University of Utah, College of Medicine, Radiobiology Division, Department of Anatomy, Salt Lake City, UT. 1972, March 31

Skeletal Retention and Distribution of Polymeric and Monomeric Plutonium 239 in Beagles. COO-119-246; Part of Dougherty, T.F., Research in Radiobiology, Annual Report of Work in Progress in the Internal Irradiation Program, (p. 126-136), 380 p.

Plutonium 239(+4) was given intravenously to beagles in: 1) the Pu-transferrin complex (Pu-T sub f), 2) the 0.08 M citrate buffer (Pu-M), and 3) as a suspension of near colloid size particles (Pu-P) at pH approximately 6. As expected, the overall distribution of the polymeric form of plutonium does not resemble that observed when it is administered as the monomeric complex with citrate or transferrin. The skeletal retention of plutonium, when injected in a monomeric form, is 50% of the injected dose. The retention of Pu-P in the skeleton was less than 1/20 that seen in Pu-M or Pu-T(f) at comparable times. The uniformity of skeletal distribution of Pu-P from bone to bone is markedly less than that seen with the two monomeric forms. Reduced skeletal retention in animals injected with Pu-P indicates a different skeletal retention mechanism in animals injected with polymeric plutonium. Autoradiographs clarify this point. (Auth)

<403>
Hempelmann, L.H., W.H. Langham, C.R. Richmond, and G.L. Voelz, Los Alamos Scientific Laboratory, Health Division, Los Alamos, NM. 1973, November

Manhattan Project Plutonium Workers, a Twenty-Seven Year Follow-Up Study of Selected Cases. Health Physics, 25, 461-479

Twerty-five male subjects who worked with plutonium during World War II under extraordinarily crude working conditions have been followed medically for a period of 27 yr. Within the past year, 21 of these men have been examined at the Los Alamos Scientific Laboratory, and three more will be studied in 1973. In addition to physical examinations and laboratory studies (complete blood count, blood chemistry profile and urinalysis), roentgenograms were taken of the chest, pelvis, knee and teeth. The chromosomes of lymphocytes cultured from the peripheral blood and cells exfoliated from the pulmonary tract were also studied. Urine specimens assayed for plutonium gave a calculated current body burden (excluding the lungs) ranging from 0.005 to 0.42 uCi, and low-energy radiation emitted by internally deposited transuranic elements in the chest disclosed lung burdens probably of less than approximately 0.01 uCi. To date, none of the medical findings in the group can be attributed definitely to internally deposited plutonium. The bronchial cells of several of the subjects showed moderate to marked metaplastic change, but the significance of these changes is not clear. Diseases and physical changes characteristic of a male population entering its sixth decade were observed. Because of the small body burdens on the order of the maximum permissible level in these men so heavily exposed to plutonium compounds, we conclude that the body has protective mechanisms which are effective in discriminating against these materials following some types of occupational exposures. This is presumably explained by the insolubility of many of its compounds. Plutonium is more toxic than radium if deposited in certain body tissues, especially bone; however, from the practical point of view, plutonium seems to be less hazardous to handle. (Auth)

<404>
Fowler, E.B., J.L. Warren, R.A. Pashman, and J.W. Healy, Los Alamos Scientific Laboratory; Los Alamos, NM. 1973, May

Transuranic Waste Research and Development Program. LA-5281-MS; 26 p.

The progress of the Transuranic Waste Research and Development Program at the Los Alamos Scientific Laboratory for the period November 1, 1972-March 1, 1973 is reviewed. The results of a survey of transuranic waste streams and waste management practices at six major AEC installations indicated the wide variety of wastes and waste handling practices in existence and the need for some uniformity in record keeping. Preliminary results of experimental studies of corrosion sources and mechanisms using 17C 55-gallon drums suggest that unrelieved stress may be a major contributor to the corrosion of the drum. Combustion studies of typical waste types demonstrated the production of large quantities of smoke and gases but failed to produce a flame at temperatures up to 450 degrees C. Leaching studies showed that plutonium is removed from the wastes by water at a rate that decreases after the first few hours of contact. Progress on the development of an assay system to detect radioactive contaminants in very low concentrations in waste is reported. (Auth)

<405>
Hackett, P.L., W.J. Clarke, V.G. Horstman, and L.K. Bustad, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1961, January 10

Blood Constituents in Pitman-Moore, Palouse and Hormel Swine. HW-69500; Part of Hungate, F.P. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1960, (p. 188-186), 195 p.

A summary of data on blood constituents compiled from sampling normal swine that are being used as control animals in studies of the biological effects of various radionuclides, including I 131, Sr 90-Y 90, Ra 226, and Pu 239, is given. The values for serum and cellular constituents are summarized in tabular form and are compared with reported values for man. The ratio of neutrophils to lymphocytes in Hormel swine was greater than unity compared with that in Pitman-Moore and Palouse swine. No other differences in blood constituents between the breeds were detected during the period of study. (ST)

<406>
Babb, A.L., University of Washington, Nuclear Reactor Laboratories, Seattle, WA. 1972, August 29

Plutonium Contamination Incident of June 13, 1972. DOCKET-50139-2; 38 p.

The second part of a description of the plutonium contamination incident of June 13, 1972 which occurred at the Nuclear Reactor Laboratories, University of Washington is reported. Included are: description of air sampling; area surveys and environmental samples; cleaning methods; Au 239 and U 233 target analyses; personnel dosimetry; and conclusions about the cause of the incident, personnel exposures, and factors affecting discovery suppression, and recovery operations. Reactor room, environmental, and personnel sampling data are given in appendices. (ST)

<407>

<407>
Jackson, P.O., and B.O. Stuart, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1969, June

The Determination of Trace Levels of Uranium, Thorium 230, Lead 210, and Polonium 210 in Soft Tissues. BNWL-105 (Part 2); Part of Annual Report for 1968, (p. 1-6), 234 p.

A method for the determination of trace concentrations of U, Th 230, Pb 210, and Po 210 in soft tissues of animals exposed to airborne uranium ore dust has been developed. The techniques have been applied to such tissue samples as lung, liver, spleen, kidney, and lymph node, as well as bioassay material such as urine. (Auth)

<408>
Havens, R., and K.C. Dean, Salt Lake City Metallurgy Research Center, Bureau of Mines, Salt Lake City, UT. 1969, August

Chemical Stabilization of the Uranium Tailings at Tuba City, Arizona. BM-RI-7208; 12 p.

Acidic and basic uranium leach plant residues located on the Navajo Indian Reservation, Tuba City, Arizona, were successfully stabilized against wind erosion using a relatively low-cost chemical method. An elastomeric polymer chemical was applied to the dike areas and a calcium magnesium lignosulfonate to the beach areas of three tailings ponds. The water-soluble chemicals were applied with an automated sprinkling system. The stabilization cost was $335 per acre for the 34.5-acre tract. (Auth)

<409>
Anspaugh, L.R., P.L. Phelps, G. Holladay, S.R. Bishop, J.C. Taylor, V.G. Fowler, K.O. Hamby, and W.E. Bell, Lawrence Radiation Laboratory, Biomedical Division, Livermore, CA. 1969, July 22

Distribution and Redistribution of Airborne Debris from the Schooner Event. UCRL-50718; Part of the Biomedical Division Preliminary Report for Project Schooner, (p. 6-28), 75 p.

Following the Schooner Event radioactivity concentrations in the air were monitored with air sampling equipment activated by a predetermined radiation level to study whether redistribution occurs under the influence of changing meteorological conditions and to what extent it occurs. Data from these studies will be used to evaluate the biological hazards of radioactive particulate to man from redistribution of nuclear debris following a cratering event. The results showed that significant redistribution of debris ocurred on site and that high levels of activity occurred off-site. Analysis of radionuclides present in the air filter samples showed that the most predominant activities at fairly early times were due to the isotopes of tungsten. Comparisons of data and air activity between stations indicated that the activity over extended time periods was due to resuspension from the fallout field. The air activity at close-in locations remained high for long periods of time after detonation. Secondary peaks of air activity were seen as late as two to four days postshot and amounted to as much as 30% of the initial activity. It was concluded that long term ecological studies on biological availability are feasible at these contaminated areas. (ST)

Table 3 lists air activities of radionuclides at a typical station from one to one and one-half hours postshot. Table 4 gives peak air activities at a station as compared to the maximum permissible air concentration for continuous exposure of occupational workers.

<410>
Hammond, S.E., C.R. Lagerquist, and J.R. Mann, Dow Chemical Company, Rocky Flats Division, Golden, CO. 1968, January-February

Americium and Plutonium Urine Excretion Following Acute Inhalation Exposures to High-Fired Oxides. CONF-680503; Part of Proceedings of the American Industrial Hygiene Symposium held in Chase-Park Plaza, St. Louis, Missouri, May 13-17, 1968. Published in American Industrial Hygiene Association Journal, 29(1), 169-172

Twenty-five persons incurred measurable inhalation exposures during a plutonium fire in 1965. Exposures ranged up to 17 times the maximum permissible lung burden as estimated by whole body counting. Urine excretion of americium and plutonium was studied for six months following the accident. The ratio of plutonium to americium alpha activity in the urine averaged 1.5-1. The exposure material initially contained an alpha ratio of 11-1, plutonium to americium. There was no apparent change in this ratio with time during the period of study. Typical excretion curves for subjects treated with DTPA and for nontreated subjects are discussed. (Auth)

<411>
Hayden, J.A., Dow Chemical Company, Rocky Flats Division, Golden, CO. 1973

Tracking Plutonium at Rocky Flats. CONF-730960; Part of Proceedings of the 19th Annual Analytical Chemistry Symposium held in Jackson Hole, Wyoming, September 3, 1973, (12 p.)

The fission track method was used to measure PuO_2 particles inside work areas, in effluent air and in biological tissue. Extremely small particles were found inside a work area, 70% of the particles were 0.07 m or less. Extrapolation indicates a count median diameter of 0.02 to 0.03 m. PuO_2 particles in stack effluents were measured over a 6 month period. The count median diameter (CMD) was consistently around 0.09 m. A number of particles (0.07 to 0.15 m) were located and measured in lymph node tissue. (Auth)

<412>
Casarett, G.W., University of Rochester, School of Medicine and Dentistry, Department of Radiation Biology and Biophysics, Rochester, NY. 1973, June

Pathogenesis of Radionuclide Induced Tumors. CONF-720505; AEC Symposium Series No. 29; Part of Sanders, C.L., et al (Eds.), Proceedings of the 12th Annual Hanford Biology Symposium on Radionuclide Carcinogenesis held at Richland, Washington, May 10-12, 1972 (p. 1-14), 500 p.

The general aspects of the mechanisms of carcinogenesis, the contribution of radiation injury to these mechanisms, and the general principles of radiation carcinogenesis with respect to the question of threshold dose, dose-incidence relationships, influence of dose rate and radiation quality, and relevant dose are reviewed. These considerations are followed by a general discussion of the carcinogenic pathogenesis of various radioisotopes. The distribution and the degree of radiation effects, including neoplastic effects, in the body from internal radioactive isotopes are conditioned by: physical-chemical form; amount administered; route of administration; changing tissue distribution and rate of excretion; radioactive decay of the isotope and its daughters, type and energy of radiations, linear energy transfer, and relative biological effectiveness; and radiosensitivity and neoplastic susceptibility of the irradiated tissues. Pituitary, thyroid, bone, lung, and soft tissue tumor induction by various radionuclides are discussed. Specific attention is given to the mechanism of tumor induction in each of the tissues. (ST)

<413>
Clarke, R.H., Berkeley Nuclear Laboratories, Central Electricity Generating Board, Berkeley, Gloucestershire, England. 1972, October

PISP, A Comprehensive Computer Program for Generating Fission Product Inventories. Health Physics, 23, 565-572

The PISP program produces number densities and activities of fission products for any type of reactor fuel after any irradiation history, together with beta-heating within the fuel and multigroup gamma-spectra for shielding calculations. The program considers all the radioactive and stable nuclides between Zn 72 and Dy 161, their yields being tabulated for thermal and fast fission in U 235, Pu 239 and Pu 241 and for fast fission in U 238. The program uses several novel features in the evaluation of the fission product inventory which makes it extremely fast and simple to use. PISP is written in Fortran IV (H) and takes about 0.4 sec per case on the IBM 360/85 computer. The program is in use with the United Kingdom Atomic Energy Association and Design Companies in the United Kingdom as well as the Central Electricity Generating Board. (Auth)

<414>
Saenger, E.L., University of Cincinnati, Cincinnati, OH. 1971

Care of Patients Involved in Radiation Accidents, Recent Advances. CONF-700671; Part of Proceedings of the 11th Symposium of the German Medical Radiologists Protection Association held in Zurich, Switzerland, June 19-20, 1970, (25p.); Part of Braun, H., et al (Eds.), Radiation Accidents and their Treatment, Diagnosis, Pathology, Therapy, and Prophylaxis. Georg Thieme Verlag, Stuttgart, Germany, (p. 53-78), 133 p.; Strahlenschutz Forschung und Praxis, 11, 54-78

The recommendations set forth in the paper enable the physician, and to some degree the health physicist, to prepare and have ready an adequate medical program for the care of employees, visitors, and the general public who might be exposed to or injured by radiation in a given installation under any possible circumstance. The principles described are applicable to civilian and military situations both for high and low levels of radiation and for short and long term external and internal contamination. (ST)

<415>
Taylor, D.M., and C.J. Danpure, Institute of Cancer Research, Department of Biophysics, Sutton, Surrey, England. 1969

Lysosomal Uptake of Actinide Elements. Part of Proceedings of the 49th Meeting of the Biochemical Society held at Queen's University, Belfast, Ireland, September, 4-5, 1969, (p. 53)

Male Marshall-August hybrid rats were injected intravenously with 0.5-2 uCi of Pu 239, Am 241, or Ac 227 in the citrate or nitrate form and killed from one hr to 90 days later. Solutions were filtered before injection to remove polymeric material. At one hr after injection, most of the plutonium or americium in liver or testes was in the soluble fraction, but at longer time intervals most was in the lysosomes. Similar results were obtained in limited studies of actinium distribution in liver. The results showed that lysosomal uptake of plutonium, americium and actinium occurs in liver and/or testes within a relatively short time after injection of the metals in a soluble form. (ST)

<416>

<416>
Holzer, A., Lawrence Radiation Laboratory, Livermore, CA. 1971, July

Plowshare and the Environment. Nuclear Technology, 11, 315-322

Some of the environmental aspects of using nuclearly stimulated natural gas in the production of electric power are analyzed and the consequences are compared with those resulting from a similar use of coal and oil. A valid basis of comparing the effects of SO2 emitted by coal and oil fired power plants with the effect of tritium and Kr 85 emitted by a plant using gas derived from nuclear stimulation is developed. Results of gas analysis for radionuclides from the Plowshare Program's Gasbuggy and Rulison Projects are reviewed. Emissions from a hypothetical 1000 MW plant using coal, oil, or nuclearly stimulated gas are compared. Tritium and Kr 85 concentrations are computed, converted to dose, and compared with doses from natural and manmade radioactive sources. (ST)

<417>
Iskra, A.A., N.V. Kulikov, and V.G. Bakhurov, Academy of Sciences of the USSR, Institute of Ecology of Plants and Animals, Urals Branch, USSR. 1970, March-April

Role of Freshwater Vegetation in Processes of Migration and Distribution of Natural Radioactive Elements in the Reservoir. Ecology (USSR), 2, 157-162

The accumulation of uranium 238, radium 226, and thorium 232 by various species of freshwater plants and the distribution of these elements among the principal components of a noncirculating reservoir were studied under experimental conditions. The coefficients of accumulation and concentration fluctuated from tens to hundred thousands of units depending on the plant species and the physicochemical properties of the element. For each element several plant species were specific accumulators. In a model system of freshwater reservoirs consisting of water and plants, the migrational ability of the elements in decreasing order was uranium, radium and thorium. In a model system consisting of water, soil, and plants, uranium accumulated predominantly in the plants, thorium in detritus and soil, and radium was distributed evenly among the components. (ST)

Table 1 gives the accumulation coefficients of radioactive elements for 27 species of aquatic plants (dry wt). Table 2 gives the concentration coefficients of radioactive elements calculated on ashed residue.

<418>
Sanders, C.L., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1967, July

Phagocytosis of Plutonium 239 PuO2 Particles. BNWL-480; Part of Thompson, R.C. and Swezea, E.G. (Eds.), Annual Report for 1966, (p. 103-105), 207 p.

Phagocytosis of carbon particles by peritoneal macrophages of the rat was more rapid than phagocytosis of Pu 239 PuO2 particles. Phagocytosis of Pu 239 PuO2 was maximal at 1 and 4 hr after administration, when determined by visual and autoradiographic counting, respectively. Larger particles were more rapidly phagocytized than were smaller particles. Smaller particles were more rapidly cleared from the peritoneal cavity than were the larger particles. DTPA inhibited phagocytosis when given simultaneously with particles. (Auth) (ST)

<419>
Schlager, K.J., University of Michigan, Ann Arbor, MI. 1965

Alpha-Active Fallout Particles - Physical Characteristics Related to Pulmonary Exposure. Ph.D. Thesis, University of Michigan, 132 p. (Dissertation Abstracts, 25(B), 7214-7215)

Samples of atmospheric dust were collected during the two and one-half year period following the Russian series of atmospheric weapons tests in September, 1961, to determine certain physical characteristics of the alpha-active fallout particles and to provide a basis for assessing their biological significance. The size of fallout particles ranged from one to four microns in diameter. Plutonium was found to be the only alpha-active element of biological importance. Its solubility was 9% after 300 days under conditions approximating the lung environment. Air concentration of plutonium averaged 2 x 10(E-3) pCi/m3 of air. From these determinations the following assessments were made: approximately equal quantities of fallout would deposit in the upper respiratory tract and deeper portions of the lungs; removal of fallout plutonium from the lungs by physical dissolution would be negligible; and the average quantity of plutonium retained in the lungs of exposed individuals was estimated to be approximately 2 to 6 pCi. This lung burden is greater by a factor of three to ten than that predicted by other investigators. Reasons for this higher estimate are discussed. (ST)

<420>
Schell, W.R., University of Washington, Seattle, WA. 1971

Gas Counting of Tritium. CONF-710809; Part of Meghissi, A.A. and Carter, M.W. (Eds.), Proceedings of a Symposium on Tritium held in Las Vegas, Nevada, August 30-September 2, 1971. Messenger Graphics, Publishers, Las Vegas, Nevada, (p. 113-126), 807 p.

The paper reviews information on techniques of tritium measurement by gas counting and indicates how some practical problems of calibration and standardization can be simplified by the use of appropriate procedures. Gas counting by ionization chambers and proportional and Geiger counters are discussed. Techniques of sample preparation, including enrichment techniques, are reviewed. Emphasis is given to methods for measuring low levels of radioactivity. (ST)

<421>
Branca, G., P. Breuer, A.A. Cigna, and R. Amaris, Comitato Nazionale per l'Energia Nucleare, Laboratorio di Ingegneria Sanitaria, Rome, Italy; Commission of the European Communities, Luxembourg, Belgium. 1973, January 18

Applications of a Derived Formula for the Discharge of Radioactive Liquid Wastes. EUR-4897-e; 36 p.

A mathematical (compartment) model of a receiving environment is used to evaluate the behavior of radionuclides discharged into a watercourse used for drinking purposes; a watercourse used for irrigation; a lake used for fishing and the supply of drinking water; from different nuclear installations into the same hydrological system; and as gaseous wastes into the atmosphere. The radionuclides considered are tritium, plutonium 239, cerium 144, cesium 137, strontium 90, ruthenium 106, cobalt 60, and iodine 131. An application of the model is also proposed to non-radioactive pollution problems. (ST)

<422>
Not given, University of Chicago, Lemont, IL. 1972, May

Environmental Levels of Radioactivity at Atomic Energy Commission Installations. 1. Argonne National Laboratory, January-June 1971. Radiation Data and Reports, 13(5), 311-318

Results of environmental sampling of air and water for radioactivity both on and off the Argonne National Laboratory site are given for January-June, 1971. Argonne's contribution to the environmental radioactivity was primarily limited to tritium, argon 41, cobalt 60, and barium 140 in the air on the site and to tritium in waters on the site and two streams offsite. The concentrations were low and did not constitute a health hazard. (ST)

<423>
Not given, U.S. Environmental Protection Agency, Office of Radiation Programs, Washington, DC. 1972, July

Plutonium in Airborne Particulates, October-December 1971. Radiation Data and Reports, 13(7), 412

Results of analyses for plutonium in airborne particulates samples from 11 nationwide Radiation Alert Network stations (October-December 1971) are given in tabular form. (ST)

<424>
Miyake, Y., Y. Sugimura, and T. Uchida, Meterological Research Institute, Koenji-kita, Suginami, Tokyo, Japan; Tokyo Kyoiku University, Ohtsuka, Bunkyo, Tokyo, Japan. 1972, March

A New Method of Spectrophotometric Determination of Uranium in Seawater and Uranium Content with Uranium 234/Uranium 238 Ratio in the Pacific Water. Records of Oceanographic Works in Japan, 11(2), 53-63

A new method of determination of uranium in seawater is described. The uranium is adsorbed on a chelating resin (Dowex A-1 or Chelex 100) under the presence of CyDTA at pH 3, and then eluted with 5 M HCl. For the spectrophotometric determination of uranium, Arsenazo-III is used at pH 1. Uranium forms 1 : 1 complex with Arsenazo-III which has a maximum absorption at 650 mu. The average recovery of uranium in seawater is 99.7 plus or minus 0.5%. By using the above method and alpha-ray spectrometry, the content of uranium of 3.31 x 10(E-6) g/l and the activity ratio U 234/U 238 of 1.13 were obtained on the average in seawater in the western North Pacific off Japan and the Japan Sea. (Auth)

<425>
Burson, Z.G., EG&G, Inc., Las Vegas, NV. 1974, January

Environmental and Fallout Gamma Radiation Protection Factors Provided by Civilian Vehicles. Health Physics, 26, 41-44

Environmental and fallout gamma radiation protection factors (PF's) were estimated for a variety of civilian transportation vehicles using measurements of the natural terrestrial radiation as a source. The PF values are below 2 in light vehicles, truck beds, or trailers; from 2.5 to 3 in the cabs of heavy trucks and in a railway guard car; and from 3.0 to 3.5 in the engineer's seat of heavy locomotives. This information can be useful in planning the possible movement of personnel from or through areas contaminated either by a wartime incident or a peacetime accident. The information may also be useful for studying the reduction of exposure to the natural terrestrial radiation environment provided by vehicles. (Auth)

Fallout protection factor (PF) is defined as the ratio of the exposure rate 3 ft above an infinite smooth plane of 1 hr fission products to the exposure rate at the point in question.

<426>
Burton, L.K., and J.S. Cole, Central Electricity Generating Board, Berkeley Nuclear Laboratories, Berkeley, Gloucestershire, England. 1967

Environmental Radioactivity and Body Burden. CONF-555; Part of Fish, B.R. (Ed.), Proceedings of an International Symposium on Surface Contamination held in Gatlinburg, Tennessee, June, 1964. Pergamon Press, Oxford, England, (p. 309-316), 423 p.

At Berkeley Nuclear Laboratories an experimental program is being set up to investigate the development of instruments to provide a rapid measure of the contamination due to specific nuclides and the internal dose to the individual from given contamination levels. The program should result in data on air and surface contamination values from conventional techniques, air activity from personal air samplers, some urine and fecal activities, and body burdens that will be used to obtain information on the relevance of the present working limits of contamination to the hazard to the individual. An air monitor instrument (impactor) is discussed in terms of technical assessment, particle size selection, performance, and counting efficiency. (ST)

<427>

<427>
McClelland, J. (Comp.), Los Alamos Scientific Laboratory, Los Alamos, NM. 1955, August

The Determination of Tritium in Urine and Water. LA-1858; Part of Analytical Procedures of the Industrial Hygiene Group, Chapter 26, [p. 140-154], 173 p.

The sample is prepared for counting in a vacuum line. Urine or water is dropped onto metallic calcium, and hydrogen and tritium are evolved. The gas flowing into the evacuated system is passed through liquid nitrogen cooled traps to remove unreacted water and condensable gases. The gas is allowed to flow into a tube similar to a Geiger-Muller tube until a pressure of 15 cm of mercury is attained. Ethylene and argon are added to give a total pressure of 22 cm of mercury. The beta activity is counted with a scaling circuit having an input sensitivity of 1/4 volt. A tube similarly filled with inert hydrogen is counted simultaneously to determine the environmental background. The ground count is subtracted from the sample count to obtain the true sample count. The method has an efficiency of approximately 40% and a precision of plus or minus 5% between the range of 1 to 250 uCi/liter of tritium. Samples with higher concentrations may be determined with appropriate dilutions. The tolerance for tritium in urine used at LASL is 250 uCi/liter. The biological half-life of tritium is about 10 days. This may be decreased by increasing the fluid intake of the individual. (Auth)

<428>
Moreira, L., and C. Lalou, University Federal, Salvador, Brazil; CNRS, Centre des Faibles Radioactivites, Gif-sur-Yvette, France. 1972, March

Experimental Study of the Ratio Uranium 234/Uranium 238 in Natural Waters Having Passed through Different Types of Rocks. Anais da Academia Brasileira de Ciencias (Brazil), 44(1), 13-18 (French, English Summary)

Alpha-ray spectrometry measurements of the ratio U 234/U 238 and of the u 238 content were made in water samples prepared by percolating through various kinds of rocks. Uranium content in the same rocks was measured by gamma-ray spectrometry. The uranium 238 content found in water samples seems to be a function of the soluble uranium content in the rock and for this reason, of its state of weathering. The U 234/U 238 ratio in the water samples after percolation is in general greater than one, which proves the greater solubility of u 234 in nature. We found a greater radioactive disequilibrium in water samples after percolating igneous rocks than after percolating sedimentary rocks. (Auth)

<429>
McClelland, J. (Comp.), Los Alamos Scientific Laboratory, Los Alamos, NM. 1955, August

Analytical Procedures of the Industrial Hygiene Group. LA-1858; 173 p.

Analytical procedures used by the Industrial Hygiene Group of the Los Alamos Scientific Laboratory have been compiled. The report includes a wide variety of analyses, principally on urine and air samples, but also on water, blood, oil, and other materials. Along with each procedure for the analysis of an air sample, the currently accepted maximum allowable concentration is given when available. The following determinations are given by chapter; acetone in air; americium in urine; anthracene in air; arsine and arsenic in air and water; barium in air; beryllium in air or swipe samples; boric acid and boric acid salts in air; cadmium in air, water, and general; chlorinated hydrocarbons; cyanide in air; fluorides in air; iron in air; lead in air, urine, and general; lithium in air; mercury in air and urine; methanol in air; naphthalene in air; nitrogen oxides; cutting oil mists in air; phosphorus in air; plutonium in urine; polonium in urine; sodium hydroxide in air; sulfate ratio in urine; trinitrotoluene in air; tritium in urine and water; uranium in urine and air; and zinc in air. Four of the chapters have been selected for separate abstracts for the data base. (ST)

<430>
Zirkle, R.E. (Ed.), University of Chicago, Institute of Radiobiology and Biophysics, Chicago, IL. 1951

Effects of External Beta Radiation. National Nuclear Energy Series, Division B, Plutonium Project Record, Volume 22E. McGraw-Hill Book Company, Inc., New York, New York, First Edition, 242 p.

This volume is one of a series which has been prepared as a record of the research work done under the Manhattan Project and the Atomic Energy Commission. The work reported was part of an intensive radiobiological program carried out during World War II at Clinton Laboratories, Oak Ridge, Tennessee. The main topics covered are: techniques of external radiation with beta rays, gross effects of beta radiation on restricted surface of rabbits and total surface of mice, rats and rabbits; comparative lethal effects of beta radiation and rate of recovery from whole body beta radiation; additivity of lethal effects of external beta and gamma irradiation; effects of beta radiation on metabolism in rats and on peripheral blood of rabbits; histopathological effects of whole body beta irradiation in mice; reactions of human skin to single doses of beta rays; delayed effects of single exposures to external beta rays; effects of periodic whole body beta irradiation; and occurrence of cutaneous and subcutaneous tumors and tissue abnormalities in rats following exposure to beta radiation from P 32 sources. Information on the tumor inducing action of superficial radiation is reviewed. (PHH)

<431>
Not given, Argonne National Laboratory, Argonne, IL. 1972

Program and Abstracts: Eighteenth Annual Conference on Bioassay, Environmental, and Analytical Chemistry, October 10-11, 1972. ANL-8014; 39 p.

Abstracts are given for the papers presented at the conference. Some of the individual papers will be included later in the Data Base. The main topics covered at the conference are: impact statements for nuclear facilities; Pu fallout; distribution of tritium in environmental samples; radionuclides in benthic materials and radioactivity levels in wild deer; excretion of Po 210 and Pu following inhalation; and U, Pu, and Ra in man and human dose from tritiated luminous watches. Some sessions dealt mainly with analytical methods and among those mentioned are isotope dilution analysis, electrostatic separation, liquid scintillation counting, autoradiography, methods for evaluating Pu 239-Am 241 in soil samples, determination of I 129 in milk and water, and scintillation counting for determination of Am 241 in liver and skull bones of baboons. (FMM)

<432>
Pink, R.M. (Ed.), University of California, School of Medicine, Los Angeles, CA. 1950

Biological Studies with Polonium, Radium and Plutonium. National Nuclear Energy Series, Manhattan Project, Division 8. McGraw-Hill Book Company, Inc., New York, New York, 411 p.

This volume is one of a series which has been prepared as a record of the research work done under the Manhattan Project and the Atomic Energy Commission. It reports the experimental studies carried out by the Biological Chemistry Section of the Division of Radioactivity in the Manhattan Department of the University of Rochester. The general problem undertaken was a comparison of the biological effects of three elements, polonium, plutonium, and radium, which had the common property of radioactive decay with emission of alpha particles. The report on the work carried out can be divided rather naturally into three main parts. Part 1 deals with the distribution and excretion of polonium in man and animals; Part 2 discusses the distribution and excretion of radium; and Part 3 deals with the comparative toxicities of polonium, plutonium, and radium in rats. The Manhattan Project reports on these subjects have been condensed and correlated, and, wherever feasible, pertinent data obtained subsequent to the writing of the original reports have been included. The three elements investigated proved to be very interesting ones for comparison studies in that they differ widely in their half-lives, distribution in the body, and rate of excretion. These differences appear to be reflected in their relative toxicities. (FMM)

<433>
Finkel, M.P., Argonne National Laboratory, Biology Division, Chicago, IL. 1947

The Transmission of Radiostrontium and Plutonium from Mother to Offspring in Laboratory Animals. Physiological Zoology, 20, 405-421

Mice which were injected with 5.0 or 2.5 uCi/gm of Sr 89 before conception produced a smaller number of litters than did the controls. Treatment during pregnancy with 10 or 5 uCi/gm of Sr 89 or 0.06, 0.03, or 0.016 uCi/gm of plutonium increased the percentage of totally stillborn deliveries, as well as the number of stillborn young in viable litters. The mice which were treated during pregnancy with either Sr 89 or Pu lived longer, on the average, than did similarly treated nonpregnant female mice. In addition, radiation damage was less severe among the Pu-treated mothers than it was among nonmothers. The amount of Sr 89 retained by the mothers immediately after parturition was the same as that retained by virgin adult females at comparable time intervals after injection. A portion of the material that would ordinarily have been excreted was lost through the placenta. The percentage of the maternal dose of either Sr 89 or Pu that was found in the young at birth varied with the injection-delivery interval. The Sr 89 activity per gram of body weight of the newborn mouse exceeded that of the mother at the time of delivery if parturition occurred within the first 8 days after administration. At the levels studied, the concentration of Pu in the young never exceeded 8 percent of the concentration in the mother. Treatment of the young animals was continued during the period of suckling by the transfer of both Pu and Sr 89 through the breast milk. The initial excretion of Sr 89 by very young mice is considerably lower than is the initial excretion by adults. The animals which were treated in utero and before weaning with Sr 89 have shown retardation of growth, malformation of the long bones, anemia, and osteogenic sarcoma. The animals of the Pu series have developed no pathologic conditions to date. There is no indication that fetal and very young tissues are either more or less sensitive to Sr 89 and to Pu than are adult tissues. (Auth)

<434>
Christensen, W.R., University of Utah, College of Medicine, Radiobiology Laboratory, Salt Lake City, UT. 1957, March 31

Radiology Report. AECU-3522; Part of Annual Progress Report, (p. 55-56), 177 p.

Routine, periodic studies of normal and poisoned animals have been continued in an effort to detect minimal changes of heavy metal injury at the earliest possible date and to ascertain the general skeletal effects induced by the materials under test. (LCW)

<435>

<435>
Cochran, T.N., University of Utah, College of Medicine, Radiobiology Laboratory, Salt Lake City, UT. 1957, March 31

Histopathological Findings. AECU-3522; Part of Annual Progress Report, (p. 73-85), 177 p.

The soft tissue histopathology of 51 toxicity beagle dogs are described. The acute toxicity changes are most evident in the kidney, liver, and intestine in plutonium injected animals. The long term plutonium animals show regenerative nodules of the liver. Partial destruction or atrophy of lymphoid tissue is seen as early as 24 hours after injection of plutonium and this moderate atrophy persists to a relative degree throughout the duration of the studies. Reticuloendothelial response, namely extramedullary hematopoiesis and hemosiderin deposition, is most evident in long term 5 level plutonium and 8 level thorium animals. (Auth) (LCH)

Table 1 gives the relative sites of blood formation in toxicity dogs with the categories in the table being time post injection in days, vertebral marrow, femoral marrow, hematopoiesis spleen, hematopoiesis liver and hemosiderin spleen.

<436>
Cohen, N., and M.E. Wrenn, New York University Medical Center, Institute of Environmental Medicine, New York, NY. 1973

Metabolic Characteristics of Americium 241 in the Adult Baboon. Radiation Research, 55(1), 129-143

The metabolism of Am 241 injected intravenously as the citrate was studied in four adult female baboons for periods ranging up to 6 months postinjection. In vivo retention measurements were made with beta-scintillation detectors positioned over the whole body and over various specific organ sites. In addition, Am 241 concentrations were measured in urine, feces, blood, and biopsy samples of liver and the frontal bone of the calvarium to determine the rates and routes of deposition and excretion. By these techniques and from data obtained at sacrifices at 1 and 3 months postinjection, it was determined that the major early sites of deposition of Am 241 in the baboon are in bone (approximately or equal to 45%) and liver (approximately or equal to 26%). Furthermore, the elimination rate of Am 241 from bone was considerably slower (T 1/2 eff. equals several years) than that from the liver (T 1/2 eff. from 1.5-8 months). The activity present in the liver appears to be almost totally excreted via the fecal route. (Auth)

<437>
Dahlman, O., The Research Institute of National Defense, Stockholm, Sweden. 1973, June

Seismic Source and Transmission Functions from Underground Nuclear Explosions with Known Yields at Nevada Test Site. FOA-4-0345-A-1; 38 p.

A model is presented for the simultaneous determination of the relative variation in transmission properties to different stations and of the relative differences between the seismic sources for closely spaced underground nuclear explosions recorded by a fixed seismological station network. The model is applied to shortperiod data reported from 24 globally distributed stations from 12 underground nuclear explosions with known yields at Nevada Test Site. The obtained transmission functions vary within a factor of 10 between the different stations and show a weak decrease with epicenter-distance and little correlation with Gutenberg amplitude-distance curve. The relative source functions for 10 explosions in tuff and rhyolite, with yields in the range 16-1200 kt are with good correlation proportional to explosion yield to 0.9. Two theoretical models, one by Haskell and one by Mueller-Murphy, are compared with each other and they agree well for frequencies around 1 Hz and for yields in the range 3-300 kt. The Haskell model for tuff is modified to be more compatible with the models for salt, granite and alluvium. The Haskell model predicts stronger amplitude variation with frequency and yield than the Mueller-Murphy model. The observed relative source functions are compared with the relative amplitudes obtained from the two source models. The agreement is fairly good when some modifications of the parameters in the Haskell models are made. (Auth)

<438>
Davies, C.N., London School of Hygiene and Tropical Medicine, London, England. 1964, July 25

Inhaled Radioactive Particles and Gases. Part of Proceedings of the 3rd Hanford Biology Symposium held in Richland, Washington, May 4-6, 1964; Nature, 203(4943), 352-355

The risks of inhaled radioactive particles and gases from nuclear auxiliary power units, and nuclear-powered rocket engines were discussed at the third Hanford Biology Symposium. Handling aerosols of mixed fission products and generation of laboratory clouds of aerosol sprays were also discussed. The problems relating from exposure to various particle sizes were subjects in the symposium. Phases of lung clearance were identified and lung studies involving dogs, rats, rabbits and man were included. (HP)

<439>
Dilley, J.V., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA 99352. 1972

The Origin of Urinary Taurine Excretion During Chronic Radiation Injury. Radiation Research, 50, 191-196

Increased urinary taurine levels were observed in dogs that had a chronic lymphopenia for 2 1/2 to 3 years after inhaling Pu 239 PuO2 aerosols. A correlation between the onset of lymphopenia and increased taurine excretion was also noted in dogs within three months after inhaling Pu 239 PuO2. Humans undergoing extracorporeal irradiation for the treatment of chronic lymphocytic leukemia demonstrated an increased urinary taurine level which correlated well with the reduction in the number of circulating lymphocytes. These data lend support to the hypothesis that the increased taurine excretion following chronic partial body irradiation originates from the destruction of circulating lymphocytes. (Auth)

<440>
Dilley, J.V., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1966, January

Taurine Excretion Following Plutonium Oxide Inhalation. BNWL-280: Part of Thompson, R.C. and Sverna, E.G. (Eds.), Annual Report for 1965, (p. 47-49), 139 p.

A decrease in circulating lymphocytes is usually correlated with an increased excretion of taurine in the urine of beagle dogs exposed to aerosols of Pu 239 PuO2. Twenty-four hour urine samples were collected from a control dog and from each of five lymphopenic dogs that had inhaled Pu 239 PuO2 three years previously. Taurine was separated on a resin column, purified by paper chromatography and spectrophotometrically determined. The results show that in in four of the five exposed beagles, taurine excretion was higher than in the control dog. It is suggested that the increased level of urinary taurine originates from, and reflects the destruction of, circulating lymphocytes. (Auth) (PHH)

<441>
Dougherty, J.H., and R. Seymour, University of Utah, College of Medicine, Radiobiology Laboratory, Salt Lake City, UT. 1957, March 31

Hematology Report. AECU-3522; Part of Annual Progress Report, (p. 57-72), 177 p.

Work in progress since the last annual report is discussed. In the routine hematology program on the toxicity dogs, three control examinations are made during the month prior to injection. The hematological values determined are hematocrit (PPRC), hemoglobin, PBC, sedimentation rate, reticulocyte count, WBC, direct eosinophil count, differential count of 400 cells and direct platelet count. To give trends and permit comparison of the effects of different isotopes on the hematopoietic system, tables are presented giving mean values of selected hematological determinations at yearly intervals for as many groups of dogs as have been on experiment for four years for each isotope. The isotopes used were Pu 239, Ra 226, Ra 228, Th 228 and Sr 90. Terminal hematology values for 7 of 9 dogs that died or have been sacrificed since the September 1956 report are tabulated and a summary of the findings is presented. Bone marrow studies on a series of 5-level test-run Pu dogs sacrificed at intervals of 1 day to 2 years are tabulated and summaries of the findings are given. Additional toxicity dogs have been added to the blood volume studies and repeat determinations have been made on toxicity dogs which have shown a change in venous hematocrit since their last determination. A discussion is presented of the studies on concentration of steroids in blood and urine, and catabolism of 4C 14 Cortisol by osteosarcoma cells. The group working in the Cancer Research Laboratory, Department of Anatomy has shown that 1) malignant cells of certain types have a steroid conversion metabolism which differs from their normal cellular counterparts and, 2) certain of these conversion products appear in blood and urine and may be of diagnostic and prognostic significance. (LCW)

A table is included on hematological determinations of 1 to 5 level Pu 239 injected dogs. Tables are presented on pre-sacrifice blood findings and bone marrow myeloid-erythoid ratios on 5-level test-run Pu dogs. A table on the blood volume studies of toxicity dogs is also included.

<442>
Dougherty, J.H., J.Z. Bowers, R.C. Bay, and P. Nayanonda, University of Utah, College of Medicine, Radiobiology Laboratory, Salt Lake City, UT. 1958, August

Comparison of Hematologic Effects of Internally Deposited Radium and Plutonium in Dogs. Part of Proceedings of the 30th Annual Meeting of the Radiological Society of North America held in Los Angeles, California, December 5-10, 1958. Published in Radiology, 65(2), 253-259.

Hematologic alterations observed during the first year following intravenous injection of Pu and Ra into beagle dogs are reported. About 90% of the Pu 239 is retained in the body and most of this is fixed on periosteal and endosteal surfaces of the bone. Approximately 25% of the Ra 226 is retained and is deposited diffusely in the bone. Hematologic responses were similar in degree when comparable amounts of the radionuclides are retained in the body. Only in erythrocyte response could any greater effect be noted for Pu. The reason for more consistant depression of red cell values was not apparent at the present stage of the study. Blood lymphocytes decreased significantly in number during the first year. (BBH)

<443>

<443>
Dougherty, J.H., and L.S. Rosenblatt, University of Utah, College of Medicine, Division of Radiobiology, Department of Anatomy, Salt Lake City, UT. 1971

Long-Term Hematological Effects of Internal Emitters in Beagles. Radiation Research, 48, 319-331

The hematological effects of five internal emitters namely, Ra 226, Pu 239, Ra 228, Th 228 and Sr 90 injected into adult beagles have been analyzed for 8 years postinjection. Five to seven dose levels were utilized per radionuclide ranging from near permissible levels to levels causing bone tumors. The main hematological alterations were depression of granular leukocytes and, to a lesser extent, erythrocytes. The depressions of leukocytes were dose dependent. Some recovery was noted at higher levels for polymorphonuclear leukocytes but not for lymphocytes. Transient depressions of blood cells were seen at lower dose levels. For any type of cell, minimal values were similar for all radionuclides and at comparable dose levels. Relative toxicities of the radionuclides to the hematopoietic system were related to deposition patterns and type of particle emission. (Auth)

<444>
Durakovic, A.B., J.G. Hollins, and M.C. Storr, National Research Council of Canada, Division of Biological Sciences, Ottawa, Ontario, Canada. 1973, May

The Influence of Age and Sex on the Metabolism of Americium by Rats. Health Physics, 24, 541-546

The retention of Am 241 by the whole body and tissues was studied in male and female rats of four ages after intravenous injection of americium in the form of citrate. Significant variations of the metabolism of americium with age and sex were demonstrated in kidney, liver, and bone. The concentration of americium by kidney and liver was positively correlated with age, while the concentration by bone was negatively correlated with age. The concentration of americium by kidney and bone was greater in male than in female rats, but the concentration by liver was greater in the female rats. The radiotoxicological implications of these results are discussed. (Auth)

<445>
Belyaev, Yu.A., Not given. 1969

Americium 241 Distribution in Rats and the Effect of Complexing Substances on Its Elimination. AEC-tr-7195; Part of Moskalev, Yu.I. (Ed.), Radioactive Isotopes and the Body, (p. 168-174), 458 p.

The distribution of americium in the body of rats after 1, 3, 14, 30, 90 and 180 days following intraperitoneal injection of americium chloride (1.2 uCi/rat) was studied. About 55% of the isotope is retained in the liver and 20-25% in the skeleton. While americium is gradually eliminated from the liver (1% of administered quantity remains after 6 months), its content in the skeleton remains constant over a half year. Americium disappears fairly rapidly from the blood: 50% of the administered dose is noted in the blood after 3 minutes and only 4% after 2 hours. DTPA and a mixture of N-aminopolyacetic acids have a strong effect on the elimination of americium. Tetracycline is least effective, lowering the americium content preferentially in soft tissues. (Auth)

Table 1 shows Am 241 content in organs and excreta of rats in % of administered dose at different periods after IP administration of Am 241 AmCl3.

<446>
Garner, R.J., U.S. Environmental Protection Agency, Radiation Office, Rockville, MD. 1972

Transfer of Radioactive Materials from the Terrestrial Environment to Animals and Man. The Chemical Rubber Company, CRC Press, Cleveland, Ohio, 57 p.

Nuclides which present a problem in the foreseeable future in transfer from the terrestrial environment to man and animals are tritium, Kr 85, I 129, I 131 and Pu 239. The data for many long-lived nuclides are inadequate to permit a valid assessment of the consequences of build-up in the environment and hence inadequate to permit little more than speculation on the significance of the impact of man's current activities upon future generations. The data necessary to make reasonable predictions of the impact of the short-lived nuclides that would predominate under circumstances of peaceful uses of atomic energy or a nuclear accident and the subsequent behavior, possibly over several decades, of many of the associated long lived nuclides are available. (HP)

Part of book on plutonium 239 abstracted separately in this data base.

<447>
Garner, R.J., U.S. Environmental Protection Agency, Radiation Office, Rockville, MD. 1972

Plutonium 239. Part of Transfer of Radioactive Materials from the Terrestrial Environment to Animals and Man. The Chemical Rubber Company, CRC Press, Cleveland, Ohio, (p. 41), 57 p.

Resuspension may become the limiting hazard to man and animals from deposited Pu 239. The criterion of hazard will be the degree of suspension of dust in the respirable size range. Although in experimental studies conducted at the Nevada Test Site little or no resuspension of Pu 239 occurred except from heavy gusts of wind or mechanical disturbance, it must be borne in mind that deposited material may become weathered or suffer disintegration to a respirable size during the process of resuspension. No studies are available to indicate if weathering increases the biological activity of Pu 239.

Whole book is abstracted separately in this data base.

<448>
Goldthorpe, H.C., S. Bennett, and R.A. Olsen, University of Utah, College of Medicine, Radiobiology Laboratory, Salt Lake City, UT. 1957, March 31

Biochemical Report. AECU-3522; Part of Annual Progress Report, (p. 115-131), 177 p.

The report is divided into four parts. The first part presents the basic clinical chemistry following radioisotope injection. The basic clinical chemistry work of this group is reported in the same manner as in previous reports, that is at thirty and sixty days, six months and at yearly intervals postinjection. Plutonium shows more blood chemistry changes than radium, radiothorium or mesothorium but the average days of life after injection with plutonium before having to be sacrificed are longer than with any of the other isotopes being studied. As the number of dogs involved in each isotope series increases the striking changes seen in the values of the various serum constitutents are less pronounced. There are still individual dogs showing striking changes but they become modified in the average values obtained with comparably treated dogs. Changes in the blood chemistry values from normal do not necessarily mean that the isotope is more toxic than another one showing smaller changes in values. The next part discusses the effects of aging on the glycoprotein and seromucoid levels in the serum. A graph is presented showing the results of the study. In part three the effects of injected radioisotopes on the blood serum glycoprotein and seromucoids are discussed. Data is tabulated for Pu, Ra, MsTh, RdTh and Sr, giving the glycoprotein and seromuccid values in mg/100 ml serum. The final part in the report discusses glycoprotein and seromucoid blood serum levels of sacrificed dogs with data tabulated for individual dogs. (LCH)

Tables are included which give the serum chemistry values and the glycoprotein and seromucoid values in mg/100 ml serum for dogs injected with Pu 239, Ra 226, Ra 228, Th 228 and Sr 90. Another table gives the glycoprotein and seromucoids values in mg/100 ml serum for sacrificed dogs.

<449>
Hamilton, E.I., Radiological Protection Service, Sutton, Surrey, England. 1972, February

The Concentration of Uranium in Man and His Diet. Health Physics, 22, 149-153

From measurements of the concentration of uranium in normal human tissues, it is estimated that a 70-kg man (ICRP Standard Man) contains a minimum of approximately 100 ug U and a maximum of approximately 125 ug U. The concentration of uranium in items of food and prepared diet from the United Kingdom suggests a daily intake of approximately 1 ug U. (Auth)

Table 1 shows the concentration of uranium in human organs and tissues. Tables 2a and 3 show the concentration of uranium in various items of diet.

<450>
Hamilton, E.I., Radiological Protection Service, Sutton, Surrey, England. 1970, October

The Concentration of Uranium in Air from Contrasted Natural Environments. Health Physics, 19, 511-520

The concentration of uranium in the air was determined by the fission track method, using polycarbonate detectors, from two contrasted natural environments, namely, the Radiological Protection Service site at Sutton, U.K., and during an ocean traverse from Belgium to Antarctica. A modal concentration of 20 x 10(E-12) g U/m3 air and 45 ug of dust/m3 air was obtained for the Sutton site which is equivalent to a modal concentration of 0.4 ppm U in the air particulate matter. A mean concentration of 4.1 x 10(E-12) ug U/m3 air was obtained for Atlantic ocean air sampled in the Northern Hemisphere; in the Southern Hemisphere, no uranium was detected in many of the samples, but a mean concentration of 3 x 10(E-12) g U/m3 air was obtained for air sampled on the land mass of Antarctica. Various sources are considered to account for the presence of uranium in the air. A correlation between the periodicity of fission products in the air and the concentration of uranium is noted. It is concluded that uranium present in the air at a particular site consists of local debris, together with distant debris transported as a result of world wide meteorological conditions. (Auth)

Figure 3 shows the variations in the concentration of uranium in a soil profile at Sutton, United Kingdom.

<451>
Harley, J.H. (Ed.), Health and Safety Laboratory, New York, NY. 1972

HASL Procedures Manual. HASL-300,(S-1): 103 p.

The first section of the Procedures Manual discusses radioactivity fundamentals, counting (detectors) and statistics. The next section is devoted to sampling principles and methods. The properties of aerosols are described, as well as instrumentation for accurate measurement of sample volume, air movers (positive displacement pumps and centrifugal pumps), application of air sampling in the evaluation and control of the occupational environment, and details of soil sampling (abstracted separately for the data base and includes some measurements for Pu 239 at various sites). Procedures are outlined for the radiochemical determination of several radionuclides including Ce 141, Cs 137, Fe 55, Fe 59, tritium, P 32 and Sr 90. (PNM)

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<452>
Hardy, E.P., Jr., Health and Safety Laboratory, Environmental Studies Division, New York, NY. 1973, January 1

Health and Safety Laboratory, Fallout Program Quarterly Summary Report (September 1, 1972 through December 1, 1972). HASL-268; 172 p.

Current data is presented from the HASL Fallout Program, the National Radiation Laboratory in New Zealand, and the EURATOM Joint Nuclear Research Center at Ispra, Italy. The initial section consists of interpretive reports on strontium 90 fallout over the Atlantic, fallout tritium and dose commitment, and quality control analyses of surface air, fallout, diet, and bone analyses during 1971. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, milk, and tap water. A bibliography of recent publications related to radionuclide studies, is also presented. (Auth)

Tables of Pu 238 and Pu 239 concentrations in surface air during 1965-1972 for several countries are given in the appendix.

<453>
Harley, J.H. (Ed.), Health and Safety Laboratory, New York, NY. 1972

Soil Sampling. HASL-300(S-1); Part of HASL Procedures Manual, (p. 43-53), 103 p.

The sampling of soil is a useful approach to determining the accumulated amounts of airborne long-lived radioactive contaminants and stable contaminants that deposit on the ground. Soil sampling is of little value in attempting to estimate small increments over a period of a few years or less and is not a good routine method of environmental monitoring except in pre-operational surveys. Collections of deposition or of airborne material are much more specific and give much more information with respect to the time when contamination occurred. Soil samples should only be used after a plant is in operation when the proper measurements have not been made beforehand and it is necessary to salvage some information after a contamination has occurred. The various purposes for which soil sampling has been adopted are described. They include deposit inventories such as the estimation of total amount of Pu released from the Rocky Flats Plant, deposition increment, agricultural availability, resuspension availability, and distribution of contaminant. The mechanical procedures recommended for sampling and for preparation of the sample are given. The procedures described include the core method, template method and depth profile. The reproducibility of sampling is discussed. (FRM)

Table 1 shows the comparison of estimates of radionuclides (Sr 90, Cs 137 and Pu 239) at nearby sites.

<454>
Hempelmann, L.H., C.R. Richmond, and G.L. Voelz, University of Rochester, School of Medicine and Dentistry, Department of Radiology, Rochester, NY; Los Alamos Scientific Laboratory, Los Alamos, NM. 1973, January

A Twenty-Seven Year Study of Selected Los Alamos Plutonium Workers. LA-5188-MS; 31 p.

Twenty-five male subjects who worked with plutonium during World War II under extraordinarily crude working conditions have been followed medically for a period of 27 years. Within the past year, 21 of these men have been examined at the Los Alamos Scientific Laboratory, and 3 more will be studied in 1973. In addition to physical examinations and laboratory studies (complete blood count, blood chemistry profile, and urinalysis), roentgenograms were taken of the chest, pelvis, knee, and teeth. The chromosomes of lymphocytes cultured from the peripheral blood and cells exfoliated from the pulmonary tract were also studied. Urine specimens assayed for plutonium gave a calculated current body burden (excluding the lungs) ranging from 0.005 to 0.42 uCi, and low-energy radiation emitted by internally deposited transuranic elements in the chest disclosed lung burdens probably of less than approximately 0.01 uCi. To date, none of the medical findings in the group can be attributed definitely to internally deposited plutonium. The bronchial cells of several of the subjects showed moderate to marked metaplastic change, but the significance of these changes is not clear. Diseases and physical changes characteristic of a male population entering its sixth decade were observed. Because of the small body burdens on the order of the maximum permissible level in these men so heavily exposed to plutonium compounds, it is concluded that the body has protective mechanisms which are effective in discriminating against these materials following some types of occupational exposures. This is presumably explained by the insolubility of many of its compounds. Plutonium is more toxic than radium if deposited in certain body tissues, especially bone; however, from the practical point of view, plutonium seems to be less hazardous to handle. (Auth)

Appendix B gives a urine assay method and equations for estimating body burden. Table 4 shows Pu body burden estimates for man following exposure. Table 5 shows accumulated average organ doses for persons exposed to Pu by inhalation.

<455>
Hillyer, R.P., and G.E. Dagle, Dow Chemical Company, Rocky Flats Division, Golden, CO. 1973, June 15

Electron Diffraction Study of Plutonium Oxide Particulates in Dog Lymph Tissue. RFP-2054; 7 p.

Popliteal lymph-node sections from beagle dogs were examined with the electron microscope in order to define localized particulates. By means of autoradiography, particulates in the lymph tissue had been determined previously to be alpha emitters (radioactive). However, with electron diffraction, the particulates have been identified as plutonium oxide (PuO_2). (Auth)

<456>
Hodge, V.F., T.R. Folsom, and D.R. Young, Scripps Institution of Oceanography, La Jolla, CA. 1973

Retention of Fallout Constituents in Upper Layers of the Pacific Ocean as Estimated from Studies of a Tuna Population. CONF-720708-10; IAEA/SM-158/15; STI/PUB/313; Part of Proceedings of a Symposium on the Interaction of Radioactive Contaminants with the Constituents of the Marine Environment held in Seattle, Washington, July 10-14, 1972, (p. 263-276), 786 p.

Repeated measurements of cobalt 60, zinc 65, manganese 54, cesium 137, silver 110m, silver 108m, and plutonium 239 in several organs of albacore tuna suggest that the upper layers of the north Pacific Ocean can retain large fractions of several species of trace elements for periods of a decade or more. For example, cesium 137 concentrations in the liver and muscle tissues of North Pacific albacore caught from 1965-1971 decreased to half in about 10 years. In comparison, the reported rate of input from fallout during this period decreased more rapidly, closer to half in one year. This suggests a strong retention of cesium 137 in the upper water masses which are accessible to the fish. It is of interest to note that long environmental persistences in the upper oceanic layers are also indicated for some other nuclides that are much more highly accumulated by organisms than is cesium. For example, cobalt 60 and silver 108m concentrations in albacore liver tissues fell to half during this period in 2.6 and 7.1 years respectively. Plutonium 239 concentrations in the livers decreased to half in about 3.5 years. The attenuation rate of zinc 65 was discontinuous between 1965 and 1968. This fact, along with observation of comparatively high ratios of zinc 65 to cobalt 60 in tunas of the southern hemisphere following 1968, suggests that new large weapons were tested that gave off relatively large amounts of zinc 65. (Auth)

Figure 7 shows the concentrations of Pu 239 in liver tissues of albacore tuna caught off the coast of San Diego from 1964-1971.

<457>
Edmundson, E., Jr., V. Schultz, and A.W. Klement, Jr., U.S. Environmental Protection Agency, Seattle, WA; Washington State University, Department of Zoology, Pullman, WA. 1972

Marine Radioecology, A Selected Bibliography of Non-Russian Literature. TID-3917 (Suppl. 1); 76 p.

The 845 references contain author, publication date, title, publication description and secondary source. No abstracts or indexes are included. (HP)

<458>
Elwood, J.W., Oak Ridge National Laboratory, Nuclear Safety Information Center, Oak Ridge, TN. 1971, July-August

Ecological Aspects of Tritium Behavior in the Environment. Nuclear Safety, 12(4), 326-337

Review of the literature indicates that tritium can be taken in by plants and animals and organically bound, regardless of means of exposure. However, there appears to be no concentration factor relative to hydrogen at any level of food chains analyzed to date. Isotope effects apparently do not significantly alter tritium behavior compared with that of stable hydrogen in natural ecosystems. Turnover times of tritium in coupled ecosystem compartments are dependent on climatic, hydrological, and meteorological factors and thus are site specific for each ecosystem. Half-times are much longer in a desert ecosystem compared with those in a tropical rain forest. The total ecosystem will have a half-time of retention at least as long as the compartment with the longest half-time. Tritium body burden is dependent on the pathways of exposure; tissue-bound fractions arise primarily from organically bound tritium in food. Biological half-lives of tissue-bound fractions are longer than the half-life of the body-water component and may be as long as one-third of the organism's life-span. Tritium in all compartments in a chronically contaminated ecosystem would be expected to be uniformly labeled with H 3, with the tritium ratio being dependent on release levels. (Auth) (HP)

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<459>
Erokhin, R.A., M.A. Koshurnikova, V.K. Lemberg, P.R. Lyubchanskii, and G.N. Reshetov, Not given. 1966

Content and Microdistribution of Plutonium 239 and Morphological Changes in the Lungs of Rats Intratracheally Administered This Isotope. AEC-tr-6944; Part of Moskalev, Yu.I., Distribution and Biological Effects of Radioactive Isotopes, (p. 122-130), 718 p.

The behavior of Pu 239 in the lungs when intratracheally administered in the form of various salts is chiefly determined by the physicochemical form of the compound administered. The Pu 239 content of the lungs following the administration of the nitrate salt of plutonium is 5-10 times as high as following the administration of sodium plutonyltriacetate. The elimination of Pu 239 following its administration in the form of the above mentioned salts obeys the exponential law, except that on administration of sodium plutonyltriacetate the elimination occurs at a much more rapid rate. The microdistribution of Pu 239 in the lungs of rats in the early stages beginning with the 3rd-8th day is relatively uniform but subsequently it becomes focal, around vessels and bronchi. A large amount of Pu 239 is transported from the lungs by the macrophages to the regional lymphatic nodes. Histological changes in the lungs depend on the pattern of microdistribution of Pu 239 and arise chiefly in the foci of build-up of the radioisotope. The earliest changes are dystrophy and desquamation of the bronchial and alveolar epithelium as well as perivascular edema. This is followed by chronic inflammation. The pathological process results in the onset of pneumosclerosis and occasionally lung cancer. The sclerotic process begins with proliferation of connective-tissue cellular elements with formation of fibrous structures. At a later stage this is accompanied by direct acellular sclerosis against a background of lympho and hemodynamic disorders and hypoxia. (Auth)

<460>
Heward, E.B., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1970, December

The Morphology of Experimental Lung Tumors in Beagle Dogs. CONF-700501; AEC Symposium Series No. 21; Part of Nettesheim, P., et al (Eds.), Proceedings of a Symposium on Morphology of Experimental Respiratory Carcinogenesis held in Gatlinburg, Tennessee, May 13-16, 1970, (p. 147-160), 483 p.

The results of a long-term study to evaluate the pathologic effects in the lungs following Pu 239 PuO2 particle inhalation, using beagle dogs as the experimental animals are described. Of 40 dogs exposed to Pu 239 PuO2 particles having a count median diameter of 0.1 to 0.5 u, 22 died with primary lung neoplasia 38 to 110 months postexposure, 8 died of pulmonary fibrosis, 5 were killed for radionuclide distribution measurements, and 5 are still alive over 9 years post exposure. Initial alveolar deposition ranged from 0.5 to 3.5 uCi, and accumulated radiation dose was 2500 to 12,000 rads. Most lung tumors were found to be bronchiolo-alveolar carcinomas of peripheral origin, with two peripheral squamous cell carcinomas and three epidermoid carcinomas. Also in this group of dogs there were three thoracic sarcomas and two dogs with malignant lymphomas. (Auth)

<461>
Bair, W.J., J.P. Herring, and L.A. George, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1962, January 15

Retention, Translocation, and Excretion of Inhaled Plutonium. HW-72500; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1961, (p. 61-66), 180 p.

The retention, translocation, and excretion of plutonium in dogs are compared for inhalation of six different plutonium dioxide aerosols and for plutonium nitrate. The translocation and excretion of Pu 239 were significantly greater after inhalation of Pu 239 Pu O2 aerosol with a count median diameter (CMD) of 0.12 u than after inhalation of aerosols with CMD's of 0.3 u to 0.60 u. The rate of urinary excretion expressed as percent of the body burden was about five times greater after inhalation than after intravenous injection of plutonium nitrate, although the same total amount was excreted over a 30-day period. (Auth)

Table 1 shows excretion, retention, and translocation of inhaled plutonium dioxide in dogs. Table 2 shows the fate of Pu thirty days after administration of plutonium nitrate.

<462>
Not given, Nevada Operations Office, Las Vegas, NV. 1972, June

Cleanup Summary Report, Tatum Dome Test Site, Mississippi. NVO-129; 16 p.

All Tatum Dome Test Site radiation dose levels which might be potentially hazardous to present and future human surface use have been reduced to the lowest practicable levels, consistent with the applicable guides. The cleanup was accomplished by (1) sampling and analyzing of soil, water, vegetation, and indigenous animal life from on-site work areas and contiguous off-site areas, (2) excavating and placing all contaminated soil and pumping all contaminated water and other accumulated contaminated fluids into the Tatum Salt Dome nuclear cavity, (3) sealing the cavity by plugging all drilled entry holes with cement, and (4) transporting for disposal at NTS all remaining solids (including several types of material), equipment, debris, and other personal property either contaminated or suspected of contamination. The post-cleanup radiological status of the site was determined by analyses of samples of water, soils, garden produce and environmental samples from man's food web including rabbit, squirrel, quail, garden produce, chicken, eggs, pecans and white-tailed deer. Migration of radionuclides to man through resuspension in air and water was determined to be negligible. Twenty-four hour air samples collected after decontamination at several locations indicated no significant activity above background levels i.e. 10(E-15-10(E-14) uCi/cc gamma, 10(E-15-10(E-14) uCi/cc beta, 10(E-17)-10(E-15) uCi/cc Sr 90, and 10(E-18)-10(E-17) uCi/cc Pu 139. (PMM)

Table 7 shows radionuclide (including Pu 238, Pu 239) content of tissues of several animals, fish and quail. Table 5 shows radionuclide content of vegetation, soil and air samples.

<463>
Smith, A.E., and W.E. Moore, Western Environmental Research Laboratory, Office of Dose Assessment and Systems Analysis, Las Vegas, NV. 1972, January

Report of the Radiological Clean-up of Bikini Atoll. SWRHL-111r; 85 p.

The Atoll of Bikini was the subject of an intensive clean-up effort in 1969 by a joint AEC-DASA task force. The task force was responsible for rehabilitating the islands of Bikini and Enyu in preparation for the resettlement of the Bikinian people to their home islands. Objectives of the clean-up effort were: removal of all debris from the islands; determination of existing radiation levels on each island; analysis of available food items for radionuclide distribution; and clearing of vegetation from land for agricultural redevelopment. Upon completion of these objectives, the islands were turned over to the Trust Territories for the agricultural phase of the program. The radiological conditions detected before, during and following the clean-up effort are described. The highest exposure-rate measured on the islands of Bikini and Enyu was 120 uR/hr. The mean exposure-rate for the proposed village area on Bikini was 44 uR/hr. Integral dose calculations involving theoretical time periods spent in various areas of the island and on the lagoon and considering shielding values from coral aggregate in the village area were made. The projected external whole body dose for a person born on Bikini in 1970 and living there for 70 years would be less than 10 rad. (Auth)

Several figures of background survey results are given. Tables 1 and 2 show mean Cs 137 and Sr 90 concentration in food from Bikini and Enyu Islands. Table 4 shows levels of Pu 239, Pu 240, Pu 238 and Am 241 in soil. Table 7 shows composite Pu 239 in air results for Bikini Island 1970. Table 8 shows composite Pu 239 in air results for Enyu Island 1970.

<464>
Dilley, J.V., Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

In Vivo and In Vitro Chelation of Plutonium by Alpha-Lipoic Acid and DTPA. BNWL-714; Part of Thompson, R.C., et al (Eds.). Annual Report for 1967, (p. 6.12-6.13), 253 p.

Experiments were performed comparing the in vitro chelating ability of 6,8-epi-dithiooctanoic acid (alpha-lipoic acid) and diethylenetriaminepentaacetic acid (DTPA), and their in vivo applicability as therapeutic agents for plutonium removal. Glass columns were packed with Sephadex G-25 and loaded with 40 uCi of Pu 239 PuO2 (0.3 u CMD). After flushing with water, the columns were treated with either 1.0 g DTPA or 0.1 g alpha-lipoic acid and washed with additional water until plutonium was no longer detectable in the eluate. About 0.3% of the plutonium was removed from the column with alpha-lipoic acid treatment; about 0.1% was removed with DTPA treatment. Female rats were intravenously injected with 1.0 uCi Pu 239 $(NO_3)_4$ and then randomized into three groups of six animals each. One group received 30 mg/kg alpha-lipoic acid, the second group received 0.1 mM DTPA per animal, the third group received 0.1 propylene glycol and served as controls. All treatments were given intraperitoneally at 3, 24, 48, and 96 hr after plutonium injection. Urine and feces were collected and the animals were sacrificed for plutonium tissue analysis on the tenth day. The results show that in leaching PuO2 from a Sephadex column, alpha-lipoic acid was more effective than DTPA but was ineffective in removing plutonium from rats. The alpha-lipoic acid however, alters the distribution of plutonium so that greater concentrations are present in liver, kidney, and viscera at the expense of the skeletal burden. (PMM)

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<465>
Dilley, J.V., and K.E. McDonald, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1968, May

Removal of Inhaled Plutonium 239 PuO2 in Rats. BNWL-714; Part of Thompson, R.C., et al (Eds.), Annual Report for 1967, (p. 6.9-6.10), 253 p.

Female Sprague-Dawley rats (150-200 g) were exposed to aerosols of Pu 239 PuO2. After exposure the animals were randomized into groups of five animals each and treated with the test agents. All animals were sacrificed 18 days after exposure. The trachea, lungs, heart, and all thoracic lymphatic tissues were analyzed for Pu 239 content. The results show that progesterone, chlorpromazine, and Sephadex G-25 were the most promising of the agents tested for the ability to stimulate removal of inhaled Pu 239 PuO2. (FMM)

<466>
Saenger, E.L. (Ed.), University of Cincinnati, College of Medicine, Cincinnati, OH. 1963, February

Medical Aspects of Radiation Accidents, A Handbook for Physicians, Health Physicists and Industrial Hygienists. TID-18867; 357 p.

The handbook presents pertinent, tested and useful information needed by anyone faced with a radiation emergency. The design is such that the simplest instructions are presented on the frontpiece. A group of rules then elaborates on these instructions in the first section. The remaining sections examine various possible accidents and techniques for coping with them. In relation to Pu 239 the recommended therapy following contamination is discussed. Washing is suggested for removing contamination or treatment with potassium permanganate followed by sodium bisulfite. For plutonium within the body, DTPA treatment is recommended. The hazards to the human body from Pu and the safety precautions to be taken following an accident are outlined. (FMM)

Table 18.82 shows the radionuclides that may be encountered in accidents and gives the critical organ and maximum permissible body burden. Tables 18.83 and 18.84 show maximum permissible concentration of unidentified radionuclides in water and air.

<467>
Lagerquist, C.R., S.E. Hammond, D.L. Bokowski, and D.B. Hylton, Dow Chemical Company, Rocky Flats Division, Golden, CO. 1972, May 1; 1973, December

Distribution of Plutonium and Americium in Occupationally Exposed Humans as Found from Autopsy Samples. CONF-720614-6; RFP-1849; Part of Proceedings of the 17th Annual Meeting of the Health Physics Society held in Las Vegas, Nevada, June 12-16, 1972, (11 p.); Health Physics, 25, 581-584

Nineteen cases are discussed where tissues were obtained from autopsy and analyzed radiochemically for plutonium and americium. Distribution patterns varied greatly from case to case, depending on: the mode of entry, the chemical form, the length of time since exposure, and perhaps many other parameters as well. A typical distribution was not found, but on the average the lung and tracheal-bronchial lymph nodes had the highest concentration of material followed by the liver, the bones and finally the other tissues. (Auth)

Table 1 shows concentrations of Pu 239 and Pu 240 in dis/min/g in human autopsy tissues. Table 2 shows concentrations of Am 241 in dis/min/g in human autopsy tissues. Table 3 shows the comparison between the systemic burden calculated from urine analyses and the extrapolated amount found at autopsy.

<468>
Spalding, R.F., and W.M. Sackett, Texas A & M University, Department of Oceanography, College Station, TX. 1972, February 11

Uranium in Runoff from the Gulf of Mexico Distributive Province: Anomalous Concentrations. Science, 175, 629-631

Uranium concentrations in North American rivers are higher than those reported 20 years ago. The increase is attributed to applications to agricultural land of larger amounts of phosphate fertilizer containing appreciable concentrations of uranium. Experiments showing a constant phosphorous-uranium ratio for various types of fertilizers and for the easily solubilized fraction of 0-46-0 fertilizers support this view. (Auth)

Figure 1 shows uranium concentrations for 22 samples taken from 15 different rivers that flow into the Gulf of Mexico.

<469>
Sonnenblick, B.P., Rutgers University, Newark, NJ. 1972, February

Low and Very Low Dose Influences of Ionizing Radiations on Cells and Organisms, Including Man: A Bibliography. BRH/DBE-72-1; DHEW(FDA)-72-8029; 325 p.

The bibliography lists a massive literature pertaining to the influence of low and very low doses of ionizing radiations (arbitrarily defined) on a wide range of cells, organelles, and intracellular macromolecules on diverse organisms and populations. More than 3400 numbered citations are listed in eleven categories, with some inevitable overlapping. The categories are human studies, mammalian studies, other vertebrate studies, invertebrate studies, plant studies, microorganism studies, macromolecule studies, dose studies, space studies, natural background studies, and general studies. The general category includes books and monographs, review articles, editorials, essays, and studies and reports of national and international commissions concerned with aspects of the problem of radiation protection for the general public and for those occupationally exposed. A separate list of the reports utilizing very low dose levels is included. (FMM)

<470>
Hollingsworth, R.E., U.S. Atomic Energy Commission, Washington, DC. 1972, April

Environmental Statement, Contaminated Soil Removal Facility, Richland, Washington. WASH-1520; 36 p.

The Environmental Statement was prepared in accordance with the National Environmental Policy Act and in support of the Atomic Energy Commission's proposal for legislative authorization and appropriations for the design, construction and operation of the Contaminated Soil Removal Facility at Richland, Washington. The U.S. Atomic Energy Commission plans to remove plutonium contaminated soil from the floor of an existing enclosed trench (Z-9) used between July 1955 and June 1962 as a subsurface disposal facility for plutonium contaminated liquids from the Plutonium Finishing Plant on the Hanford Reservation near Richland, Washington. It is estimated that the soil to be removed contains approximately 100 kilograms of plutonium in a volume of approximately 1800 cubic feet. It is believed that more than three-fourths of the plutonium in the soil (worth approximately $3,000,000) can be economically recovered in the nearby Plutonium Finishing Plant. The proposed operation will permit extensive evaluation of soil dissolution and plutonium extraction techniques. Residues from the extraction operations and contaminated soil with insufficient plutonium to permit economical extraction will be packaged in plastic bags, placed in steel drums and stored in a new Underground Storage Vault. The proposed operation will also permit the extensive evaluation of techniques for contaminated soil removal, and for measuring the plutonium content of the contaminated soil. The Contaminated Soil Removal Facility and the Underground Storage Vault will discharge air through high efficiency filters which will release less than one uCi of plutonium per day to the atmosphere of a controlled area at a concentration estimated to be less than three percent of the concentration guide for a controlled area as defined in applicable federal standards. In assessing and balancing the benefits to be obtained from removing plutonium contaminated soil from the Z-9 enclosed trench against the environmental and economic costs, and after considering the range of alternatives and their environmental impact, the Atomic Energy Commission has concluded that the proposed action should be undertaken. (Auth) (FMM)

<471>
Not given, U.S. Atomic Energy Commission, Washington, DC. 1972, December

Draft Environmental Statement, Transuranium Solid Waste Development Facility, Los Alamos Scientific Laboratory, New Mexico. WASH-1527,(Draft); 85 p.

The environmental impact of constructing and operating a Transuranium Solid Waste Development Facility at the Los Alamos Scientific Laboratory (LASL) in New Mexico is estimated. The present annual generation of solid radioactively-contaminated wastes is about 70,000 cubic feet, most of which is contaminated with transuranium radionuclides. A portion of this volume will be sent to the development facility; however, administrative procedures will limit the radioactive inventory in the facility at any one time to 100 g of Pu 239 and 10 mCi of mixed fission products. The proposed project provides for construction of a building with equipment for demonstrating solid waste volume reducing processes such as sorting, compaction and incineration. Improvements to land, filtration for airborne effluents, accidents such as fires and the eventual decontamination and removal of the buildings are considered. In assessing and balancing the anticipated benefits against the environmental and economic costs of the proposed facility, and after considering the range of alternatives and their environmental impacts, the AEC has concluded that the proposed solid radioactive waste volume reduction facility should be designed and constructed. (FMM)

<472>
Schulz, W.W., and G.E. Benedict, Atlantic Richfield Hanford Company, Richland, WA. 1972, October

Neptunium 237, Production and Recovery. TID-25955; 85 p.

Modified Purex processes are operated at the U.S. Atomic Energy Commission's Hanford and Savannah River plants to recover kilogram amounts of Np 237 from irradiated uranium metal. The Savannah River Purex process is operated to force all the Np 237 (as inextractable Np(+5)) into the first-extraction-cycle aqueous raffinate, from which it is recovered by sorption on an anion-exchange resin. In the Hanford scheme Np(+6), produced by HNO2 catalyzed nitrate oxidation of Np(+5), is coextracted with uranium and plutonium in the first cycle; neptunium is subsequently separated from uranium in the second uranium cycle. Variables that affect the equilibrium and kinetics of the HNO2 catalyzed oxidation step are enumerated and described; careful control of these parameters is critical to satisfactory operation of the Hanford recovery scheme. At both the Hanford plant and the Savannah River plant, anion-exchange processes are used to concentrate and purify the recovered Np 237. Updated chemical flow sheets for these main-line production-scale Np 237 recovery and purification processes are provided and discussed. Projections summarized in the review indicate that by 1990 as much as 3500 kg of Np 237 could be available each year for recovery from power reactors in the United States. If anticipated demands for Pu 238 in medical and space applications materialize, recovery of the major part of this Np 237 will be mandatory. Behavior of Np in several nonaqueous (fluoride-volatility and pyrochemical) fuel-reprocessing methods is examined in the concluding chapter. Preparation, properties, and reactions of NpF_6 and its separation from UF_6, PuF_6, and fission-product fluorides are emphasized. (Auth)

<473>

<473>
Thomson, B.J., and A. Walton, Yale University, Department of Geology and Geophysics, New Haven, CT; Bedford Institute, Atlantic Oceanographic Laboratory, Dartmouth, Nova Scotia, Canada. 1972

Natural Radioactive Decay Series Elements in the Oceans and Sediments. Royal Society of Edinburgh, Series B, 72, 167-182

A review is presented of studies of the three naturally occurring radioactive decay series (Th 232, U 238 and U 235) daughter radionuclides in the oceans and sediments. The origin of high radium concentrations in sediments and the migration of radium in sediments are discussed. Studies of thorium and protactinium are reviewed under the following headings: analytical advances--direct measurements of U, Th and Pa isotopes; the thorium isotope ratio (Th 230/Th 232) approach; the thorium/protactinium (Th 230/Pa 231) approach; the uranium isotope ratio (U 234/U 238) deviation; leaching versus solution of sediments; and comparisons of age determination methods. (FMM)

<474>
Thompson, R.C. (Comp.), Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1973, September

Biology of the Transuranium Elements, A Bibliography. BNWL-1782; 126 p.

The bibliography is a simple listing, alphabetical by senior author, of over 1000 literature citations. The biological behavior and biological effect of the transuranium elements have been covered--"biological" being broadly interpreted to include behavior and effect within natural ecosystems and work locations as well as within discrete organisms. In areas where complete coverage is attempted, the coverage extends only to publications in scientific and technical journals, books, and the published proceedings of scientific meetings. Coverage includes articles abstracted in Nuclear Science Abstracts through the issue of June 30, 1973. (FMM)

<475>
Tamura, T., E.R. Eastwood, and C.M. Sealand, Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN. 1973, February

Applied Soils and Waste Management Studies. ORNL-4848; Part of Annual Progress Report for Period Ending September 30, 1972, (p. 49-51), 127 p.

Progress is reported on the characterization of Pu-contaminated soil from Nevada Test Site and in the development of plugs to be used as sealants in the salt mine repository. In the Pu study the results of extraction from four surface soil samples are presented. The samples permit determination of Pu on different size and mineral fractions. The results show that about 75% of the Pu is extractable with nitric acid in three of the four samples. (FMM)

<476>
Stannard, J.N., University of Rochester, Rochester, NY. 1973

Biomedical Aspects of Plutonium: Discovery, Development, Projections. Part of Hodge, H.C., et al (Eds.), Handbook of Experimental Pharmacology, Uranium, Plutonium, the Transplutonics, Chapter 8. Springer-Verlag, New York, New York, (40 p.)

The chapter provides an historical and prospective overview of Pu and covers the primary features of Pu toxicology. First produced in 1941 in less than microgram quantity, grams were available in a remarkably short time and this was followed within months by kilogram quantities. As for the future, about 20,000 kilograms of the isotope Pu 239 are expected to be needed by 1980, 60,000 kilograms in the decade 1980-90, and 80,000 kilograms in the 1990-2000 decade. Pu is a most effective agent in producing long-term effects in the body. Its general toxicology is that of a "bone-seeker". Because of its tendency to be a "surface seeker" rather than a "volume seeker" it is markedly more effective than radium on an activity basis in producing damage such as the induction of osteogenic sarcoma. The question of chemical toxicity is discussed. The development of biomedical information on Pu is presented under the following headings: early beginnings; the "Pu Project" years; the Utah Project; inhalation studies; information from experience with man; therapeutic removal; and work abroad. The chapter concludes with a short review of prospective newer uses of plutonium isotopes in the space program and in medicine. (FMM)

<477>
Spiers, F.W., University of Leeds, Department of Medical Physics, General Infirmary, Leeds, Yorkshire, England. 1968

Radioisotopes in the Human Body: Physical and Biological Aspects. Academic Press, New York, New York, 346 p.

The physical and biological factors that affect the dose delivered by an internally absorbed radioisotope to the human body are discussed. Metabolic pathways are considered as well as modes of entry, distribution of the radioisotope in the body, relative biological effectiveness (RBE) and linear energy transfer (LET), measurement of radioactivity in tissues and determination of maximum permissible levels of radioisotopes in the body. A portion of the monograph has been devoted especially to bone structure and the irradiation of bone including dosimetry and radioautography studies, since many of the available radioisotopes are deposited in bone and because of the importance of bone in relation to potential radiation damage. (FMM)

Table 2.6 has biological data relating to organ uptake for several elements including U, Pu and Am. Table 4.5 shows the location of elements (including Pu and Am) in bone.

<U78>
Lewis, R.S., J. Wilson, and E. Rabinowitch (Ed.), State University of New York, Albany, NY; Los Alamos Scientific Laboratory, Experimental Physics Division, Los Alamos, NM. 1971

Alamogordo Plus Twenty-Five Years. The Viking Press, New York, New York, 281 p.

Twenty-five years ago, on July 16, 1945 at the so-called Trinity site near Alamogordo in the desert country of New Mexico, man first unleashed a nuclear explosion. Twenty-five years later the most one can say of mankind in the age of the atom bomb is that it has so far survived. The articles in the book deal on the factual level with events and developments of the first quarter-century of the nuclear age. Part 1 of the book covers projection and recollection, for example, the nuclear future--1995 is projected by Glenn T. Seaborg and the recollections of July 16, 1945 are presented by Lt. Gen. Leslie R. Groves. Part 2 deals with the international atom, nuclear energy in Japan, Britain and Western Europe. Part 3 covers application and research with a discussion on nuclear energy and the environment, nuclear power in industry and plowshare. Part 4 discusses the military atom such as disarmament problems, nuclear weapons and the decision to bomb Japan. (PMM)

<U79>
Bair, W.J., B.C. Stuart, J.F. Park, and W.J. Clarke, Hanford Laboratories, Richland, WA. 1964

Factors Affecting Retention, Translocation and Excretion of Radioactive Particles. CONF-104-51; HW-SA-3161; Part of Proceedings of a Symposium on Radiological Health and Safety in Mining and Milling of Nuclear Materials held in Vienna, Austria, August 26-31, 1963, Vol. 1, (p. 253-274)

Published data are cited demonstrating that the behavior of many inhaled radioactive aerosols cannot be predicted on the basis of their known chemical properties. For example, the uptake of I 131 by the thyroid was equally rapid following inhalation of I 131 vapor and the less water-soluble Ag I 131 particles, and Sr 90 SrSO4 was absorbed from the lungs at a rate comparable to that of the more soluble Sr 90 Cl2. The pulmonary retention of soluble CeCl3 and insoluble CeO2 were similar but much greater for insoluble CeF3. The pulmonary retention of soluble and insoluble forms of Eu 152, Co 60, U 238, and Pu 239 are also compared. The results of plutonium sutdies also illustrate the effect of a further complicating variable, particle size of the aerosol. When inhaled as an aerosol with a mass median diameter (MMD) of 0.2 um, "insoluble" Pu 239 PuO2 was cleared from the lung at a rate comparable to that observed for the more soluble plutonium nitrate, i.e., retention half time of about 30 d. Retention half time values of greater than 100 d were obtained when the MMD of the Pu 239 PuO2 aerosol was 2-7 um. The rapid clearance of Pu 239 PuO2 inhaled as extremely small particles, substantiated by autoradiographic studies, was reflected in higher rates of excretion and translocation to other tissues. These results were applied to the problem of inhaled uranium ore where the chemical species and physical characteristics of the dust may determine whether or not uranium remains in secular equilibrium with its daughter products after deposition in the lung. (Auth)

Table 1 shows pulmonary retention and translocation of inhaled radioactive aerosols of several chemical species.

<480>

<480>
Corley, J.P., Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, WA. 1973

Environmental Surveillance at Hanford for CY-1970. BNWL-1669; 66 p.

The 1970 Hanford environmental surveillance program indicated continued compliance of the Hanford contractors and their operations with applicable environmental standards. Most of the environmental radiation dose for people living in the Hanford environs was due to natural sources and regional fallout rather than to Hanford operations. The largest source of radioactivity released to man's immediate environment from Hanford continued to be reactor cooling water discharged from the Columbia River. The surveillance program included sampling and analysis on a routine basis of river water, municipal drinking water, groundwater, air, milk, foodstuffs, fish, shellfish, and gamebirds. Measurements were made of external gamma exposure rates at land stations and in and around the river. Contamination surveys were made at selected ground plots and along public highways adjacent to the Hanford site. Columbia River water and Richland drinking water were routinely sampled for chemical and biological analysis, and air quality measurements were made at locations adjacent to the site boundaries. In 1970, average river concentrations of radionuclides were less than 3% of the Concentration Guides, and transport rates of radionuclides in the river were much reduced from 1969. The radionuclide showing the highest average percentage of its Concentration Guide in treated water at the Richland water plant was Na 24 at 2.1%. Unusually high concentrations of P 32 were found in four of fifteen ducks collected at two trenches receiving undiluted reactor cooling water. Immediate consumption of a normal meal of the duck with the highest P 32 concentration in muscle, 0.14 uCi/g, could theoretically have resulted in a radiation dose to skeletal bone of about 6 rem, four times the applicable standard. For 1970, the calculated GI tract and bone doses to the average Richland resident were 2% of the standard of 500 mrem per year for this population group. The whole body dose was estimated to be about 1% of the standard of 170 mrem per year. The thyroid dose to the average Richland infant was calculated to be about 7% of the standard of 500 mrem per year. A detailed review of airborne radioactivity data is given. It is shown that Pu alpha accounted for less than 1% of the total alpha activity and Sr 90 for about 2% of the gross beta activity. (PHH)

Table 10 shows radioactivity (gross beta, total alpha, I 131) in air, 1970. Table 11 shows radioactivity (gross average beta, Sr 90, average total alpha, Pu-alpha) in air, quarterly average. Table 9 shows radionuclide concentrations in local milk and foods, 1970. Table 8 shows concentrations of radionuclides including Pu 239 and tritium in the Columbia River, 1970.

<481>
Hardy, E.P., Jr., Health and Safety Laboratory, Environmental Studies Division, New York, NY. 1973, April 1

Euratom Joint Nuclear Research Center, Japan Establishment Quarterly Report. HASL-273; Part of Fallout Program Quarterly Summary Report, December 1, 1972-March 1, 1973, (p. III-29 - III-33), 227 p.

Data are presented for air radioactivity and fallout deposition in 1972 at the Euratom Ispra Establishment located in Northern Italy 52 Km NW from Milan and 14 Km W from Varese. The activity levels given represent world wide fallout, and do not reflect any contamination from the site. The sampling methods for air, wet and dry deposition and milk are described as well as the chemical procedures and counting techniques used for Sr 90, Cs 137, gamma emitting nuclides, Pu 238 and Pu 239. The Pu 239 concentration in air varied from 0.8 x 10(E-5) pCi/m3 to 1.4 x 10(E-5) pCi/m3 and the Pu 239 content of fallout deposition varied from 0.11 uCi/Km2 to 0.25 uCi/Km2. (PHH)

Tables show air radioactivity and fallout deposition of Sr 90, Sr 89, Cs 137, Pu 239, Pu 238 at Ispra, Northern Italy, in 1972.

<482>
Moghissi, A.A., U.S. Environmental Protection Agency, Radiation Office, Las Vegas, NV. 1971, December

Methodology. CONF-710562; BRH/ORO-72-2; Part of 3rd Annual National Conference on Radiation Control held in Scottsdale, Arizona, May 2-6, 1971, (p. 305-308), 390 p.

Techniques for counting krypton 85 and for separating krypton from ambient air are described. A coprecipitation technique for determining Pu in environmental samples is outlined. Gamma spectroscopy is briefly discussed and different types of radiation detectors are compared. (PHH)

<483>
Bair, W.J., and T.M. Beasley, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1967, July

Plutonium-Americium Ratios in Dogs After Inhalation of Plutonium 239 PuO2. BNWL-480; Part of Thompson, R.C. and Swezea, E.G. (Eds.), Annual Report for 1966, (p. 61-63), 207 p.

Pu 239 to Am 241 ratios in tissue samples from dogs exposed to plutonium oxide aerosols were compared with the ratios in samples of the aerosol. Preliminary results from dogs sacrificed 3 months after inhalation of PuO2 indicate that Am 241 remained in equilibrium in all dogs with the possible exception of those which inhaled the oxide prepared from the delta form of the metal at 450 degrees centigrade. In this case there were increased ratios of Pu 239 to Am 241 in both lung and lymph nodes. Ratios of Pu 239 to Am 241 determined from tissues of dogs which died 3-1/2 to over 6 years after inhaling PuO2 indicated disequilibrium in the bronchial lymph nodes but not in the lung. No clear pattern of change can be discerned from the limited number of dogs thus far studied. (FNM)

<484>
Campbell, I.R., and E.G. Hergard, University of Cincinnati, College of Medicine, Kettering Laboratory, Department of Environmental Health, Cincinnati, OH. 1972, May

Biological Aspects of Lead: An Annotated Bibliography, Literature from 1950 through 1964. AP-104 (Parts 1-2); 933 p.

The material included in the biblicgraphy represents the scientific periodical literature covered by the principal abstracting and indexing services. Inclusion of works on analytical methodology is limited to those concerned with the determination of lead in air, biological materials, foods and beverages, drugs, and water, and to those concerned with the analysis of metabolic indicators of adverse effects (e.g., porphyrins). Section 1 includes abstracts of books, historical publications, proceedings of conferences, and general reviews. Specific reviews and discussions are included in the sections dealing with those aspects (e.g., reviews of signs, symptoms, and cases of clinical poisoning appear in Section 4, Man). Section 2 covers lead in the environment, including contamination of food by utensils and pesticides, and contamination of home water supplies by lead pipes, cisterns, etc. Abstracts of reports on industrial atmospheres and occupational exposure are given in Section 5; related medical information (case reports, medical surveys, etc.) is covered in Section 4. Section 6 includes pollution by lead of air, soil, and water, and the effects of such pollution on humans, animals, and plants under actual (field) conditions of exposure. Section 7 covers legal matters, regulations, and recommendations for threshold concentrations, maximum allowable concentrations, drinking water standards, and tolerance limits for food products. Section 10 is confined to chemical reviews, reviews of technological develcpments, and works dealing with specific chemical properties and syntheses of new compounds. (FNM)

<485>
Phillips, C.R., U.S. Environmental Protection Agency, Radiation Office, Las Vegas, NV. 1971, December

Levels Measured in the Environment. CONF-710562; BRH/ORO-72-2; Part of 3rd Annual National Conference on Radiation Control held in Scottsdale, Arizona, May 2-6, 1971, (p. 309-317), 390 p.

The level of most fallout nuclides has decreased since the cessation of main atmospheric weapons testing in the early 1960's. To illustrate this the results of the pasteurized milk network are cited. The nuclides of primary concern in the milk samples are I 131, Sr 89, Sr 90 and Cs 137. Cesium 137 reached a nationwide peak concentration in June 1963 at about 160 pCi/l. At the present time the national average is below 10 pCi/l. The levels of tritium in surface water and in precipitation are discussed. Pu in air is continuously monitored from samples collected throughout the United States as well as in the Pan American Health Organization Air Network from the South American countries. The levels of these samples are shown, and the difference in levels of Pu 239 for the Northern Hemisphere (49-123 aCi/m3) to the Southern Hemisphere (17-30 aCi/m3) is noted. Kr 85 levels in air are also presented. (FNM)

Table 3 shows a comparison of Pu 238 and Pu 239 in air from locations in the northern and southern hemispheres.

<486>
Borisova, M.D., Academy Nauk SSSR, Ural'skii Filial, Trudy Institute Biology, Sverdlovsk, USSR. 1966

The Effect of Various Diets on the Behavior of Yttrium 91 and Unseparated Solution of Uranium Fission Products. AEC-tr-7169; Part of Metabolism of Radioisotopes in the Animal Organism, (p. 137-152), 220 p.

The effects of various diets on the behavior of Y 91 in rats following oral and intravenous administration, and on the behavior of unseparated solution of U fission products following intraperitoneal administration were studied. Concurrently the effects of complexons and folliculin on excretion of the emitters were tested. The results show that diets that affect organic metabolism (proteinfree, carbohydrate, and fatty) induce negligible changes in the behavior of yttrium mainly in soft organs, whereas diets that affect mineral metabolism (rachitogenic, calcium and carrot) variously alter the yttrium content in soft tissues and the femur. With all three diets, the liver shows a decrease in yttrium content, whereas the bones show a rise with the rachitogenic diet, decline with the calcium diet, and no change with the carrot diet. Addition of phosphorus to the rachitogenic diet somewhat increases the yttrium content not only in bones (by 1.3 times as compared to the control, and 1.1 times as compared to the rachitogenic diet without phosphorus) but also in the liver (100% more than on the rachitogenic diet without added phosphorus). The fatty, carbohydrate, and proteinfree diets diminish and the high protein diet increases reabsorption of yttrium from the gastrointestinal tract. A maximum effect with respect to eliminating yttrium from the organism is obtained by administration of Na2-EDTA in the case of a rachitogenic diet, however, with other diets Na4-EDTA yielded a somewhat greater effect than with an ordinary diet. Administration of trimetaphosphate (TMP) and folliculin had almost no effect on the behavior of yttrium with all diets tested. These diets also had no effect on the behavior of unseparated solution of uranium fission products, with the exception of the fatty diet and control diet with added phosphorus, with which there is a marked rise in radioactivity of the liver. (Auth) (FMM)

Table 2 shows yttrium content in rat tissues 6 hr and 16 days after IV injection, as related to preliminary diet. Table 3 shows yttrium content in rat tissues 6 hr and 16 days after oral ingestion, as related to preliminary diet.

<487>
Hardy, E.P., Jr., Health and Safety Laboratory, Environmental Studies Division, New York, NY. 1973, April 1

Fallout Program Quarterly Summary Report, December 1, 1972 through March 1, 1973. HASL-273; 227 p.

Current data is presented from the HASL Fallout Program; The Laboratory of Radiation Ecology, University of Washington; and the EURATOM Joint Nuclear Research Center at Ispra, Italy. The initial section consists of interpretive reports on radium daughter products (Po 210, Pb 210) and stable lead in marine organisms, inventories of radionuclides in the stratosphere, strontium 90 in diet, and the tropospheric baseline concentration of lead. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, foods, milk, and tap water. Numerous tables are given for global atmospheric Pu 239 and Pu isotopic ratios for 1959-1970. A bibliography of recent publications related to radionuclide studies, is also presented. (Auth)

<488>
McLean, F.C., and A.M. Budy, University of Chicago, Department of Physiology, Chicago, IL. 1964

Radiation, Isotopes, and Bone. Academic Press, New York, New York, 216 p.

The book deals with radiation in all its aspects in relation to bone. A considerable amount of material concerning the physiology and biochemistry of skeletal tissue is included. The pathology of the effects of radiation, as well as the use of tracer amounts of radioisotopes in the study of pathological physiology are given consideration. The properties that lead radioisotopes to seek bone and to remain deposited therein are discussed. A few isotopes, more particularly some of the alkaline earths, including Ra, Sr and several of the isotopes of Ca, may substitute for stable Ca in the mineral of the bone and once deposited there may remain fixed indefinitely. Others, such as Pu, Y, and Th are deposited in the bone matrix rather than in the mineral, but they also may remain in the skeleton for long periods of time. Natural radioactivity, radioactive fallout and removal of radionuclides, including Pu, Th, Y, and Ce, from bone by chelates or carriers are also discussed. (FMM)

<489>
Boulay, P., Commissariat a l'Energie Atomique, Centre d'etudes de Bruyeres-le-Chatel, France. 1970

Direct Measurement of Pulmonary Plutonium Contamination. CONF-701112; STI/PUB/269; IAEA-SM-143/49; Part of Proceedings of a Symposium on New Developments in Physical and Biological Radiation Detectors held in Vienna, Austria, November 23-27, 1970, (p. 287-297), 756 p. (French)

For the direct measurement of pulmonary Pu contamination the following three conditions must all be met: the detector used must have a suitable window surface and efficiency; the background noise should be very low; and it must be possible to reduce the error due to morphology. The counter proposed has a useful diameter of 190 mm and a mean efficiency of 60% for Pu 239 x rays. The background noise is reduced by lead shielding, 10 cm thick, covered with 1 mm of stainless steel, an anti-coincidence circuit and a pulse rise-time discriminator. Under these conditions the sensitivity threshold can be estimated at 5 nCi of Pu 239 for a "standard man". A method of internal calibration of the individual based on additional Pa 233 overloading is proposed. (Auth)

<490>
McClelland, J. (Comp.), Los Alamos Scientific Laboratory, Los Alamos, NM. 1955, August

The Fluorophotometric Determination of Uranium in Urine and Air. LA-1958; Part of Analytical Procedures of the Industrial Hygiene Group, Chapter 27, (p. 155-157), 173 p.

The method is based on the intense yellow-green fluorescence (the principal line of which is reported to be at 555 mu) produced by traces of uranium fused in sodium fluoride. It is sensitive to concentrations of uranium from 10(E-5) to 5 x 10(E-10) g per 0.25 g of sodium fluoride, with a precision of plus or minus 10%. The tolerance for normal uranium in urine used at LASL is 100 ug per liter. Air for the determination of uranium is sampled by filtration, impingement or impaction. Glass or molecular filters are usually used and with special extraction methods, HV-70 paper may be used. Ten percent nitric acid is used as the collecting medium for impinger samples. The air tolerance for normal uranium used at LASL is 50 ug per cubic meter, which is approximately 66 d/m/M3. (Auth)

<491>
Hardy, E.P., Jr., Health and Safety Laboratory, Environmental Studies Division, New York, NY. 1973, April 1

Global Atmospheric Plutonium 239 and Plutonium Isotopic Ratios for 1959-1970. HASL-273; Part of Fallout Program Quarterly Summary Report, December 1, 1972-March 1, 1973, (p. III-2 - III-28), 227 p.

A program of atmospheric sampling and radiochemical analysis was undertaken from 1959 through 1970 to determine the distribution of nuclear debris by means of filter collection of airborne radioactive particulate matter on IPC-1478 paper carried by aircraft. The isotopic concentrations of plutonium 239 and the plutonium isotopic ratios Pu 240/Pu 239, Pu 241/Pu 239 and Pu 242/Pu 239 obtained from these samples are reported. Aircraft sampling was normally conducted in the vicinity of four latitudes: 70 degrees N, 35 degrees N, 10 degrees N and 40 degrees S. Altitudes sampled varied from approximately 15,000 to 70,000 feet. These data were collected as part of a cooperative effort by the U.S. Department of Defense, Atomic Energy Commission and degrees National Oceanic and Atmospheric Administration. (FMF)

Numerous tables are given for Pu 239 concentrations and Pu ratios at various latitudes and altitudes.

<492>
Belyaev, Yu.A., Not given. 1959

The Physico-Chemical State of Plutonium (Plutonium 239) in the Blood Upon Its Intravenous Administration. Meditsinskaya Radiologiya, 4(9), 45-51 (Russian)

The physico-chemical state of Pu 239 was studied in the blood upon its intravenous administration to rats in the form of nitrate of quadrivalent plutonium and a citrate complex. It was found that the speed of disappearance of plutonium from the blood is lesser for the complex salt than for plutonium nitrate. Up to 90-95% of plutonium circulating in th blood is bound with proteins; in the plasma the content of plutonium is 5 times higher than in the cellular elements. The electrodialysis of the serum of rats given plutonium showed that in the blood approximately 10% of plutonium is in an ionogenic condition, in the form of negatively charged ions. Determination of the plutonium content in individual protein fractions carried out by the method of paper electrophoresis, did not produce satisfactory results. (Auth)

<493>
Belyaev, Yu.A., Not given. 1963

Chemical Forms of Plutonium (Plutonium 239) in the Liver and Spleen of the Rat. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 58-69), 267 p.

Rats were injected intraperitoneally with plutonium nitrate or citrate (3.6-4.9 uCi/kg) to identify the chemical forms in which plutonium is retained in the liver and spleen. Results showed that plutonium exists in the liver in the form of a protein complex. About 50% was bound to the globulins of the cytoplasm. In the nuclear fraction, 17-24% was bound to the desoxyribonucleoprotein fraction, 12-16% with the acid protein, and 1.5-4% with the residual protein. Plutonium content in the protein fractions of of the liver did not vary within the time interval of 1 day to 2 months after administration, but in animals sacrificed at 7 1/2 to 9 months following administration an increase in the plutonium content of the residual protein was observed. Chemical form had no effect on distribution to the various fractions. In the spleen the plutonium level was lower (5-8%) in the desoxyribonucleoprotein fraction and higher in residual protein (20%) than in the liver. Plutonium complexes with nucleic acids, formed in vivo, were isolated. Of the total liver plutonium, 1.9-3% was bound with DNA and 0.2-0.8% with RNA. Methods of cell fraction separation were discussed. (ST)

<494>

<494>
Tseveleva, I.A., Not given. 1963

Plutonium Content in Protein Fractions of Bone. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 70-76), 267 p.

Rats were injected intraperitoneally with 1.9 uCi of plutonium citrate 7-14 days prior to sacrifice and rabbits were injected intravenously with 7 uCi of plutonium nitrate 30 days prior to sacrifice to study plutonium distribution in various protein fractions of tubular bone diaphysis. Up to 90% of the plutonium was fixed in the organic (protein) fraction. Collagen, albumoids, mucoids, and residual protein which constituted 90, 2.0, 1.6, and 6.9%, respectively, of the bone protein contained 65-80, 15, 4, and 5%, respectively, of the total plutonium. Proteins with a high metabolic rate (albumoids) bound 4-10 times as much plutonium, per 1 mg of nitrogen, as did collagen and residual proteins. The relative specific activity of mucoids exceeded that of collagen by a factor of two, probably due to the participation by the SO4 group of chondroitin sulfate in plutonium fixation. Techniques of bone decalcification and protein separation are given. (ST)

<495>
Elkina, N.I., and I.A. Tseveleva, Not given. 1963

Mineral and Protein Metabolism in Bone Tissue of Plutonium-Injected Rats. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 77-87), 267 p.

Plutonium nitrate and citrate were administered to rats in doses causing subacute (20 uCi/kg) and chronic (1.9 uCi/kg) injuries and the metabolism of some mineral and nitrogenous substances in the bones was studied. Metabolic processes were studied with the aid of radiotracers P 32, Ca 45, and glycine tagged with C 14. Calcium, phosphorus, and nitrogen metabolism, and phosphatase activity in the epiphysis and diaphysis of control and experimental rats were studied. The epiphysiel portion of bone differed from the diaphyseal part both in the content of the substances under consideration and in the intensity of metabolic processes. No appreciable changes were noted in the bone tissue content of phosphorus, calcium, and nitrogenous substances at different times following plutonium administration. Alkaline phosphatase activity following administration in amounts causing chronic injury, declined in both diaphysis and epiphysis, by about 25% after one year and by about 50% after 18 months. Incorporation of P 32 and Ca 45 into the epiphyseal portion was considerably lower in the experimental animals as compared with controls. In the diaphysis Ca 45 incorporation was also lowered. In chronic injuries, incorporation rate of labeled glycine into proteins of the epiphysis was reduced by a factor of 1 1/2 to 2 as compared with normal values. (ST)

<496>
Konstantinova, V.V., Not given. 1963

Content and Regeneration of Nucleic Acids in Rat Liver Following Plutonium Injury. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 92-103), 267 p.

Four groups of rats were injected intraperitoneally with a solution of plutonium nitrate to study the effect of plutonium on nucleic acid metabolism in the liver. The four dose levels were 20, 6.2, 3.7, and 1.9 uCi/kg. To determine the rate of nucleic acid regeneration, the animals were injected with a P 32 labeled Na2HPO4 solution at a dose of 4-6 uCi/100 g of body weight. The 20 uCi/kg dose was lethal to all rats within six to seven months; the 6.2 uCi/kg dose was lethal to 58% within nine months; and in the third and fourth groups, fatalities were 40 and 30%, respectively, over a one year period. Leukopenia was observed in all groups and erythropenia was observed at the three higher dose levels. Both content and specific activity of RNA increased at one and two months following injection in the first group. The rate of P 32 incorporation into DNA increased over all observation periods following administration of the 20 uCi/kg dose and reached a peak value after two months. Concentration of DNA phosphorus fell below control values after two weeks. At chronic dose levels the most conspicuous changes in nucleic acid metabolism were at the level of 6.2 uCi/kg (calculated per single nucleus). At this dosage level, content and incorporation rate of RNA and DNA phosphorus increased over a period up to three months. (ST)

<497>
Libinzon, R.Ye., and V.V. Konstantinova, Not given. 1963

Effect of Plutonium on Nucleic Acid Metabolism in the Liver and Bone Marrow of the Rabbit. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 104-112), 267 p.

Six to eight month old rabbits were injected intravenously with a plutonium nitrate solution (7 uCi/kg) to study the metabolism of nucleic acids in the liver and bone marrow over an extended period of time. The animals were sacrificed at intervals of 1-6 days and 1-6 months postinjection. To determine the rate of nucleic acid regeneration, the rabbits were injected subcutaneously four hours before sacrifice with P 32 labeled Na2HPO4 solution. The results showed an increase of RNA and DNA phosphorus concentration of 50% and 37.5%, respectively in the liver. At six months the amount of DNA declined 21% below normal level. In bone marrow, RNA and DNA phosphorus concentration increased, but DNA decreased somewhat at six months postinjection. Average RNA and DNA content, calculated per nucleus, began to increase at one month and reached a peak value at 4 1/2 months after the poisoning. Average RNA and DNA content per bone marrow cell rose substantially beginning with the 30th day of experimentation. A marked increase in specific activity, for liver RNA, was first noted at 3 months after the poisoning. The DNA regeneration rate began to rise on the first day of observation. At 6 months following Pu administration it reached a peak value, 7.1 times the normal level. The specific activity of bone marrow RNA and DNA showed a distinct decline after one week, but began to increase consistently after months. (Auth) (ST)

<498>
Libinzon, R.Ye., and V.V. Konstantinova, Not given. 1963

Activity of Tissue Phosphatases in Rats Suffering from Subacute or Chronic Plutonium Injury. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 113-121), 267 p.

Plutonium nitrate solution was administered intraperitoneally to rats in amounts causing subacute (20 uCi/kg) and chronic (6.2, 3.7, and 1.9 uCi/kg) injuries to test the effect on tissue phosphatases. At all dose levels acid phosphatase activity in the liver was stimulated at 2, 6, and 9 months following injection. The activity of alkaline liver phosphatase increased 2-5 times above control level during the same observation periods. A rise in alkaline phosphatase activity occurred in the bone marrow and spleen only in the case of subacute injury. A sharp decline of alkaline phosphatase activity, in both subacute and chronic injury, was noted for the kidneys and intestinal mucosa during all observation periods. Activity was reduced by a factor of 2-3 in the kidneys and by a factor of 2-5 in the intestines, as compared to control values. Ionization doses absorbed by the liver were calculated. (ST)

<499>
Moskalev, Yu.I., L.A. Buldakov, and V.N. Strel'tsova, Not given. 1963

Effect of Plutonium 239 on Rat Body. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 122-132), 267 p.

Following a single dose of plutonium citrate (1.25, 2.5, 5, 10, 20, 40, and 80 uCi/kg) the survival time of male and female rats was reduced with progressively higher doses. Doses below 5 uCi/kg did not appreciably reduce the mean survival time. Doses that reduced survival time (10-20 uCi/kg) but caused no acute pathology caused the weight of experimental animals to lag behind that of controls. A loss of body weight was noted for doses exceeding 40 uCi/kg. A lowering of the leukocyte count was observed at every dosage level with the severity depending on the dose. The drop in leukocyte count at doses of 2.5-80 uCi was irreversible. The erythrocyte count for doses ranging from 2.5-5 uCi/kg initially increased and then stabilized at the control level. At higher dosage levels erythrocyte count was reduced by the 18-30th day and remained low over the entire survival period. The change in hemoglobin content nearly paralleled that of the erythrocyte count. The formation of erythrocytes by spleen, liver, and other organs as a compensatory mechanism following bone marrow injury is discussed. The incidence of any particular pathological symptom (tumors), as revealed by autopsy, was higher for a specific radioactive dose. (ST)

Tables 1-4 list survival time, weight dynamics, blood cell counts, and erythrocyte and hemoglobin levels, in rats following a single dose of Pu 239 (1.25-80 uCi/kg).

<500>

<500>
Lemberg, V.K., N.A. Koshurnikova, and K.N. Klyzhuk, Not given. 1963

Changes in the Blood System of Rabbit Effected by Plutonium 239. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 133-149), 267 p.

Rabbits were injected intravenously with a plutonium nitrate solution at dose levels of 7 and 2 uCi/kg body weight and the resultant hematologic changes were evaluated in the light of histological data and plutonium microdistribution patterns from histoautoradiograms. Peripheral changes in the two groups of animals are given in tabular and graphical forms. Results showed that the incorporated plutonium caused distinct changes in the blood system and the extent of such changes depended directly on dose, the post injection time interval, and the characteristic microdistribution pattern of the radioisotope. Bone marrow and spleen contained the highest amounts of plutonium and the plutonium was retained preferentially by the reticuloendothelial elements in the marrow. The characteristic pattern of distribution in the bone marrow, along with its aggregation in the reticular cells within a few isolated areas, noted at one week and later, led to nonuniformity of irradiation and focally restricted injuries. Microdistribution in the spleen (red pulp) and lymph nodes (reticuloendothelial elements) was conducive to preservation of lymphatic tissue. Thus the absence of distinct changes in peripheral blood was due to the limited nature of injury and to a high rate of regeneration in the blood forming organs. (ST)

<501>
Bogatov, L.V., Z.I. Kalaykova, N.P. Kudasheva, and S.A. Rogacheva, Not given. 1963

Peculiarities in the Course and Outcome of Radiation Sickness in Dogs Injected Intravenously with the Nitrate of Plutonium 239. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 150-172), 267 p.

Plutonium nitrate was administered intravenously in a fractionated dose (0.2 uCi/kg total dose) to ten adult mongrel dogs and the functioning of various systems and organs was observed. Over a period of nearly five years the pulse rate, respiration, arterial pressure, condition of the nervous system, gastric secretion, some blood coagulation indices, and the cellular composition of blood were tested at regular intervals. Chronic radiation sickness developed in the dogs and the clinical symptoms passed through three stages: the appearance of progressive changes, partial compensation and stabilization of clinical symptoms at a reduced level, and the outcome. In the first stage of chronic radiation sickness, which lasted a year following the final plutonium injection, the clinical symptoms involved moderate changes in the nervous, cardiovascular and digestive systems, as well as in hemopoiesis and blood coagulation. In the second stage (2nd-4th year) the functioning of the cardiovascular, digestive and nervous systems was almost completely normalized, as was the process of blood coagulation, but the impairment of hemopoiesis persisted. The final stage set in at the end of 2 years 7 months to 4 years and 7 months after the last plutonium injection. The most frequent outcome of the disease stricken dogs was the development of osteosarcomas, observed in 75% of cases. The average latent period for bone tumor formation, under conditions of Pu 239 administration, was 3 years and 10 months. (Auth) (ST)

Table 3 lists the effects of cumulation radiation dose from plutonium nitrate in dogs as shown by symptoms of radiation sickness and development of tumors.

<502>
Strel'tsova, V.N., Not given. 1963

Pathological Anatomy of Plutonium 239 Sickness. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 173-193), 267 p.

Rats were injected intravenously with a plutonium citrate solution in doses ranging from 1.25-250 uCi/kg and intramuscularly with doses ranging from 1.25-60 uCi/kg and dogs were injected intramuscularly with doses ranging from 1.25-3 uCi/kg to study the characteristic morphological changes in animals suffering from acute, subacute or chronic radiation sickness. Symptoms were noted primarily in the blood forming organs, bone tissue and liver and were correlated with the distribution of plutonium 239 in the body. In acute injuries the pathological processes were characterized by circulatory disorders including massive multiple hemorrhages and perivascular edemas, destruction of blood forming tissue, and similar developments in the parenchymatous organs and gastrointestinal mucosa. In the subacute stage the pathological processes were more variable. In rats the regeneration of blood forming tissue in the bone marrow was incomplete; lymphopoiesis was restored; and ulcers and necroses in the colon along with precirrhotic and cirrhotic changes in the liver and cessation of spermatogenesis were noted. Rats and dogs suffering from chronic radiation injury developed cirrhoses of the liver hyper- and hypoplastic changes in the blood forming tissue, nephrosclerosis, nonspecific inflammatory processes, and malignant neoplasms in blood forming tissue and bones. In dogs the same pathological symptoms were induced by doses that were 10 times less than those administered to rats. Necrotic angina developed in some of the dogs. Rats injected with doses insufficient to shorten the natural life span did not develop neoplasms. (ST)

<503>
Nifatov, A.P., Not given. 1963

Morphological Changes in Rabbit and Dog Liver Induced by Plutonium 239. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 194-214), 267 p.

Rabbits were injected intravenously with the nitrate salt of plutonium in doses of 21, 14, 7, and 2 uCi/kg and rats were injected intraperitoneally with a single dose of 7 uCi/kg to study the morphologic changes in the liver following plutonium injury. In addition sodium plutonyl triacetate was administered intraperitoneally to rats in a single dose of 6.3 uCi/kg. An attempt was made to evaluate quantative changes in the liver by making a differential count of the various liver cells. The animals were sacrificed at various intervals up to one year postinjection. Morpholcgic changes in the liver following plutonium injury developed in a definite sequence and depended on the physico-chemical state of the isotope at the time of administration, on the dose, and on the species of experimental animals. The majority of rabbits injected with plutonium nitrate, in doses of 21, 14 and 7 uCi/kg, developed liver cirrhoses after 3-6 months. At the dosage level of 2 uCi/kg a moderate number of the animals showed late symptoms of cirrhosis at the end of 9 months. In animals injected with 2 uCi/kg of plutonium, 9 months after administration, the destructive processes were succeeded by regeneration, including the formation of regenerative hepatomas and adenomas of the bile ducts. Morphological changes in rats induced by plutonium nitrate (7 uCi/kg) were much less pronounced then in rabbits, and were, characterized by simultaneous dystrophic and regenerative processes leading to some rebuilding of the liver structure. Plutonium administered to the rat in the form of a complex salt, sodium plutonyl triacetate, caused less damage to the liver than did plutonium nitrate. (Auth)(ST)

<504>
Bukhtoyarova, Z.N., Not given. 1963

Dynamic Changes of Bone Tissue in Rabbits Poisoned with Plutonium 239. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 215-229), 267 p.

Following intravenous injection of plutonium nitrate (21, 14, 7, and 2 uCi/kg), into six to eight month old rabbits, the proximal epiphysis of the femur, tibia and humerus; the distal epiphyses of the femur; ribs 3 to 6; thoracic vertebrae; sternum; and occipital bones were examined. The three higher doses of plutonium caused a shortening of the animals' survival time, changes in the peripheral blood, and a sharp drop in body weight. In acute and subacute radiation sickness (21, 14, and 7 uCi/kg) destructive processes, associated with bone marrow aplasia, predominated. In chronic injuries destructive changes were less distinct. New tissue formation accompanied by pretumorous changes were apparent by the third month. At the dosage level of 2 uCi/kg tumors were present in 51.5% of the animals. Tumors were located in the spinal column (41.2%) and long bones (11.7%). (ST)

<505>
Belyaev, Yu.A., Not given. 1963

Effect of Ion Exchange Resins and Complexons on Distribution of Plutonium Introduced into the Gastrointestinal Tract. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 230-236), 267 p.

Experimental data are reported on the effectiveness of some ion exchange resins and one chelating agent (DTPA) on plutonium removal from the gastrointestinal tract of the rat. Following administration of plutonium nitrate or citrate solutions (120-270 uCi/kg) through a feeding tube, the experimental animals received per os an aqueous suspension of an ion exchange resin or an intravenous injection of DTPA. The animals were sacrificed 72 hours later and skeletal and liver plutonium determinations were made. Both cation and anion exchange resins reduced plutonium absorption from the intestines and skeletal liver content by a factor of 2 1/2-10. Anion exhange resins were more effective than cation. Effectiveness declined with time postinjection and was related to the rate of plutonium absorption from the gastrointestinal tract. Injected CaNa3DTPA was effective at later times, when ion exchange resins proved no longer effective. (ST)

<506>
Belyaev, Yu.A., Not given. 1963

Effect of Some Complexons on Plutonium Removal in Rats. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biolcgical Effects and Accelerated Elimination, (p. 237-245), 267 p.

The results of testing the effects of five complexons on plutonium removal in rats following intraperitoneal injection of 4.4 uCi/kg of plutonium citrate are reported. The compounds studied were 1,2-diaminocyclohexanetetracetic acid (DCTA), ethyl ester of diaminotetracetic acid (EEDTA), diethylenetriaminopentacetic acid (DTPA), di-N-carboxymethylenediamino-bis-methy lphosphinic acid (EDPA) and EDTA. EEDTA and DTPA showed both early and late effects and reduced the plutonium level in the skeleton and parenchymatous organs. DTPA was superior to EEDTA, especially in acute experiments. The calcium diammonium salt of EDPA had no effect on plutonium excretion except in acute experiments and was fairly inactive when administered 24 hours after plutonium administration. DCTA and EDTA were the least effective. (ST)

<507>

<507>
Ferguson, J.M., U.S. Naval Radiological Defense Laboratory, San Francisco, CA. 1963, May 7

Ground Roughness Effects for Fallout-Contaminated Terrain: Comparison of Measurements and Calculations. USNRDL-TR-685; AD-410413; 24 p.

The effect of ground roughness on the radiation field above fallout-contaminated ground was studied at the Nevada Test Site. Measurements were made by five different field projects on four different shots (Operation Teapot, Operation Plumbob, Operation Jangle and Operation Sunbeam) over different ground, and at different times after detonation. At past weapons tests, the dose rate over fallout-contaminated ground has been measured as a function of height and angle. Those measurements are compared with calculations of the same quantities for 1.12-hr fission products uniformly distributed on a smooth plane. None of the experiments is detailed enough to lead to firm conclusions about the ground roughness effect. However, the data indicate that the ground roughness effect can be simulated by assuming that the fallout is buried under a thin layer of material. For desert terrain this thickness of material is equivalent to about 25 plus or minus 10 ft of air. At 3 ft above the ground this corresponds to a reduction in dose rate by a factor of 0.6 to 0.7, compared to what would be received over a smooth plane. (Auth) (FNM)

<508>
Wilkinson, P.N., and P.E. Haecker, University of Kansas, Lawrence, KS. 1953

Selective Placental Transmission of Radioactive Alkaline Earths and Plutonium. Transactions of the Kansas Academy of Science, 56(3), 341-363

A series of experiments is described in which the placental transmission of several of the alkaline earth metals and plutonium is investigated in rats. On the 15th day of gestation the pregnant females were injected intraperitoneally with the radionuclide. Results are presented which demonstrate the existence of significant differences in the physiological activity of these elements. It was found that the arrangement of these compounds in order of the magnitude of transmission is Ca 45 > Ba 140 > Pu 239 > Ra 226. A discussion of the possible significance of these results and the results obtained by other workers is presented. It was concluded that the placental transmission of the compound investigated is dependent upon the molecular weight of the cation and that analogies between the known properties of one member of the group and those of another member should be made with extreme caution. It was conjectured that the results were indicative of a fundamental difference in metabolic handling of these substances by the animal organism and that similar differences might exist in the mechanism of deposition of these elements in mammalian bone. (Auth)

Figure 4 shows litter average values of fetal and placental activity measurements for Pu 239.

<509>
West, J.E., and W.J. Bair, General Electric Company, Hanford Laboratories, Biology Laboratory, Richland, WA. 1964

Plutonium Inhalation Studies. 5. Radiation Syndrome in Beagles After Inhalation of Plutonium Dioxide. Radiation Research, 22, 489-506

The clinicopathologic changes in beagles after a single inhalation exposure to about 2 mCi of Pu 239 PuO2 aerosol are described. Death occurred in 4 of 5 dogs within 96 days. The earliest clinical change was a progressive depression of lymphocytes beginning within 1 week after exposure. Radiation damage to the lungs was first evidenced by increased respiratory rates at 5 weeks after exposure. Respiratory rates of over 200 per minute, a tenfold increase above the normal breathing rate, occurred before death. Cyanosis, a concomitant finding at later stages, was an additional indication of injury to the lungs. Other important signs included anorexia, dehydration, and progressive weight loss of up to 25% of pre-exposure values. Tissue changes were limited to the lungs and associated lymph nodes which contained 99% of the body burden of plutonium. (Auth)

Figure 1 shows urinary and fecal excretion of Pu 239 after inhalation of Pu 239 PuO2. Table 1 shows Pu content of tissues and excreta.

<510>
Weeks, M.H., J. Katz, W.D. Oakley, J.E. Ballou, L.A. George, L.M. Bustad, R.C. Thompson, and H.A. Kornberg, General Electric Company, Radiological Sciences Department, Biology Section, Richland, WA. 1956

Further Studies on the Gastrointestinal Absorption of Plutonium. Radiation Research, 4, 339-347

In chronic-feeding experiments the concentration of plutonium in the solution fed had no effect on the fraction absorbed from the gastrointestinal tract of rats over the range 10(E-5) ug/ml to 1 ug/ml The average absorption from a pH 2 Pu(+4) nitrate solution was 0.0028%. In single-feeding experiments the absorption of plutonium (pH 2 Pu(+4) nitrate solution) from the gastrointestinal tract of 3 pigs averaged 0.0022%. This figure did not differ significantly from results obtained from single-feeding and chronic-feeding experiments on rats. Plutonium in more acidic solutions and Pu(+6) were absorbed to a considerably greater extent. Excretion of plutonium in the urine of rats during the first 9 days after intragastric administration amounted to about 20% of the total plutonium absorbed. Less than 1% of plutonium fed to rats remained in the gastrointestinal tract 2 days after feeding. (Auth)

<511>
Wagner, V., J. Andrlikova, and J. Sevc, Czechoslovak Academy of Sciences, Otorhinolaryngological Laboratory, Prague, Czechoslovakia; Institute of Industrial Hygiene in Uranium Industry, Pribram, Czechoslovakia; Institute of Hygiene and Epidemiology, Department of Radiation Hygiene, Prague, Czechoslovakia. 1973

Investigation of Immunoglobulin Levels in Blood-Serum of Uranium Miners After a Higher Exposure to Ionizing Radiation. CONF-720503; Part of Bujdoso, E. (Ed.), Health Physics Problems of Internal Contamination, Proceedings of the IRPA 2nd European Congress on Radiation Protection held in Budapest, Hungary, May 3-5, 1972, (p. 341-347), 655 p.

The influence of 7.35 x 10(E+5) MeV WLM mean exposure of ionizing radiation on levels of immunoglobulins (Ig) was followed in a group of 35 uranium miners compared with a control group with lower exposure to mean 4.7 x 10(E+5) MeV working level months. The levels of Ig were ascertained in the group with higher exposure at the time of starting work and after 1 year of exposure. The Ig levels in the group with lower exposure were tested after 1 year of exposure and were compared with a control group of non-exposed persons. The IgG levels were reduced in 85%, the IgM levels in 61% of the cases in the higher exposure group. The reduction reached the hypogammaglobulinemic levels in some miners and was followed by a propensity to infections of the respiratory tract. The IgA levels rose slightly in many cases. The dependence of the Ig levels on the rate of exposure was not absolute and showed great variations. (Auth)

<512>
Volchok, H.L., E. Knuth, and M.Z. Kleinman, Health and Safety Laboratory, Environmental Studies Division, New York, NY. 1974, January 1

The Respirable Fraction of Strontium 90, Plutonium 239 and Lead in Surface Air. HASL-278; Part of Hardy, E.P., Jr., Fallout Program Quarterly Summary Report, September 1, 1973 through December 1, 1973, (p. I-36 - I-40), 163 p.

Equipment has been developed to obtain samples of airborne dust closely approximating the particle characteristics of the respirable fraction. One such device, the horizontal elutriator, removes all of the larger particles on a series of horizontal, closely spaced, plates. A back-up filter collects the respirable particles. Using a small horizontal elutriator, the respirable fractions of airborne Sr 90, Pu 239 and stable lead were obtained for surface air in and near New York City. The mean results were greater than or equal to 0.96, 0.88 and 0.81 respectively.

<513>
Vaskov, I.S., Joint Research Institute of Hygiene and Labour Safety, Sofia, Bulgaria. 1973

Comparative Clinical Studies on the Occupational Hazards from Inhaled Radon Daughters in Workers of Non-Uranium Mines and Mineral Baths. CONF-720503; Part of Bujdoso, E. (Ed.), Health Physics Problems of Internal Contamination, Proceedings of the IRPA 2nd European Congress on Radiation Protection held in Budapest, Hungary, May 3-5, 1972, (p. 645-650), 655 p.

Clinical, laboratory, functional respiratory, and sputum cytological studies in 588 workers of non-uranium metal mines and 234 workers in mineral baths with similar atmospheric concentration of radon daughters were reported. No significant radiation alterations in the radon workers were found, except a tendency to increase the percentage of "atypical" cells in sputum. Further international studies at different levels of "pure" radon daughters exposures are necessary in order to find more exactly the dose-effect relationships. (Auth)

<514>
Ullberg, S., A. Nelson, S. Kristoffersson, and A. Engstrom, Royal Veterinary College, Department of Pharmacology, Stockholm, Sweden; Research Institute of National Defense, Medical Division, Sundbyberg, Sweden; Karolinska Institutet, Department of Medical Physics, Stockholm, Sweden. 1962, February

Distribution of Plutonium in Mice, An Autoradiographic Study. Acta Radiologica, 58, 459-471

The distribution of plutonium 239 was investigated by whole body autoradiography in male mice, and pregnant as well as non-pregnant female mice, at 5 min up to 128 days after administration. The plutonium was accumulated predominantly in the hard tissues but an uptake and retention was also observed in certain soft tissues such as the liver, ovarian follicles, fetal membranes and mammary glands. (Auth)

<515>
Tsahropoulos, E.G., C.E. Breckinridge, Jr., W.J. Bair, and K.E. McDonald, General Electric Company, Hanford Atomic Products Operation, Biology Laboratory, Richland, WA. 1964, January 15

Attempts to Remove Inhaled Plutonium. HW-80500; Part of Kornberg, H.A. and Swezea, E.G. (Eds.), Hanford Biology Research Annual Report for 1963, (p. 84-86), 242 p.

DTPA decreased the total body burden of Pu in rats but not the amount retained in the lung after plutonium nitrate inhalation. Attempts to remove Pu after the inhalation of PuO2 were unsuccessful. Drugs that increased sucus secretion in the respiratory tract, e.g., KI, tend to reduce the clearance of PuO2 and bronchodilators, e.g., isoproterenol hydrochloride (Isuprel) tend to accelerate the clearance rate. (Auth)

<516>
Lebedinsky, A.V., and Yu.I. Moskalev, Not given. 1963

Plutonium 239: Its Distribution, Biological Effect and Accelerated Elimination. FTD-tt-63-559 (Translated Edition); 267 p.

The symposium covers a wide range of topics relating to plutonium 239 toxicity. The scope of investigation covers standard plutonium compounds and the peculiarities of distribution and biological activity displayed by recently synthesized compounds such as Na plutonyl triacetate. Topics covered include plutonium nitrate accumulation and retention, variation of plutonium 239 distribution with species, plutonium transfer from mother to fetus, and physicochemical state of plutonium in the blood and binding to cellular fractions. The second part of the symposium contains data on the specific biological effects of plutonium as dependent on the introduced activity and the animal species. Clinical symptoms, pathological-anatomic changes, and metabolic impairments following administration to the dog are outlined and, where possible, correlated with microdistribution. The effect of five complex building compounds on excretion and gastrointestinal tract absorption was studied. Twenty-one papers were delivered at the symposium; all were abstracted separately for the data base. (ST)

<517>
Belyaev, Yu.A., V.V. Konstantinova, and N.I. Yelkina, Not given. 1963

Plutonium Distribution in Rabbits. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 1-7), 267 p.

Male and female rabbits were injected with Pu 239 Pu(NO3)4 solution at doses of 7 and 2 uCi/kg body weight to study the characteristic pattern of plutonium distribution. Animals were sacrificed at 1-14 days and 1-12 months postinjection and the amounts of plutonium deposited in the skeleton, liver, kidneys, spleen, lungs, muscles, bone marrow, and gastrointestinal tract were determined. Up to 70% of the total dose accumulated in the liver during the first days following injection. At 6 and 12 months 43 and 22%, respectively were retained in the liver. Skeletal content increased from 20-30% in the first few days to 45% after six months. Substantial amounts were retained by the bone marrow. The effect of the type of compound administered and physiochemical state in the blood on distribution is discussed. (ST)

<518>
Rysina, T.N., and R.A. Yerokhin, Not given. 1963

Distribution and Excretion of Plutonium in Dogs at Long Intervals Following Administration. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 8-18), 267 p.

Dogs were injected intravenously with a solution of Pu(NO3)4 four times at one month intervals to study plutonium distribution and excretion at long intervals following administration. The total dose amounted to 0.2 uCi/kg. Several of the dogs were also exposed to external irradiation from a cobalt source in daily doses of 10 R over a five month period. At three months 73% of the administered plutonium was retained by the body. Skeletal and liver retention were 40 and 30% respectively. The rate of excretion from the body varied with different tissues. The effective half-life for the skeleton was 4000 days. No consistent decline of liver activity was observed. The highest rate of excretion (1.42-0.19% per day) was recorded in the first three to four days following injection. After two years the rate of excretion fell to 0.005% daily. During the first six months, nearly equal amounts of plutonium were excreted in the urine and feces; thereafter, rate of excretion through the kidneys was higher. External irradiation had no appreciable effect on plutonium distribution or excretion. (ST)

<519>
Belyaev, Yu.A., N.I. Yelkina, V.V. Konstantinova, and I.A. Tseveleva, Not given. 1963

Toxicologic Properties of Sodium Plutonyl Triacetate and Its Distribution in the Rat Body. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 19-24), 267 p.

Adult rats were injected intraperitoneally with 21, 11, 6.3, 3.3 and 1.6 uCi/kg of sodium plutonyl triacetate, Na $PuO_2(CH_3COO)_3$, to study the long term distribution, excretion, toxic effect, and carcinogenic doses of this salt. The distribution pattern resembled that of plutonium citrate and plutonyl nitrate. Fifty to sixty percent of the administered dose accumulated in the skeleton and 15-18% in the liver. Distribution did not depend on dosage level. Skeletal plutonium content decreased to 42 and 27% of the administered dose after 9 and 18 months. The dosage levels of 3.3 and 1.6 uCi/kg were found to be most carcinogenic. The dose level of 1.6 uCi/kg had no effect on mean survival time. Excretion with the urine proceeded at a higher rate than with other plutonium compounds. Erythrocyte count was reduced at all doses and leucocyte count at the three higher dose levels. (ST)

<520>
Lemberg, V.K., and A.P. Nifatov, Not given. 1963

Microdistribution of Plutonium in Rabbit and Rat Liver. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 25-38), 267 p.

The dynamics of microdistribution of plutonium 239 in rabbit and rat liver was studied using the technique of histoautoradiography. Rabbits were injected intravenously and rats intraperitoneally with plutonium nitrate in a single dose of 7 uCi/kg. Additional rats were injected with 6.3 uCi/kg of sodium plutonyl triacetate. Plutonium nitrate preferentially accumulated in the reticuloendothelial cells of the liver. Sodium plutonyl triacetate was retained by the liver to a lesser extent and was uniformly distributed throughout all the structural elements. Species differences were noted in the dynamics of microdistribution of plutonium nitrate in the liver. (ST)

<521>
Lemberg, V.K., and Z.M. Bukhtcyarova, Not given. 1963

Histoautoradiography Data on Plutonium Distribution in the Bones of Rat and Rabbit. FTD-tt-63-559 (Translated Editicn); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Eliminaticn, (p. 39-51), 267 p.

Histoautoradiography was used to study plutonium distribution in the bones of rats and rabbits injected with 7 uCi/kg of plutonium nitrate. Animals were sacrificed from one day to 7 1/2 months postinjection. Plutonium administered in the nitrate form was deposited largely in the skeleton and predominantly in the endosteum, periosteum, and bone marrow and, to a lesser extent, in bone tissue proper. Numerous species differences were observed. In rabbits the plutonium content was maintained at a maximum value from the seventh day through 4 1/2 months. In rats it reached a maximum after three days followed by a gradual decrease in the bone marrow. Rabbits showed a marked aggregation of plutonium particles in the bone marrow reticuloendothelial cells. In both species the endosteum and periosteum showed an affinity for plutonium 24 hr following administration. In rats it reached a fixed level after three to seven days; in rabbits it increased for a period of 4 1/2 tc six months after administration. (ST)

<522>
Rysina, T.N., and I.A. Tseveleva, Not given. 1963

Transmission of Plutonium to Offspring. FTD-tt-63-559 (Translated Edition); Part of Lebedinsky, A.V. and Moskalev, Yu.I. (Eds.), Plutonium 239: Its Distribution, Biological Effects and Accelerated Elimination, (p. 52-57), 267 p.

Pregnant and lactating dogs received four intravenous injections of plutonium nitrate at one month intervals to study the transmission of plutonium to offspring. The tctal administered dose was 0.2 uCi/kg. The amounts of plutonium transmitted to the fetus were minute. The specific activity in newborn puppies was of the order of 10(E-5) to 10(E-6)% of the dose received by the mother. Plutonium concentration in the tissues of pups three to seven months old was less by a factor of 20-50 as compared with newborn puppies. Specific activity values obtained for the bones were higher than those recorded for the liver. Ionization doses calculated for the vertebrae of newborns ranged from 0.2 rem/day during the plutonium administration stage to 0-0.045 rem/day at later observation periods. (ST)

<523>
Finkel, M.P., Argonne National Laboratory, Division of Biological and Medical Research, Lemont, IL. 1959

Late Effects of Internally Deposited Radicisotopes in Laboratory Animals. Radiation Research, Supplement 1, 265-279

The late effects of moderate and low doses of radioisotopes are reduction in life span and induction of tumors. These responses are influenced by the type and energy of the radiations, by the amount of material that remains in the body, and by the location of the retained material. Comparisons of the effects of intravenous injections of Ra 226, Pu 239, U 233, Pc 210, Sr 90, and Ca 45 in mice can contribute to an understanding of the many factors involved in the long-term effects of internal emitters. On an injected microcurie basis, the alpha-particle emitters are more toxic than the beta-particle emitters. Radium is the least effective of the former in reducing life span, and its potency as a skeletal carcinogen is less than that of Pu 239 but slightly greater than that of U 233. The differences in effectiveness between injected microcurie doses of Sr 90 and Ca 45 are largely due to differences in beta-ray energy. In addition to the induction of soft tissue tumors by Po 210 and the induction of malignant bone tumors by the other isotopes, all influenced the tumors of the blood-forming tissues. Since these neoplasms seemed to be affected by levels of Sr 90 that produced no change in life span or in number of osteogenic sarcomas, and since they show certain similarities to the human leukemias, they are an important subject for further study. (Auth)

<524>
Fabrikant, J.I., and C.L.D. Smith, Institute of Cancer Research, Physics Department, Sutton, Surrey, England. 1964, January

Radiographic Changes Following the Administration of Bone-Seeking Radionuclides. British Journal of Radiology, 37(433), 53-62

During investigations on the carcinogenic effects of alpha and beta emitting radionuclides, serial radiographs of rats injected with single and repeated doses of P 32, Pu 239, or Am 241 were studied to record the development of radioinduced changes. Among the lesions observed were failure of longitudinal bone growth, abnormal bone moulding, pathological fractures, and the production of sclerosing, lytic, and mixed forms of osteosarcoma. The induction of bone tumors could be identified early and the development followed closely; radiographic changes were described. (Auth)

<525>
Fioratti, M.P., and S.R. Piermattei, Comitato Nazionale per l'Energia Nucleare, Laboratorio Dosimetria e Standardizzazione, Rome, Italy. 1973

Evaluation of Activity in Lung and Lymph Nodes Following Inhalation of Radioactive Insoluble Aerosols. CONF-720503; Part of Bujdoso, E. (Ed.), Health Physics Problems of Internal Contamination, Proceedings of the IRPA 2nd European Congress on Radiation Protection held in Budapest, Hungary, May 3-5, 1972, (p. 65-76), 655 p.

Data available in the literature for the period 1962-1972 on the elimination of insoluble Pu compounds from the lungs and retention in lymph nodes of experimental animals following inhalation are examined. Using the Kotrappa expression the absorbed dose from lymph nodes is also evaluated. On the basis of the experimental data it is concluded that for the elimination of insoluble material existing in the lung a component with a half-life of about 257 days exists and a fraction p = 0.0086 of this material is transferred to lymph nodes. Considering in the analysis of data only particles with a count median diameter less than or equal to less than 0.5 u, a long-life component for the elimination of plutonium from lung appears, but its existence is rather questionable owing to the lack of experimental data. Functions are given which can be used to obtain information on the fraction of insoluble compounds released from lung and on the build-up of this material to lymph nodes in the range to about 3,000 days after inhalation. (PMM)

Table 1 shows experimental values of the ratio of Pu content in the lymph nodes to that in the lung.

<526>
Norwood, W.D., General Electric Company, Hanford Atomic Products Operation, Health Operation, Richland, WA. 1962, August

Radioactive Material in the Body: Detection and Treatment. Archives of Environmental Health, 5, 81-86

Methods of identifying and determining the amount of radionuclide in the body, evaluating the hazard involved, and decontamination treatments are reviewed. (ST)

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Tombropoulos, E.G., and B.O. Stuart, Battelle Memorial Institute, Pacific Northwest Laboratories, Biology Department, Richland, WA. 1967, July

Effect of Plutonium 239 PuO2 Inhalation on Lung Tissue. BNWL-480; Part of Thompson, R.C. and Swezea, E.G. (Eds.), Annual Report for 1966, (p. 80-81), 207 p.

Ninety-six 4-month-old female rats were exposed to six different levels of plutonium oxide aerosols resulting in initial lung burdens ranging from 0.3 to 8 uCi. Within 2-1/2 months after exposure, lungs from 24 animals representing all groups were analyzed for total lipid, lipid phosphorus, collagen, and elastin content. Tissue samples were also taken for histopathology. It was shown that inhaled Pu 239 PuO2 caused an increase in collagen associated with a decrease in elastin and neutral lipids of lung tissue. Histologically, lungs of the Pu 239 PuO2 rats generally exhibited a thickening of alveolar walls and a deposition of fibrinous material within the alveoli. These observations agree with the biochemical findings. (PMM)

Table 1 shows rat lung collagen, elastin and lipid content after inhalation of Pu 239 PuO2.

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Taylor, G.N., T.P. Dougherty, and L. Shabestari, University of Utah, College of Medicine, Radiotiology Division, Department of Anatomy, Salt Lake City, UT. 1963, September 30

Non-Skeletal Tumor Incidence Observed in Beagles with Retained Burdens of Radium 226, Radium 228, Thorium 228, Plutonium 239 or Strontium 90. CCO-228; Part of Dougherty, T.F., Research in Radiobiology, Semi annual Report of Work in Progress on the Chronic Toxicity Program, (p. 95-108), 185 p.

Beyond six to seven years age, a significant number of non-skeletal tumors have been observed in beagles receiving a single intravenous injection of Ra 226, Ra 228, Th 228, Pu 239, or Sr 90. Comparison with the control animals has tentatively indicated that most of these were naturally occurring tumors and were not radiation induced. The debility and premature deaths arising from this naturally occurring factor have been successfully minimized by early surgical care. Such measures to limit the losses from this and other non-radiation induced causes have become especially important at the lower dose levels where long latent periods are anticipated for some of the radiation induced lesions. (Auth)

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NOTE: Our computer counts in an unorthodox manner. You will find BNWL-280 listed after BNWL-1782; everything that begins with the digit two will be listed after everything that begins with the digit one. The machine reads and numbers material beginning at the left instead of the usual way of beginning at the right of a series of digits.

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