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Report CH-632

55-A

Metallurgical Project

A. H. Compton, Project Director

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HEALTH, RADIATION, AND PROTECTION

R. S. Stone, M.D., Division Director

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HEALTH DIVISION PROGRAM

May 10, 1943

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Metallurgical Project

A. H. Compton, Project Director

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HEALTH DIVISION PROGRAM

May 10, 1943

I. Scope of Health Division Responsibility

1. Protection of Health of Workers on the Project by -
   a) Evaluating the hazards in the laboratories and plants
   b) Indicating methods of protection against same
   c) Clinical studies of workers

2. Protection of Health of Public by -
   a) Evaluating the hazards to people in territories near laboratories and plants from air, water or ground pollution.
   b) Finding methods of protecting against same

3. Study of Hazards peculiar to Project Operation by -
   a) Reviewing all literature with any possible bearing on problems
   b) Experimentation , to fill gaps in our knowledge

4. Evaluation of Effectiveness of Radioactive Materials as a Military Weapon.
   a) Defense - Tolerance of and protection of troops and civilians
   b) Offence - Radiations needed to be effective

II. General Considerations

The clinical and physical sections of the Health Division have made considerable progress. The biological section has been hampered by lack of materials, space and personnel. The experiments peculiar to this project can only be made when a pile is operating at high power. Hence a great deal of the work has been planned for the future at Sites B and X.

Since there is a great deal of coordinating of the work between the sections the problems will first be presented in a general way and later the individual experiments presented. The physicists must check the physical condition of the biological and clinical work. The hematologists and pathologists must study the radiation effects conjointly with the biochemists, etc.

It must be remembered that the whole clinical study of the personnel is one vast experiment. Never before has so large a collection of individuals been exposed to so much irradiation. It is our hope that the tolerance dose based on

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very scanty previous knowledge will be found correct - when we have the actual dose carefully followed by the physicists and the clinical conditions followed by the physicians.

It is almost impossible to classify the experiments according to Mr. Cooper's "urgency" list (repeated below with modifications) but an attempt will be made.

A. (1) Research leading to information urgently and immediately needed for design and operation.

(2) Research, the vital need for which is foreseen, which must be pressed as actively as possible.

B. Research leading to essential information which is not so immediately urgent as Class A.

C. Studies of Alternatives.

D. Fundamental Studies - leading to information that may have a definite bearing on program but whose practical application is not so definite.

III. General Problems and Methods of Study

	Class
A. Chemical Toxicity of Materials Used	
1. Objectives	
a) Tolerated amounts	A(2)
b) Tolerated Concentration in air	A(2)
c) Distribution in body - and local effects on tissues	B
d) Variation between acute and chronic exposures	B
2. Materials	
a) X-metal and its compounds	
b) F-Products	
3. Method of Study	
a) Clinical - exposed personnel	
b) Laboratory animals exposed by	
Ingestion	
Inhalation-dust	
Skin Absorption	
Injection	
4. Location of Studies	
a) Medical School	
b) Michael Reese Hospital	
c)(Site B)	

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B. External Irradiation Effects — Class

1. Objectives
   a) Tolerance Doses - Acute and chronic; total body and local; fixed sources, diffuse sources as air and water — A(1)
   b) Effects of over-exposures — B
   c) Recovery time from over-exposure — B
   d) Aids to recovery — B

2. Sources of Exposure
   a) Radium sources - alpha, beta and gamma ray
   b) High voltage apparatus - x-rays, neutron
   c) Cyclotron - beta, gamma and neutron
   d) X-metal - alpha, beta and gamma rays
   e) Pile - fast and slow neutrons, gamma rays, beta and gamma from exhaust
   f) Separation and purification - alpha, beta and gamma rays from solids (dust), liquids and gases (F-products)
   g) By-product disposal

3. Methods of Study
   a) Physical measurements of ionizing effects of radiation
   b) Clinical effects on personnel known to be exposed
   c) Total body exposure with varying rates and total doses to humans (incurable) and animals (bacteria, drosophila, mammals, and fish). Observing survival, blood changes, other tissue changes, genetic effects and lack of changes for safe doses.
      1. X-rays - from high voltage apparatus
      2. Gamma rays - Radium
      3. Fast Neutrons and Gamma rays - Cyclotron
      4. Beta rays - separate F-products
      5. Beta and Gamma rays - F-products, solids gases and liquids
      6. Slow and Fast neutrons - Pile.

4. Location of Studies.
   a) Project Personnel - wherever they are
   b) Project - Drexel Building, Medical School, Cyclotron, (Site B)
   c) National Cancer Institute
   d) Chicago Tumor Institute
   e) Memorial Hospital
   f) University of California Hospital
   g) Site X

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C. Internal Body Radiation - from radioactive elements — Class

1. Objectives
   a) General body tolerance doses from materials widely spread in body - as Xenon — A(1)
   b) Local tissue tolerance doses due to
      1. Materials that localize physiologically as Iodine in thyroid, Strontium in bones — A(1)
      2. Materials that localize physically as particles in lungs, from air. Any material passing through Gastro-Intestinal system; any material deposited on skin. — A(2)
   c) Absorption of F-products by — A(1)
      1. Inhalation
      2. Ingestion
      3. Absorption through skin
   d) Distribution of F-products in the body — B
   e) Changes in distribution due to radioactive decay to another element — D
   f) Methods of aiding elimination — B

2. Sources of Exposure
   a) Pile - through cooling air or water, recoil off metal, coating failure, disaster.
   b) Separation Plant - too rapid solution, in air; pipe failure or mechanical breakdown, in cells or central gallery
   c) By-product disposal - accident or sabotage
   d) Chemical laboratory - careless handling

3. Method of Study
   a) Physical measurements of radiations in air or pure gases, in fluids and from solids
   b) Clinical study - of exposed personnel
   c) Biological studies of animals exposed to inhalation, ingestion, skin absorption and injection of F-products.
      1. Biochemical studies of exposed animals, including tracer studies.
      2. Autoradiographs of affected organs and tissues.
      3. Pathological studies of blood and other tissues.

4. Location of Studies
   a) Project - Abbot Building, (Site B)
   b) Radiation Laboratory - University of California
   d) Site X.

D. Protection Studies - Physical

1. Objectives
   a) To know the kind and quantity of ionizing radiations at all points at all times — A(1)

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Class

b) To know physical protection methods for all kinds of radiation. A(1)
c) To foresee any hazards from radiation A(1)
d) To know meteorological conditions A(1)

2. Method of Study
   a) Development of apparatus for measuring x-rays, gamma-rays, alpha-rays, beta-rays, fast and slow neutrons, either separately or as mixtures from -
      1. Fixed point - as radium source
      2. Large masses - as pile or extraction plant
      3. Gaseous sources - as air
      4. Liquid sources - as water solution.
   b) Development of apparatus for constant recording of radiation intensities and integrated doses.
   c) Measurement of radiation from all possible sources
   d) Investigation of protective shielding for areas, individuals and parts of the body
   e) Calculation of expected radiation intensities from previously known data.
   f) Study of Meterological conditions.

3. Location of Studies
   a) Project - Eckart Hall and all areas having radioactive sources.
   b) Sub-contract laboratories.
   c) Sub-contract industrial plants.
   d) Sites X and W

IV. Organization

A. Section on Clinical Medicine and Medical Research
   Section Chief - Dr. S. T. Cantril
      Hematology and Pathology - Group Leader, Dr. L. O. Jacobson
                Asso.Group Leader, Mrs. Mahon
      Clinical - Group Leader, Dr. J. J. Nickson
      Toxicology - Group Leader, Dr. A. Tannenbaum

B. Section on Experimental Biology
   Section Chief - Mr. K. S. Cole
      Radiation Biology - Group Leader, Mr. R. E. Zirkle
      Biochemical - Group Leader, Mr. W. E. Cohn
      Biophysics - Group Leader, Mr. R. Abrams

C. Section on Radiation Physics
   Section Chief - Mr. E. O. Wollan
      Protection Measurement - Group Leader, Mr. H. M. Parker
      Meteorology - Group Leader, Mr. P. E. Church.

D. Consultants
   Clinical Toxicologist - Dr. Joseph C. Aub
   Cytological Pathology - Dr. Wm. Bloom
   Physiology - Dr. R. W. Gerard
   General Radiology - Dr. Paul C. Hodges
   Radiation Physics - Dr. G. Failla

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I.

CLINICAL MEDICINE AND MEDICAL RESEARCH

S. T. Cantril - Section Chief

Class

Pre-employment physical and laboratory examinations on all employees. Subsequent physical and laboratory examinations are done as indicated. A(2)

Special Hazards (radiation and toxicologic) are surveyed and exposed personnel are checked by frequent laboratory studies. A(2)

Industrial hazards in plants supplying X-metal are surveyed in conjunction with Major Friedell, to reduce the hazard to employees. Personnel in these plants are checked physically and by laboratory examination. A(2)

Wollan's Group has adapted a Derschem electrometer to measure X-metal dust samples taken from the air by electrostatic precipitation. Major Friedell and Dr. Nickson are at present collecting information on these concentrations in industrial plants.

The care of accidents to employees in the Chicago Laboratories is followed by the Health Division. In this regard we are undertaking a program to reduce accidents by furnishing safety glasses to chemists, preparing posters calling attention to hazards such as unchained compressed gas cylinders, ether fumes and use of respirators where indicated.

Surveys of the existing literature have been made on: (1) X-metal Toxicity (2) The Effects of Radiation on the Blood and Blood Forming Tissues (3) Radiation Genetics (4) The Tolerance Dose (5) Whole Body Irradiation. D

Design and operation of future operating plants have been studied and checked for hazards. A(1)

Total Body irradiation in man. These studies on incurable patients are designed to study the effects of whole body irradiation in man. They are being done at Memorial Hospital, New York, the University of California Hospital, San Francisco, and the Chicago Tumor Institute. Single exposures of 60 r (400 kv), multiple daily exposures in short time periods of 10 r to 50 r (100 and 200 Kvcp) and continuous irradiation at the rate of 10 r per day (200 kv) for 30 days is being given. These experiments will give some useful information which we do not have on the effect of whole body irradiation. They may permitt an appraisal of the effects after several months, and at the most 1 - 2 years, as the majority of the subjects used will not survive longer due to existing disease. They also serve to judge the magnitude of an exposure to which a man could be subjected in an emergency and the length of time before restoration takes place (as well as can be judged from present laboratory methods). D

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Class

Radiation Hazard of X-metal. Parker's data in the month's report together with a statement of the hazard to the skin involved in handling the metal, furnishes the basis for a study of methods to reduce this hazard in all operations. A(2)

Finger Print Studies. We propose to study radiation effects to the skin of hands by using the finger prints as an index of skin change. This will be done on the chemists handling radioactive materials. D

Blood Pressure Studies. The duPont physicians are interested in the relation between blood pressure and toxic effects in general, and at the Clinton Laboratories will investigate the relation of blood pressure to radiation exposure. D

X-metal Toxicity. (Animal Experiments - Dr. Tannenbaum). Studies in animals of the toxicity of X-metal oxide and X-metal nitrate by ingestion have been in progress for five months. Skin absorption study of ether extract of X-metal nitrate has been in progress for four months. Subcutaneous injection of X-metal nitrate studies were done on a limited scale and will be continued to form a complete study of X-metal deposition, excretion and toxic effects. Inhalation and feeding experiments on dogs have been in progress for four months using powdered X-metal and oxide, A(2)

A complete picture of X-metal toxicity by injection experiments, using X-metal nitrate.

Studies of the X-metal compounds in most common use (UO_2, UF_4, UCL_4, metal) to determine the absorption and toxicity by the route of exposure most likely in practice - ingestion, inhalation or skin absorption.

Wollan's section has now perfected a Derschem electrometer which satisfactorily measures the quantity of X-metal in ashed tissue samples to within $\sim 5 \mu$gm. This now permits Dr. Tannenbaum to carry through his experiments with a convenient and sufficiently accurate measure of X-metal deposition in relation to toxic effects.

The results of certain of these experiments have already proved useful in appraising the immediate hazard of the ingestion of the oxide and nitrate, and the skin absorption of the ether extract of the nitrate. Further studies will be completed in time to appraise the relative toxicity of other compounds. Animals are kept from each group to ascertain the chronic effects over a long period (maximum for mice 2 years). The results of these experiments will still be useful in appraising any expected toxicity.

The effect of Vitamin C on radiation induced leukopenia. There is some evidence in the literature that massive administration of Vitamin C has a beneficial effect upon recovery from radiation induced leukopenia. We propose to study this effect in animals. The work will be started when the new experimental laboratory is completed at Chicago (June 1) and approximately 4 months will be required to carry out the study. No additional D

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Class

Radiation Hazard of X-metal. Parker's data in the month's report together with a statement of the hazard to the skin involved in handling the metal, furnishes the basis for a study of methods to reduce this hazard in all operations. A(2)

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The results of certain of these experiments have already proved useful in appraising the immediate hazard of the ingestion of the oxide and nitrate, and the skin absorption of the ether extract of the nitrate. Further studies will be completed in time to appraise the relative toxicity of other compounds. Animals are kept from each group to ascertain the chronic effects over a long period (maximum for mice 2 years). The results of these experiments will still be useful in appraising any expected toxicity.

The effect of Vitamin C on radiation induced leukopenia. There is some evidence in the literature that massive administration of Vitamin C has a beneficial effect upon recovery from radiation induced leukopenia. We propose to study this effect in animals. The work will be started when the new experimental laboratory is completed at Chicago (June 1) and approximately 4 months will be required to carry out the study. No additional D

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personnel will be required other than that provided in the new laboratory.

If the results reported in the literature are confirmed the work will have performed a most useful purpose. We feel that it is essential to study the validity of present claims.

Work for the coming month. Medical and accident control, industrial hygiene and safety studies will continue.

Total body radiation studies in man will continue.

Emphasis will be placed on the hazard of X-metal to late skin damage.

X-metal toxicity studies will continue.

Plans for safety control of work and experiments at the Clinton Laboratories will be surveyed.

A review of blood counts of the Chicago personnel on a statistical basis will be undertaken.

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II.

BIOLOGICAL RESEARCH

K. S. Cole - Section Chief

A. Experiments in Progress

1. Fast n- and x-rays (Zirkle and Jacobson)

   a. Drosophila egg survival. To give comparison of dose-survival curves, x/n ratio for 50% survival and cross check with Victoreen dosimeters. 90 percent complete.

   b. Rabbit survival after single doses. To give x/n ratio for 50% survival, and comparison of dose-survival curves. 50 percent complete.

   c. Rabbit blood and tissue changes after single doses. To determine and compare injuries and recoveries of the hemopoetic system primarily. 30 percent complete.

2. Beta and gamma radiation from F-products (Zirkle and Jacobson)

   a. Mammalian survival for continuous exposure to gamma rays from bombarded nitrate. To determine lethal dose and compare with value for x-rays. Preliminary experiment.

   b. Mammalian blood and tissue changes during continuous exposure to gamma rays from bombarded nitrate. To determine injuries to the hemapoetic system and compare with those caused by x-rays. Preliminary experiment.

   c. Bacteria colony formation. To determine dose-survival curve for combined continuous beta and gamma radiation from bombarded nitrate and compare with x-rays. Preliminary experiment.

   d. Bacteria colony formation. To determine dose-survival curve for gamma radiation from isolated Ba-La fraction. Preliminary experiment.

3. Radioactive gases (Abrams)

   a. Guinea pig blood and tissue changes for continuous exposure to Xe^{127} and A^{41}. To determine nature and extent of injury caused by beta and gamma radiations to respiratory and lipoid tissues primarily and check calculated tolerance. Preliminary experiments.

4. Radiations from Pile #1 (Zirkle and Jacobson)

   a. Rabbit blood changes during exposure to gamma and n leakage radiations. Complete.

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B. Experiments Planned

1. Mixed gamma and n radiation at Pile #3 (Zirkle and Jacobson)

   a. Mouse survival, weight, blood and tissue changes for as wide a range of intensities and durations in pile at low level as operating schedule will permit. To give basis for schedule of experiments at high levels, preliminary cross-check with dosimeters, and preliminary estimate of pile hazard.

   b. Mouse and rabbit survival, weight, blood and tissue changes for large doses at pile face and for long exposures at low intensity at outer shield face. To give rapid estimate of pile hazard and preliminary data on additivity of radiations and on dosimeters.

2. Isolated fast n, slow n and gamma at Pile #3 (Zirkle and Jacobson)

   a. Rabbit survival, weight, blood and tissue changes for small to large doses of each isolated radiation. To compare fast n and gamma effects with each other and results already obtained, to compare slow n effects with calculated equivalent gamma radiation, and to detect any specific slow n effects.

3. Fast n and x-rays (Zirkle)

   a. Mouse survival to single doses. To determine whether difference in shapes of previous dose survival curves and x/n ratios for 50% survival are characteristics of species or geometry.

   b. Mouse survival to superposed n and x doses. To obtain preliminary data on the extent to which radiation effects are additive.

   c. Mouse survival to high intensity continuous x-ray exposure. To obtain preliminary estimate of time-intensity relation and indicate usefulness of further investigation.

4. External gamma and beta rays from fission products (Zirkle, Jacobson and Cohn)

   a. Mouse and rabbit survival, weight, blood and tissue changes for continued exposure to beta and gamma from separated F-products. To eliminate self-absorption of uranium now used, obtain lethal and tolerance levels with decaying sources.

   b. Mouse skin effects in enclosure surrounded by fission products with high beat to gamma ratio. To determine gross and microscopic effects of beta rays as guide to beta action and tolerance.

   c. Rabbit ear effects as compared to x-ray, for same purpose

5. Radioactive gases (Abrams and Jacobson)

   a. Rabbit weight, blood and tissue changes for long exposure to pile discharge air. To monitor discharge air and check calculation of tolerance for N^{16} and A^{41} and to determine metabolism of F-products in case of coating failure.

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b. Rabbit weight, blood and tissue changes for long exposure to calculated tolerance for Xe^{133} and I^{131}. To check calculations of stack discharge hazard.

c. Rabbit weight, blood and tissue changes for long exposure to Xe^{133} and I^{131} in solution kettle gas discharge. To determine effect of these gases with and without dilution made at stack.

d. Rabbit, guinea pig and mouse survival and tissue changes for continuous exposure to Xe^{133}. To determine nature of beta and gamma action, lethal level and time-intensity relations.

e. Guinea pig accumulation of I^{131} from atmosphere for short and long exposures. To determine thyroid assimilation from lung and estimate thyroid tolerance.

6. F-products (Cohn, Jacobson and Zirkle)

a. Rat metabolism of inhaled recoil F-products from uncoated metal in Pile #3 by chemical separation, activity and radio-autographs. To locate and trace paths of daughters of short-lived gaseous F-products in body.

b. Rat and rabbit metabolism, survival, blood, tissue changes and tissue activities for high doses and for long exposures to inhaled recoil F-products. To estimate hazard, tolerance and time factors involved in coating failure, pile disaster and military operations.

c. Rat survival, weight and tissue changes and autographs after ingestion of long-lived F-products. To estimate and check hazards and tolerances of fission product distribution.

d. Rat and mouse tissue changes, activities and autographs after inhalation of long-lived f-product dusts. To estimate effects of distributions.

7. Water contamination (Zirkle and Cohn)

a. Fish exposure to x-radiation. To determine nature of radiation damage for species and distribution.

b. Fish assimilation of metal and F-products from exposure to metal pool discharge. To simulate hazards of water cooled plant in effects of temperature and coating leaks.

c. Fish metabolism and injury from high concentrations of fresh F-products allowed to decay.

C. <u>Program for May 1943.</u>

1. To be finished:

a. Specific ionization report.

b. Drosophila survival for x- and fast n- plus gamma radiation.

c. Mouse exposure chambers for beta-radiation from bombarded nitrate.

d. Design of low concentration Xe exposure chambers.

2. To be continued:

a. Rabbit lethal and blood effects for x- and fast n-radiation.

b. Drosophila survival for fast n-radiation

c. Guinea pig tissue changes for A-41 exposure and controls.

d. Design of No_x and Xe extraction processes for Site X.

3. To be begun:

a. Rat metabolism of recoil F-products at Berkeley and Chicago.

b. Rat metabolism tissue changes following ingestion of large amounts of F-products.

c. Mouse weight and lethal effects from bombarded nitrate beta-radiation.

d. Construction and testing of low concentration Xe exposure chambers.

e. Design I^{131} vapor exposure experiments

f. Design F-product dust exposure experiments.

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III.

HEALTH PHYSICS

E. O. Wollan - Section Chief

I. Present Status of Work

A. Radiation Instruments

1. Pocket meters (H. M. Parker)
   a. For gamma-rays.
      Type developed here for use in humid climates on order from Victoreen Instrument Company. Projection meter for reading these instruments is being developed by Victoreen at our request.

   b. For beta-rays.
      Special thin wall meters for beta-ray measurements are being used for experimental work. The design for a commercial model is being worked out.

   c. Dental Films.
      Work will be started soon on a study of the usefulness of films as an exposure meter.

2. Recording Integron meters.
   Being manufactured by Victoreen. Testing of this instrument is being carried out here.

3. Rate meters.
   Mr. H. A. Wilson is spending some time studying possible improvements in this type meter.

4. Fast neutron measurements.
   Work is still in progress on the development of an instrument which will give an accurate measurement of neutron dosage.

5. Air and water sampling meters.
   Techniques for these measurements are being studied.

6. Work of Radiation Monitoring and Instrument Coordinating Committee.
   Plan for X is approximately completed.
   Work begun on a study of requirements for W.

B. Biology Experiments.

A cooperative survey with Cole's Section of the biology experiments is being made with the view of helping to plan the necessary physical measurements.

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C. Personnel

The plan for radiation monitoring at X requires several men who will need to be trained. The shifting of part of this section to X requires a reorganization of the section at Chicago.

D. Air and Tissue Sampling

Work is being continued on the measurement of the metal content of dust collected in plants. The work with Dr. Tannenbaum on the metal content of tissues will soon be turned over to him.

E. Meteorological Program (P. E. Church)

1. Obtaining personnel and instruments for meteorological work at W. Most of the instruments and personnel have been acquired. It is expected that this work will be started soon.

2. Studies at X in connection with experimental stack in cooperation with Leverett.

3. Correlation of radiation measurements and meteorology at X after operation begins.

F. Health Section of Project Handbook

To be completed by June 15th.

II. Work for Current Month

Practically all the sections listed in"I" will require attention during the current month.

III. Work for Future.

A. Setting radiation monitoring plan at X in operation.

B. Testing all instruments to be installed.

C . Experimental work with biology section

D. Meteorology studies

E. Improvement of instruments for W.

F. Continuation of Health Hazard studies.

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IV.

REPORTS OF SUB-PROJECTS

R. S. Stone

NATIONAL CANCER INSTITUTE- Dr. Carl Voegtlin, Chief

Problem I. (Drs. Lorenz, Heston and Deringer). To find the level of exposure over 8 hours out of each 24 that will cause demonstrable blood and other changes, and the effect of additional exposures on top of these.

1. Chronic Exposures - to determine tolerances.
   Exposures of 0.1 r, 1 r, 2 r, 4 r, and 8 r during 8 hours of each 24.

   Observe: (a) Blood counts
   (b) Weight curves
   (c) Histological changes
   (d) Breeding

2. Chronic Exposures plus Acute Exposures - to determine whether there is a local reserve and greater response to acute doses.

   (a) Same chronic exposures as in 1 with "acute" doses of 50 r and 12.5 r in 5 hours (x-ray), and return to chronic exposure.

   (b) Same as "a" except no more acute exposure.

   (c) Same as "a" except repeat acute exposure when blood returns to normal.

   Mice-fully. Guinea Pigs-partially. Rabits-very incompletely.

3. Chronic Exposures to 8 r for limited time - 1 month and 2 months.

4. Control Single exposures to 50 r and 12.5 r in 5 hours time.

   Rabbits and Guinea Pigs to be tried at critical levels.

Problem II. (Drs. Henshaw and Nettleship). To determine the exposures in short periods required to cause definite blood and other changes, the time it takes to recover, and the effect of repeating similar exposures.

1. Tissue and Blood changes caused by acute doses of 0, 12.5 r, 25 r, 50 r, 100 r, 200 r, and 400 r.

2. Tissue and blood changes caused by repeating doses in 1 at stated intervals, or when blood returns to normal.

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3. Tissue and Blood changes by acute doses of x-ray to Guinea pigs.

4. Same as above in Rabbits and Dogs.

Drs. Lorenz, Heston and Deringer have seen fit on their own account to extend their previous series of experiments with 24 hour continuous exposures, using LAF_1 mice, exposed to the same dose to which they had previously exposed C_3H mice.

UNIVERSITY OF CALIFORNIA HOSPITAL, MEMORIAL HOSPITAL, and CHICAGO TUMOR INSTITUTE.

Total body irradiation experiments included in Dr. Cantril's report.

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V.

METABOLISM OF FISSION PRODUCTS

J. G. Hamilton, I. L. Chaikoff, D. M. Greenberg
(Radiation Laboratory, University of California)

THE OBJECT OF THE EXPERIMENTS

1. Metabolism of the Long Life F-products

This problem has the primary purpose to enable us to meet the problems of protection of the civilian and military population, and the protection of those individuals who may be exposed either directly or indirectly to hazards arising from the operation of the pile. A necessary correlary to the above is the investigation of procedures for decontamination of individuals infected by F-products. The tracer studies which have been either completed or are under way have been restricted to the long life F-products which are produced in significant quantities by slow neutron fission. The so-called middle group of F-products which arise from fast neutron fission may have to be examined in a similar manner. At present I have not sufficient information of the overall problem to enable me to make a decision concerning this middle group.

2. Proposed Procedures Planned for Securing an Answer to Problem Noted Above.

A. Tracer Studies

Successful procedures have been accomplished for the preparation of the long life slow neutron F-products without the presence of inert carrier. Both the individual elements and the raw mixture of F-products free from X-metal are being administered to rats to evaluate the distribution in the body. These substances are administered by mouth, by injection into the peritoneal cavity, directly into the muscle, and into the lungs.

In addition, a procedure has been devised by which it is anticipated that both short lived and long lived active deposits arising from the slow neutron fission of X-metal can be suspended in the air and their distribution in the body determined following inhalation of these substances. In addition it is planned to evaluate both the distribution and radiation effects of the raw fission mixture containing the long life material upon human leukemia patients.

B. Removal Studies

Studies have been initiated under the direction of Professor D.M. Greenberg for the evaluation of different methods for the decontamination of the animals to whom F-products have been administered. The procedures which he is studying are in the main comparable to those employed in the removal of elements such as Lead, Barium

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and Bismuth which tend to be deposited in the bone in a manner which at least superficially resembles the behavior of several of the more important long life fission products.

3. Tentative Completion Dates (To be accepted with considerable mental reservation)

A. The general picture of the metabolism of the long life slow neutron group of X-metal F-products should be in hand to a usable degree, barring unforeseen delays, by October 1, 1943.

B. The practicability of the removal from the body of the groups mentioned above is less amendable to a date line. At present this work is just getting under way. My personal opinion, for which I assume sole responsibility is that by March 1, 1944, we should be in a position to know how useful decontamination methods will be for the treatment of clinical subjects.

C. The deadline for the fast neutron group cannot be predicted since its urgency is at present unknown to me.

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