Bo (Los Alamos)
574

~~CONFIDENTIAL~~



REPOSITORY Oak Ridge Operations Office
COLLECTION Records Holding Area Documents 1944-1994
BOX No. H-1085 Records Holding Area Building 3714-A
FOLDER None

MEDICAL RESEARCH PROGRAM OF LOS ALAMOS SCIENTIFIC LABORATORY 707769

By: Louis H. Hempelmann, M.D.

I. Purpose:

a) To investigate medical problems resulting from the hazards to laboratory employees existing at this and other nucleonic installations.

b) To use the unusual facilities of this laboratory to promote fundamental biological and medical research.

c) To train new medical biophysics and biochemistry personnel in radiobiologic techniques.

II. Scope of Medical Research Program (approved in principle by Manhattan District:

a) A budget of approximately $200,000.00 per annum (not including overhead) for the fiscal year 1947-48.

b) A permanent research staff of 35 persons.

c) 6 - 12 trainees in research and industrial medicine.

III. Research Program:

A. Study of Radiation Disease.

1. Physiological and biochemical changes in radiation disease.

a) Fluid balance.

b) Nucleoprotein metabolism (in collaboration with Dr. David Lipkin, Washington University, St. Louis).

c) Membrane permeability.

DECLASSIFIED
by authority of:
(Authorized Declassifier's name and organization)
or Sin Sgalli 3/1/94 - Request for Rapid
(Official declass. notice-- memo, TIC notice, etc.)
Jane Wilder 3/14/94
(Person making change) (date)
Emilie J. Huth 3/14/94
(Document identification verified by) (date)

1033584

d) Cellular physiology of blood cells.

e) Morphologic changes in blood cells as shown by ultraviolet and phase microscopy and by the supravital staining techniques.

f) Intracellular chemical changes as seen by histochemical techniques.

g) Effect of radiation on cocarboxylase enzyme system as evidenced with coenzymes I and II marked with $C^{14}$.

2. Treatment of Radiation disease.

a) Effect of lowering of body metabolism.

b) Administration of nucleic acid precursors (mononucleotides, etc.) with Dave Lipkin.

c) Study of products of tissue breakdown and methods of detoxification.

d) Effect of thymine, folic acid, pituitary hormones and other substances known to affect the bone marrow.

e) Effect of adrenal cortical hormones.

3. Methods of diagnosis of early radiation damage.

a) Changes in physiology of the blood cells indicated by supravital staining techniques, histochemical techniques, membrane permeability and other methods mentioned in I-A.

b) Morphologic changes in blood cells as seen by the ultraviolet ray and phase microscope and electron microscope.

B. Biochemistry of Plutonium, Uranium 235 and other radioactive materials.

1. Continuation of studies of metabolism of plutonium including absorption, deposition, excretion, etc.

2. Removal of plutonium from the body.

1033585

3. Studies of decontamination of plutonium and fission products from surfaces and wounds.
4. Improvement of present biochemical techniques.
5. Effect of endocrine system and endocrine products on deposition of plutonium in bone.
6. Metabolism of Americium in the animal organism.

C. Biophysical Methods.

1. Methods of detection of small amounts of alpha emitting radioactive materials in the lungs.
2. Development of methods of calculation and measurements of energy absorption in man from complex radiations such as are emitted from nuclear reactions. This includes studies of neutron induced activities in biological tissues.
3. Response of film to ionizing radiations.
4. Tritium detection and control.
5. Development of methods of detection of heavy ionizing particles in tissue ash by means of micro wave techniques.
6. Study of ionic efficiencies of radiation in producing cellular changes.
7. Study of the laws of cell growth.
8. Distribution of cell and nuclear volumes in health, radiation and other diseases.

D. Fundamental Research unrelated to effect of radiation on tissue utilizing the special physical facilities available at this laboratory.

1033586

E. Training Program including trainees from the hospital, the Army and possibly the Navy and Public Health Services.

Priority of Problems:

1. Treatment of radiation disease.
2. Detection of plutonium in the lung.
3. Detection of early radiation damage.
4. Removal of plutonium from the body.

1033587

AEC-730 (Los Alamos)

~~CONFIDENTIAL~~

SUMMARY OF MEDICAL AND BIOLOGICAL RESEARCH ACTIVITIES OF THE LOS ALAMOS SCIENTIFIC LABORATORY (1942 to 1947)

By: Louis H. Hempelmann

Joseph G. Hoffman

Wright H. Langham

1033588

SUMMARY OF MEDICAL AND BIOLOGICAL RESEARCH ACTIVITIES
OF THE LOS ALAMOS SCIENTIFIC LABORATORY (1942 to 1947)

A. Clinical Section

1. Hematology Research

(a) The hematologic data on all project personnel chronically and acutely exposed to ionizing radiation and radioactive materials have been analyzed. It has been concluded that the usual type of routine blood examinations, even under the most careful conditions, is not a good index of early radiation damage.

(b) An aid in the evaluation of blood changes due to ionizing radiation has been worked out. A large series of observations of the morphology of cells in supravital preparations of blood indicates an increase in the number of refractite neutral red bodies in the lymphocytes in the circulating blood of persons exposed to ionizing radiation in the tolerance range. This non-specific increase in intracellular bodies which stain with neutral r can be correlated with the degree of exposure.

(c) The hematology of persons and animals receiving large doses of radiation in accidental nuclear reactions and at the Alamagordo test has been studied.

2. Clinical Research

(a) The clinical courses of two persons fatally injured by radiation and twelve persons seriously overexposed to radiation have been exhautively studied.

3. Research and Observations directly related to Alamagordo operation include:

   (a) Study of the behavior of fission products spread across the country side by the nuclear explosion. Rate of spread across the state. Decay laws observed in the field. Physical distribution of the products on the ground.

   (b) Measurement of beta and gamma doses sustained by personnel in the country side where fission products fell. Dosage from suspended and from precipitated products.

   (c) Assay for plutonium in the country side about the nuclear explosion. Agreement with bomb efficiency determinations.

   (d) Special studies of the beta and gamma doses sustained by livestock upon which fission products fell (Beta radiation burns).

4. Biophysics studies pertaining to critical assemblies include:

   (a) The study of events in critical assembly accidents. "Blue glow" energy considerations. Health-physics monitoring regulations appropriate to critical assemblies.

   (b) Measurement and evaluation of slow neutron induced activities in the personnel working with critical assemblies (beta activity in urine and blood sera).

   (c) Calculation and measurements of gamma radiations emitted from personnel exposed to neutrons. (Skin and teeth as well as entire body).

1033590

3. Research and Observations directly related to Alamagordo operation include:

   (a) Study of the behavior of fission products spread across the country side by the nuclear explosion. Rate of spread across the state. Decay laws observed in the field. Physical distribution of the products on the ground.

   (b) Measurement of beta and gamma doses sustained by personnel in the country side where fission products fell. Dosage from suspended and from precipitated products.

   (c) Assay for plutonium in the country side about the nuclear explosion. Agreement with bomb efficiency determinations.

   (d) Special studies of the beta and gamma doses sustained by livestock upon which fission products fell (Beta radiation burns).

4. Biophysics studies pertaining to critical assemblies include:

   (a) The study of events in critical assembly accidents. "Blue glow" energy considerations. Health-physics monitoring regulations appropriate to critical assemblies.

   (b) Measurement and evaluation of slow neutron induced activities in the personnel working with critical assemblies (beta activity in urine and blood sera).

   (c) Calculation and measurements of gamma radiations emitted from personnel exposed to neutrons. (Skin and teeth as well as entire body).

4. At 30 days the rat excretes over 10 times as much Pu in the feces as in the urine. This is not the case with the human for which the fecal to urinary excretion ratio is 1/1.

(b) Effect of citrate ion on the metabolism of $Pu^{+4}$ administered intravenously to the rat.

When $Pu^{+4}$ is administered in 0.3% sodium citrate solution the excretion is not vastly different from that for $Pu(NO_3)_4$. Deposition in the liver is greatly decreased, however, and deposition in bone is increased to about 60% of the injected dose.

(c) Effect of size of dose on the metabolism of plutonium citrate administered intravenously to the rat.

When doses ranging from 0.03 micrograms to 52.0 micrograms of plutonium were given in a single injection the per cent deposition in the various tissues and the per cent excretion in feces and urine was not affected by the size of dose.

(d) Effect of citrate ion on absorption of plutonium from the gastrointestinal tract.

In the absence of citrate ion the absorption of $Pu^{+4}$ from the gastro-intestinal tract was about 0.01% of the ingested dose. When administered in 5.0% sodium citrate solution absorption was about 0.3% of the dose.

(e) Metabolism of plutonium in the human (Relation between blood level and urinary and fecal excretion when plutonium is administered intravenously in sodium citrate solution),

1033592

4. At 30 days the rat excretes over 10 times as much Pu in the feces as in the urine. This is not the case with the human for which the fecal to urinary excretion ratio is 1/1.

(b) Effect of citrate ion on the metabolism of $Pu^{+4}$ administered intravenously to the rat.

When $Pu^{+4}$ is administered in 0.3% sodium citrate solution the excretion is not vastly different from that for $Pu(NO_3)_4$. Deposition in the liver is greatly decreased, however, and deposition in bone is increased to about 60% of the injected dose.

(c) Effect of size of dose on the metabolism of plutonium citrate administered intravenously to the rat.

When doses ranging from 0.03 micrograms to 52.0 micrograms of plutonium were given in a single injection the per cent deposition in the various tissues and the per cent excretion in feces and urine was not affected by the size of dose.

(d) Effect of citrate ion on absorption of plutonium from the gastrointestinal tract.

In the absence of citrate ion the absorption of $Pu^{+4}$ from the gastro-intestinal tract was about 0.01% of the ingested dose. When administered in 5.0% sodium citrate solution absorption was about 0.3% of the dose.

(e) Metabolism of plutonium in the human (Relation between blood level and urinary and fecal excretion when plutonium is administered intravenously in sodium citrate solution),

1033593

1. There was a high correlation between blood level and urinary excretion and fecal excretion and between blood level and urinary plus fecal excretion.
2. At thirty days the urinary excretion was 0.014% ± 0.007%.
3. At thirty days the mean fecal excretion was 0.02% ± 0.01%. This corresponds to a fecal to urinary excretion ratio of approximately 1/1.
4. A fitted curve for urinary plus fecal excretion indicates that it would require fifty years for a human to excrete 15% of the injected dose.

(f) Deposition of intravenously administered plutonium in the tissues of the human.

A study of two cases show that the skeleton and the liver of the human are the principle sites of deposition of plutonium.

3. Research on monitoring of plant personnel.

(a) A study of exposure of certain plant personnel to plutonium.

1. Several hundred urine assays conducted on plant personnel show a high correlation between plutonium excreted in the urine and the number of high nose counts recorded for the individual.
2. There was a high correlation between plutonium in the urine and the nature of the job being performed.

(b) Urinary excretion of plutonium by four human subjects highly exposed in a plant operation.

Four individuals working in the plutonium recovery operation reached or exceeded the 1 microgram tolerance level. After being removed from their work, their

1033594

1. There was a high correlation between blood level and urinary excretion and fecal excretion and between blood level and urinary plus fecal excretion.
2. At thirty days the urinary excretion was 0.014% ± 0.007%.
3. At thirty days the mean fecal excretion was 0.02% ± 0.01%. This corresponds to a fecal to urinary excretion ratio of approximately 1/1.
4. A fitted curve for urinary plus fecal excretion indicates that it would require fifty years for a human to excrete 15% of the injected dose.

(f) Deposition of intravenously administered plutonium in the tissues of the human.

A study of two cases show that the skeleton and the liver of the human are the principle sites of deposition of plutonium.

3. Research on monitoring of plant personnel.

(a) A study of exposure of certain plant personnel to plutonium.

1. Several hundred urine assays conducted on plant personnel show a high correlation between plutonium excreted in the urine and the number of high nose counts recorded for the individual.
2. There was a high correlation between plutonium in the urine and the nature of the job being performed.

(b) Urinary excretion of plutonium by four human subjects highly exposed in a plant operation.

Four individuals working in the plutonium recovery operation reached or exceeded the 1 microgram tolerance level. After being removed from their work, their

1033595

CONFIDENTIAL

persons have reached or exceeded the present tolerance limit of 500 c/m per 24-hour sample of urine.

(g) Effect of time of day and fluid intake on excretion of Postum by a human subject.

Results show no appreciable effect of increased fluid intake on excretion of Postum. There is some indication of a higher concentration in the early morning voiding of urine.

(h) An investigation of neutron induced activity in blood and urine of persons involved in critical assembly accidents.

Extremely high $P^{32}$ and $Na^{24}$ activities were observed in the blood and urine of persons exposed during critical assembly accidents.

1033596