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Report of the
23-24 January 1947 Meeting
of the
INTERIM MEDICAL COMMITTEE
U. S. ATOMIC ENERGY COMMISSION

by
Stafford L. Warren, M. D.
Chairman, Interim Medical Advisory Board

Members Attending:

Dr. R. S. Stone	Dr. J. G. Hamilton
Dr. G. Failla	Dr. A. Hollendaer
Dr. John Wirth	Dr. S. T. Cantril
Dr. H. L. Friedell	Dr. J. Svirbely
Dr. R. E. Zirkle	Dr. L. Donaldson
Dr. J. Sterner	Dr. James Nolan
Dr. A. H. Dowdy	Dr. E. L. Vosburgh
Dr. A. M. Brues	Dr. B. S. Wolf
Dr. Louis Hempelmann	Dr. K. Z. Morgan

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Report of the 23-24 January 1947 Meeting of the
Interim Medical Committee of the
United States Atomic Energy Commission

I. Review and Scope of the Medical Research Program.

A. Since the inception of the Atomic Bomb Project, an expanding research program aimed at the diagnosis and control of hazards peculiar to the development of atomic energy has been in effect. These hazards include those injurious effects produced through accidental external body exposure to radiations emitted by various radioactive materials during the experimental or processing operations, as well as the chemical toxicity or localized radiation from such materials deposited within the body.

Considerable preliminary or pilot experimental and clinical information has been obtained by this research program during the last three years. Of necessity, many fields were completely neglected. The injurious effects following single exposures to large amounts of radiation have been determined experimentally; some of the changes following prolonged chronic radiation exposure have been surveyed; the biological effects which follow the introduction of various toxic and radioactive materials into the body have been partially demonstrated. Such pilot studies have been useful in the estimation of maximum allowable exposure levels of radiation or toxic materials to which personnel can be safely exposed for a period of time, and the control of such hazards by the prevention of such exposures. Such standards were designed for war time expediency and are not necessarily applicable to peace time.

While the above information has been extremely useful in this work, it immediately becomes obvious that many critical problems of far reaching scope remain to be solved. Information concerning the method of production of these injurious effects in body tissues is almost completely lacking. No methods are available which might stop or delay the development of radiation injuries. No therapeutic measures are at hand to use following accidental injury due to radiation or radioactive materials. Such problems relate to the fundamental nature of living matter and demand the careful and continued attention of competently trained scientists.

B. The following list indicates briefly the survey of the general studies on radiation effects.

The known radiations encountered in nuclear fission, as well as those encountered from naturally radioactive substances divide themselves into the following types: alpha rays, beta rays, gamma rays and neutrons. The literature on the biological effects of x-rays and gamma rays is voluminous and a good deal of background information was obtained from this source. On the other hand, very little had been written about the biological effects of alpha rays, beta rays and neutrons. It became necessary, therefore, to initiate studies to cope with the unique and pressing problems as rapidly as possible.

The report of the Medical Advisory Committee to the Director of the Medical Division of Manhattan Engineer District of September

9, 1946 contained the following summary of the problems and the methods of approach being used up to the present.

1. The Physical Measurement of Radiation of various types. Here it was and still is necessary to develop better methods of accurately measuring and standardizing the dosage of radiation in two vitally important areas (1) the measurement of the extent of any radiation which might be found in an industrial area and (2) in the biological experimentation.

2. The Biologic Effects of Radiation. Because of the known deleterious effect of radiation on the animal organism, it becomes necessary to determine the effect of controlled dosages of the various types of radiation on various animal and plant species, including marine life. Such observations can be used in the control of possible human exposure and have practical use in medico-legal problems arising from contamination by effluents.

Some of the types of biological effects it is possible to study are given below. Only pilot studies have been done on most of these effects.

a. The survival time or percentage reduction in normal life span of different animal and plant species following a given dose.

b. The genetic effects of radiation as manifested in the development of abnormal individuals from changes in the heredity mechanism.

c. Histopathological changes as demonstrated by abnormal changes in the makeup of the various body tissues.

d. Physiological changes produced by the alteration of the normal functioning of living tissues following irradiation.

e. Biochemical and enzymatic disturbances which are the potential sources of these physiological abnormalities.

3. Methods for the Detection of Minimal Radiation Damage are being developed directly from experiments of the above types and are applied to the study of the human individual. These include studies on:

a. Biochemical and enzymatic changes which may be detected and which, if measurable, can be corrected before irreversible damage has taken place. Examples of such changes would be effects on the metabolism of coproporphyrins, excretion of abnormal substances in the urine, and the like.

b. It has been known that radiation depresses the function of the hematopoietic system (bone marrow, lymph nodes, etc) and detailed study is indicated to detect early changes under controlled dose radiation with all blood elements under continuous observation.

c. The production of anatomical changes such as epilation, skin erythema, and alterations in the integrity of the skin and the like, must likewise be studied under controlled dosage.

4. Methods for the Prevention of Radiation Injuries. These include:

a. Methods of physical detection of external radiation by the development of sensitive direct reading instruments capable of the detection of amounts of radiation well below those necessary for demonstrable injury to the animal or human subjects.

b. Methods for the determination of harmful amounts of radioactive dusts and gases in air, in water and in body tissues. Many radioactive materials are deposited in the body, like radium, and in such locations produce injury to tissue, particularly the bone marrow. Methods based on the determination of dangerous amounts of these substances by examination of the excreta and direct measurements of the body itself are first developed in animals and then applied to human beings.

5. Protective Measures. Studies on (1) the efficiency of shielding against radioactive materials (2) the efficiency of exhaust and ventilating systems against dangerous amounts of dusts (3) the development of protective clothing and devices and (4) the development of remote control processing methods have been extremely important in the Manhattan District protection program to date and will continue to be fundamental to the development of a safe atomic power program.

6. The possible treatment of radiation injury deserves extensive study with high priority. Experimental replacement of the damaged hematopoietic elements destroyed by severe radiation exposure offers one possibility. Detection and neutralization of hypothetical but unknown toxic substances produced by radiation is another possibility. This difficult and fundamental problem deserves consistent and detailed study.

All the above studies are of necessity done with alpha, beta and gamma rays and neutrons of varying intensity, singly and in various combinations. Also, the effects of acute and chronic exposure must be determined separately because of their dissimilarity.

C. The following list indicates briefly the study of the hazards due to special materials. For brevity, it is preferable to discuss the potential toxicity of special materials by first indicating the types of studies to be carried out, and then by listing those materials on which studies have been made or on which studies are necessary.

1. First, an actual determination of the toxicity of a substance must be made, measuring how poisonous it is, both in acute and in chronic exposures. The amounts administered are decreased until asymptomatic levels are found. In this way, toxic levels may be avoided in laboratory and plant environments. Some pilot work in this direction has been completed for a few compounds of uranium, plutonium and certain special oils.

a. The mode of entrance into the body (ingestion, inhalation or skin absorption) must be studied as different manifestations and degrees of toxicity may be produced by each route employed.

Storage in and excretion from the body must be studied in chronic experiments at various levels of exposure.

b. A careful analysis must be made as to the character of the biological changes; specifically, production of physiological, histopathological and biochemical and genetic evidences of damage. Some progress has been made here.

c. The nature of these injuries and the mechanism by which they occur must likewise be studied. This affords information as to the necessary protective measures, and indicated therapy after exposure. Very little has been attempted here except in one or two instances.

2. Preventative measures require study.

a. The comparative effectiveness of physical methods for the removal of hazardous dusts; namely, the reduction in skin contact and prevention of ingestion, must be measured. Methods for accurate estimation of such hazards must be developed and used. The efficiency of certain protective chemicals, ointments, etc., must be studied. Only pilot studies have been done here.

b. Protective devices such as portable respirators and clothing must be tested for those hazardous substances against which they will be used. No practical mask, military or otherwise, which will protect against some of the worst hazards has been found yet.

c. Finally, appropriate investigation must be made of those therapeutic measures to be used in the treatment of both acute and chronic toxicity states.

3. Completion of the various phases of the program outlined above would provide complete information as to those medical aspects which must be taken into account in the protection of the worker, as well as treatment of injury should it occur. The following is a nearly complete list of the substances on which studies of this type are necessary:

a. Uranium and its compounds.

(1) Uranium metal and its chemical compounds: oxides, nitrate, chlorides, bromide, tetra and hexafluoride, sodium and ammonium diuranates. Some pilot studies have been completed.

(2) Uranium chain of heavy metals:

Uranium X^1
Uranium X^2
Radium
Polonium

Relatively little has been accomplished here.

(3) Fission products of cleavage of U-235 and plutonium. Very meagre pilot studies have been done here.

(4) Artificial isotopes of uranium - 232, 234, etc. Almost nothing has been done here.

b. Thorium and its chain, almost unknown.

c. Plutonium - some pilot work.

d. Special accessory materials - pilot work only.

(1) Fluorocarbons

(2) Fluorine

(3) Beryllium

(4) Others

D. Production Hazards. The results of the laboratory studies made on the materials discussed above are applied to the prevention and control of industrial hazards which arise in the large manufacturing areas where these materials are used in large amounts. These are illustrated by the following:

1. In the Electromagnetic and Diffusion Methods for the isolation of uranium 235, the major hazards are from the uranium compounds, the concentration of uranium X1 and X2, and the special accessory materials and byproducts formed in the process of manufacture.

2. In the graphite pile where plutonium (239) is produced on a large scale, the hazards are from the alpha, beta and gamma rays, neutrons, the plutonium metal and its compounds, the various radioactive fission products resulting from the pile operation.

3. The chemical isolation of polonium following its formation in the pile incorporates hazards from alpha radiation following absorption into the body.

4. Chemical purification process in making uranium metal results in hazards from alpha, beta and gamma radiation and the chemical toxicity of the uranium of other products used.

5. Study of the medical aspects of plant programs aside from the determination of the effect of radiation and chemical toxicity, include additional information obtained from plant investigations as from:

a. Clinical survey of all exposed personnel.

b. Monitoring of hazards by special instruments and methods.

c. Surveys of new types of graphite piles and production equipment.

E. Hazards of Atomic Catastrophe in Production Areas.

1. Immediate effects:

a. Radiation. The radiation occurring at the time of the explosion coupled with blast and heat causes biological effects which may differ from those occurring following other acute known effects from gamma and neutron radiation, and demand study. Some pilot work and observation of the Japanese indicate that this may be so.

b. Blast. The total blast energy of atomic explosion is very great and may have totally different types of shock waves, recoil waves from ordinary explosives and unique biological effects may be produced. Some pilot work has been done.

c. Actinic radiation. The intense burns from actinic type of radiation have not been studied. This also includes the combination effect of all three items in this group: blast, radiation and heat.

2. Delayed Effects.

a. Protective devices. Study of methods of protection against the radioactivity deposited at the time of blast.

b. Decontamination. Methods of decontamination of soil and the like must be worked out for cleaning up active areas. Some experience is available on this from New Mexico and the ships from Bikini which is applicable.

c. Investigative equipment. Special equipment must be developed and tested for use in investigating bombed areas.

d. Study of casualty effects. Field study of fission clouds, possible injury to water supply, soil and the like, human damage by population surveys.

e. Study of treatment of all immediate effects such as radiation, heat and blast.

F. Preparation of pertinent information in proper form for use by catastrophe units in production areas.

II. Current Medical Research Program.

A. To permit continuity, it is recommended the current program be continued during 1947-1948. The current program is reviewed by topics under the following list of the participating organizations:

Argonne National Laboratory
University of Rochester
University of California at Berkeley
Columbia University
University of Washington
Monsanto Chemical Co. (Clinton Lab) USPHS
Monsanto Chemical Co. (Dayton)
Los Alamos
Western Reserve University

University of California at Los Angeles
University of Tennessee
University of Virginia

Brookhaven and other future laboratories are not included.

B. Future expansion of the medical and biological research program on a long term contract basis (5 years or more) is necessary in order to secure information of a more fundamental character which is necessary in order to cope with the special hazards of atomic energy development. Also it is imperative to open new fields of application for the products of atomic energy in biology and medicine. The Committee feels that such expansion can best be planned and put into effect after the establishment of a Medical-Biological Division. (See Appendix A). After the Regional Laboratories are well organized, the obvious usefulness of isotopes in a wide application to biological research will offer so many tremendous opportunities that developments in this field are assured.

C. Specific Projects: (in brief, topical outline)

1. Argonne National Laboratory - Dr. Austin M. Brues, Director.

a. The physiological picture of animals exposed to acute and chronic irradiation.

b. The effects of irradiation on the structure and functions of the blood and on the hematological defenses against infection.

c. The acute toxic effects of external radi tion and absorbed radioactive substances: their mechanism of injury; prevention of possible damage and treatment of already injured individuals.

d. The abnormal responses of blood cells, cultured tissue cells and single celled organisms to various types of radiation.

e. The chronic effects of radiation and radioactive materials in animals.

f. The mode of a ction of radiation in the production of cancer.

g. The response to different types of radi tion of the various organs and tissues, including tumors.

h. Studies on the chemical effects of radiation which are fundamental to its biological response.

i. The absorption, deposition and elimination of radioactive elements from the body.

j. The design and standardization of instruments to

carry out the foregoing.

2. University of Rochester - Dr. Andrew H. Dowdy, Director.

a. Radiation and Radiology Section:

(1) Instrument design, measurement standardization, industrial monitoring.

(2) Biological effect of tracer amounts of polonium, radium and uranium in human and animal subjects. Application of tracer experiments to serve other parts of the project.

(3) Physiological effects of exposure to acute and chronic radiation including the radio-isotopes; search for therapeutic methods of value.

(4) Development of possible chemical techniques or methods of detection of radiation damage, and the mechanism by which such effects are produced.

(5) By means of spectroscopic methods, to study the distribution of uranium and other heavy metals of importance in animal tissue; a search for possible clues as to the method of bony deposition of radioactive materials.

(6) Study of the time intensity factor in radiation, and development of methods of producing instantaneous exposure to radiation (A bomb effect).

(7) Study of the metabolism of plutonium, polonium, radium, etc., in human subjects.

b. Pharmacology:

(1) Study of the inhalation toxicity of various uranium, beryllium and thorium compounds. Studies in the mechanism of production of inhalation toxicity.

(2) By chemical techniques, studies of the mechanism of uranium fixation in bones, uranium complex formation, methods of excretion of uranium.

(3) Acute toxicity effects of uranium, beryllium and thorium compounds by ingestion.

(4) Pathological effects of uranium, beryllium and thorium poisoning, and mechanism by which produced.

(5) Physiological effects of uranium, beryllium and thorium poisoning.

(6) Special toxicity studies.

(7) Certification of respiratory protective devices.

c. Experimental Surgery.

(1) Clinical, hematological and pathological effects of acute lethal radiation.

(2) Methods of bone marrow transplantation.

(3) Studies in bone marrow reserve and radiaiton effect.

(4) Tissue culture studies related to bone marrow production.

(5) Effect of folic acid and rutin on marrow regeneration.

(6) Studies of metabolism of iodine by thyroid.

d. Experimental Hematology.

(1) Comparative study of blood histamine after radiation and hematological effects in cells.

(2) Studies of life cycle of blood platelets.

(3) Studies on life cycle of leukocytes.

(4) Studies on marrow reserves after radiation.

(5) Evaluation of coagulation defects following irradiation.

(6) Techniques for early detection of hematological changes resulting from ionizing radiation.

e. Genetics.

(1) Continuation of studies of effect of chronic radiation on mice.

(2) Continuation of studies on effect of acute and chronic radiation (x-ray) on D rosophilia.

(3) Histogenetics.

f. Training personnel in all above sections.

3. University of California at Berkeley .

a. Dr. Joseph Hamilton's program.

(1) Metabolism of fission products, radium, actinium, protoactinium, uranium, neptunium, plutonium, americium and curium in animals and man.

(2) Metabolism of possibly hazardous artificially induced radioactive elements from plant construction materials such as chromium, nickel, etc.

(3) Metabolism of beryllium.

(4) Development of methods of treatment of poisoning from fissionable elements, notably plutonium and uranium 233 and from the long lived fission products.

(5) Behaviour of fission products and fissionable elements in soils and plants.

(6) Study of alpha particle irradiation and the thyroid gland in animals and man by Astatine (Element 85).

(7) Development of methods for decontamination of radioactive ships from Operation Crossroads.

(8) The execution of certain radio chemical analyses for Operation Crossroads and training of Army and Navy personnel.

(9) A study of the metabolism of elements chemically similar to the fissionable elements and the fission products.

b. Dr. John H. Lawrence's program.

(1) Biological effects of fission products.

(2) A search for uranium compounds that will localize in organs other than the liver and spleen.

(3) Biological effects of the disintegration products of boron and lithium following neutron irradiation.

(4) Genetics of the carcinogenic effect of beta rays.

(5) Physiological chemistry of the biological action of radiations.

(6) Changes in water balance following radiation injury.

(7) Radiation effects on tissue cultures.

(8) Effects of selective irradiations of individual organs and tissues.

c. Dr. Robert S. Stone's program.

(1) Studies in whole body radiation of human subjects by external and internal radiation.

(2) Studies on the [illegible] radioactive [illegible]

(3) Joint studies with Dr. Joseph G. Hamilton to evaluate the therapeutic applications of the fission products and the fissionable elements.

(4) Exploration and therapeutic applications of other radioactive elements and compounds.

4. Columbia University - Dr. G. Failla, Director.

a. Measurement of fast neutrons for biological purposes.

b. Measurement of time dose relationship resulting from radioactive isotopes distributed in the tissues.

c. Measurement of specific gamma ray emission.

d. Study of the quantitative relationships in chemical effects produced by gamma rays and fast neutrons.

e. Further study of eye and gonad injury produced by fast neutrons.

f. Study of the biological action of ionizing radiations.

g. An attempt to reduce radiation injury.

h. Study of the distribution of radioactive isotopes in tissues and cells.

i. Protection data for the safe handling of radioactive isotopes in small amounts.

j. Training of personnel.

k. Measurement of very high energy radiations for biological dosage.

5. University of Washington School of Fisheries - Dr. Lauren R. Donaldson, Director.

a. The work of this project is to explore the general problem of the effect of radiation on aquatic organisms, and in particular, to study the problems arising from the discharge effluent from the Hanford plants into the Columbia River and the possible contamination of sea water (including Bikini). The work under this contract involves studies of the following nature:

(1) Acute and chronic effects of external radiation on fishes.

(2) Breeding studies on salmon and trout following irradiation.

(3) Studies of the effects of the Hanford effluent on salmon and trout.

(4) Effects of internally deposited radioactive

materials on aquatic organisms.

(5) Field studies on the effect of possible Hanford pollution on aquatic life in the Columbia River.

(6) Studies on the transfer of radioactive materials in "food chains", starting with the simpler biological forms (ie plankton) and following the distribution and fate of such materials as these contaminated animalcules are successively eaten and metabolized by higher forms (fishes, etc).

(7) Feeding experiments using radioactive materials in the foods.

6. Hanford Engineer Works (Research Project) - Dr. Simeon T. Cantril, Director.

a. Health physics research and development in radiation monitoring, instrumentation.

b. Training of technicians and other personnel in problems of radiation protection.

c. Applied biologic research relative to phases of radiation hazard peculiar to Hanford Engineer Works operations and waste disposal:

(1) Soil, water and air contamination by radioactive materials.

(2) Studies under controlled conditions of the effects of radioactive materials on domestic animals.

(3) Studies under controlled conditions of the effects of radioactive materials on vegetation.

(4) Fish Studies: (In collaboration with University of Washington, project listed previously.)

(a) Effects of waste effluent on salmon and trout.

(b) Effects of internally deposited radioactive materials.

(c) Field studies on possible pollution of Columbia River and fish by Hanford waste.

(d) Plankton experiments - absorption studies.

7. Monsanto & U. S. Public Health Service, Clinton Laboratories - Dr. Alexander Hollaender, Director.

a. Studies of the biological effects of slow and fast neutrons, beta and gamma radiation are in progress as a follow-up of

previously reported work.

b. Effects of plutonium on bone healing is being studied.

c. The parabiotic twin technique is being used to study the indirect effects of radiation.

d. A concentrated attack is being made on radiation effects on the rate of mitosis, chromosome breaks and exchanges, gene mutations and the general genetical makeup of the cell, including cytoplasmic factors.

e. Tracer experiments of a number of metabolic systems have been initiated using various microorganisms.

f. Effects of radiation on cell constituents, proteins, nucleic acids and enzymes are being studied by modern physical-chemical tools; (including isotopes.)

g. Radiation effects are being investigated on blood constituents and blood forming organs as well as on the nervous system.

h. Cooperative research arrangements are being made with the Universities of Tennessee, Vanderbilt University, Washington University, University of Pennsylvania, John Hopkins University and Carnegie Institution.

i. Close cooperation with the National Institute of Health and the National Cancer Institute has been set up.

j. Instrumentation of radiation monitoring developed by health physics will be continued.

k. Health physics research is to be extended.

l. A training program.

8. Monsanto Chemical Co (Dayton) - Dr. James Svirbely, Director.

a. Biological effects of chronic and acute exposures to polonium and polonium compounds by various modes of administration to determine the maximum permissible levels for human exposure. Tracer experiments may be indicated for clinical investigation. Mechanism of action, correlation of excretion levels with visceral content and genetic effects will be studied.

b. Maximum permissible levels for alpha radiation in individual viscera, especially the kidney. This is a specific phase of the first problem.

c. Study of maximum permissible levels for polonium to use in safe waste disposal.

d. Correlation of excretion levels and exposure in production personnel.

e. Study of prophylaxis and therapy of the toxic effects of polonium.

f. Biologic effects and methods of measurement for protection against radiation from special neutron sources prepared at Dayton.

g. Development of continuous monitoring equipment and other types.

h. Studies of the prevention of contamination and on decontamination.

9. Western Reserve University - Dr. Hymer L. Friedell, Director.

a. Studies on toxicity of thorium.

(1) Biological effects.

(a) Study of biological effects of soluble thorium compounds, lethal effects, weight changes, histopathologic, hematologic and biochemical changes.

(b) Study of biological effects of insoluble thorium compounds as in a(1) above, but also includes radiation effects.

(2) Distribution studies.

(a) Study of thorium distribution in tissues by chemical assay.

(b) Study of distribution by tracer technique.

(3) Biochemical studies.

(a) Transport of thorium across gastro-intestinal and respiratory epithelium.

(b) Mode of transfer of thorium in blood and tissues.

(c) Manner and characteristics of thorium deposition in tissue.

(d) Review of enzyme systems affected and enzyme inhibition.

b. Study of radiation effects of internally distributed radioactive elements.

(1) "Summation" studies of several radioactive elements of widely varying specific ionization.

(a) Study of beta emitters lodging in specific tissues (bone, kidney, thyroid, etc).

(b) Study of alpha emitters lodging in specific tissues (bone, kidney, thyroid, etc).

(c) Comparison and summation of alpha and beta emitters having approximately similar deposition in tissue.

c. Synthesis of compounds into which radioactive elements may be introduced.

(1) Comparison of radiation effects of various beta emitters alternately introduced into the same compound.

(2) Comparison of radiation effects of beta and alpha emitters (wide divergence of specific ionization) alternately and concomitantly introduced into the body.

d. Study of the distribution of the above noted radioactive compounds.

(1) By assay of radioactivity in tissues.

(2) By radioautographs of tissues and similar suitable means.

10. Los Alamos - Dr. Louis Hemplemann, Director.

a. Plant hazard research.

(1) Development of method for the determin tion of minute amounts of plutonium in the excreta and body tissues of humans and animals.

(2) Determination of the fraction of injected plutonium excreted per day by humans and animals. (In collaboration with the University of Rochester).

(3) Metabolism of plutonium in animals.

(4) Hematological studies in laboratory personnel exposed chronically to small repeated doses of radiation and radioactive material and accidentally exposed to large doses of radiation.

(5) Development of instruments to measure radiation.

(6) Development of safe techniques for plant operation.

(7) Clinical studies on acute radiation disease.

b. Proposed fundamental and applied research program.

(1) The fundamental studies on the acute effects of radiation.

(2) Treatment of acute radiation disease.

(3) Methods of detecting early radiation injury.

(4) Continued studies of the metabolism of plutonium U-235 and other radioactive materials.

(5) Detection of accumulated plutonium in the lungs.

(6) Biochemical studies of nucleoprotein and the effect of radiation of the fundamental physiology of the cell. (In collaboration with Washington University, St. Louis, Mo.)

(7) Detailed study of absorption of plutonium from contaminated surfaces and wounds.

(8) Any special problems arising from new operating hazards on this project.

11. University of California at Los Angeles - Dr. Stafford L. Warren, Director.

a. The mechanism of blood vessel injury by radiation.

b. Bone marrow injury by radiation, its repair and treatment.

c. Mechanism of "metal" deposition in bone and mechanism of removal from bone.

d. Protein degradation following radiation and chemical injury.

12. Contracts approved by the Interim Medical Committee and awaiting U. S. Atomic Energy Commission approval:

a. University of Virginia - Dr. Alfred Chanutin, Director.

(1) Study of the effects of various types of radiation (alpha, beta, gamma and neutrons) on the circulating blood proteins by electrophorosis and protein fractionization technique. To determine whether means of early detection of radiation damage can be accomplished in this way.

b. University of Tennessee - Dr. Henry Wills, Director.

(1) Study of the mechanism of toxic effects of uranium and other heavy metal compounds on the kidney. This is a continuation of Dr. Wills' work with the Rochester Manhattan Project during the war and contributes to that general study.

D. Estimated total Health-Safety research budgets for fiscal year 1946-1947 and 1947-1948.

1.

Contractor	Fiscal Year 1946-1947	Fiscal Year 1947-1948	Probable Local Budget
Los Alamos	$ 100,000.	$ 200,000.	$ 500,000.
Univ of Rochester	1,200,000.	1,300,000.	1,800,000.
UofC at Berkeley			
Program II 3a	100,000.	125,000.)	
II 3b	115,000.	200,000.) :-	400,000.
II 3c	20,000.	35,000.)	
Clinton Lab	180,000.	500,000.	500,000.
Monsanto (Dayton)	40,000.	225,000.	200,000.
Hanford	200,000.	500,000.	500,000.
Western Reserve	100,000.	155,000.	200,000.
U of Washington	28,000.	100,000.	150,000.
Columbia University	100,000.	100,000.	100,000.
Argonne	1,200,000.	1,400,000.	1,500,000.
Brookhaven		400,000.	500,000.
U of Virginia	25,000.	50,000.	50,000.
U of Tennessee	16,000.	16,000.	16,000.
UofC at Los Angeles	100,000.	200,000.	200,000.
Western Regional		400,000.	500,000.
Total Medical-Biological	$3,524,000.	$5,906,000.	$7,116,000.
Health-Physics	500,000.	1,000,000.	1,300,000.
Training	(?) 50,000.	5,000,000.	1,750,000.
Field Survey & Service Research	(?) 3,000,000.	2,000,000.	3,000,000.
Estimated Grand Total	$7,074,000.	$13,906,000.	$13,166,000.

Note: See D2 for estimated totals of Regional Laboratories including budgets for research in the participating universities. Only those currently active are shown.

2. Eventual Health-Safety research budgets, 1949-50. Estimated annual budget for research. Does not include monitoring or clinical services which are charged to operating budgets. Each Regional Laboratory budget represents the totals of the local research and those of the participating universities.

Regional Laboratory	Training	Biological-Medical	Health-Physics	Field Survey & Service Research
Argonne	$ 500,000.	$4,000,000.	$ 250,000.	$ 100,000.
Brookhaven	500,000.	4,000,000.	250,000.	1,425,000.
Clinton Lab	250,000.	1,000,000.	250,000.	200,000.
Hanford	100,000.	1,000,000.	100,000.	50,000.
Los Alamos	200,000.	750,000.	250,000.	25,000.
Western	200,000.	1,000,000.	200,000.	100,000.
Total	$1,750,000.	$11,750,000.	$1300,000.	$2,000,000.
Grand Total				$16,000,000.

This total should be equivalent to approximately 20-25% of the total research effort of the U. S. Atomic Energy Commission.

3. Example of estimated Medical Research Budget for a Regional Laboratory. 1949-50.

Brookhaven	Training	Medical-Biological	Health-Physics	Field Survey & Services
Local	$ 100,000	$1,000,000	$ 50,000	$ 50,000
Rochester	175,000	900,000	25,000	700,000
Columbia	25,000	200,000	25,000	50,000
Cornell	25,000	200,000		
Harvard	50,000	200,000	25,000	
Yale	25,000	200,000		
M.I.T.	50,000	200,000	50,000	50,000
Princeton	25,000	50,000		
Brown		50,000	*	*
Others	25,000	1,000,000	25,000	500,000
Total	$ 500,000	$4,000,000	$ 200,000	$1,425,000**

*May be directed into new or above affiliated group as need arises for investigation of certain problems.

**This total is large because this area carries the major industrial and production activities.

III. Health-Physics.

A. Health-Physics is the name applied to a newly developed and highly specialized branch of Radiology. The principal function of Health-Physics has been to make a study of radiation problems and to devise means of preventing radiation damage. The records obtained by this group are of medico-legal importance. The manpower shortage in this field is acute.

In general there are two principal sections in each health-physics division:

1. Research and development in instrumentation and energy levels.

2. Service under operating conditions in the plant.

B. The duties of the service section of health-physics are:

1. Personnel monitoring the measurement and recording of the daily radiation dosage received by each person.

2. Instrument service.

a. The calibration and maintainance of the varied and numerous instruments employed.

3. Building surveys. A daily measurement and recording of working areas.

4. Off-area surveys. An approved monitoring of the radiation level in the air and water discharged from the plants so that

it presents no hazard to neighboring communities. The cost of the service sections of health physics should be borne by each plant as an operating cost. Only the costs of the research and development sections are indicated in Section II D1 and 2.

C. The problems of the research and development sections of the health-physics divisions have been quite varied and perhaps can be indicated best by the following list which presents a few typical examples:

1. Instrument development.

a. Personnel monitoring instruments such as pocket meters and film badges have been developed but still need improvement.

b. Many problems were encountered in the development and production of fairly suitable portable and fixed meters to measure the alpha, beta, gamma, thermal neutron and fast neutron exposures received by personnel under varying situations.

c. Survey meters of all types, especially electrostatic and electronic instruments were developed and produced. These need considerable improvement, particularly for alpha and neutron measurements.

2. Special measurement of energies to which personnel is exposed.

a. Relative to instruments:

(1) Test meters for energy dependence and saturation effects.

(2) Develop photographic film monitoring techniques.

(3) Develop an instrument to measure fast neutrons in the presence of gamma rays.

(4) Devise methods of measuring plutonium in air in the presence of other alpha emitting substances.

(5) Develop continuous air monitoring instruments to measure alpha, beta and gamma radioactive gas and suspended dust in the air.

(6) Develop automatic hand counters, area radiation warning instruments automatic water activity counters, etc.

b. Applied physics measurements.

(1) Develop remote control operations for working with radioisotopes.

(2) Make a study of various types of shielding, radiation shipping containers, etc.

(3) Develop methods of determining the amount of

of plutonium, polonium, uranium, etc., that are fixed in the body.

(4) Develop methods of estimating excessive radiation exposures from the amount of radioactive sodium and potassium in the blood.

(5) Measure the efficiency of masks, respirators, gloves, and clothing in preventing body radiation exposure.

(6) Develop and operate methods of decontamination.

(7) Study new methods of radioactive waste disposal.

(8) Help in the design of new buildings to minimize radiation exposure.

c. Physics research.

(1) Carry out "sky-shine" experiments.

(2) Study effects of high energy radiation on tissue.

(3) Study radiation scattering in shields and in tissue.

(4) Determine value of n/r, etc.

d. Theoretical.

(1) Make numerous tolerance calculations to determine radiation hazards presented by external and internal exposure.

(2) Calculate radiation from extended sources.

(3) Set up radiation protection tables, rules, regulations, etc.

e. Educational program.

(1) Train health physicists for other atomic energy sites, for those universities and laboratories that have radiation problems, as well as for the Army and Navy.

(2) Consult with numerous individuals and committees on radiation problems.

(3) Help outside organizations to audit their laboratories and operations for radiation hazards.

(4) Train chemists, physicists, etc, who are not health physicists but who need a proper respect for radiation problems.

(5) Operate health-physics training programs. This is urgently needed. None are available now.

D. The table in Section II D1 and 2 gives an indication of the present and future total manpower and total expenditures of health-physics. Past annual costs have been quite large but are not available.

IV. Training program.

A. One of the most serious difficulties impeding the immediate progress of the general program designed to safeguard civilian and industrial personnel against the deleterious effects of the products of nuclear energy and the promotion of the beneficial utilization of such products is the lack of a sufficient number of well-trained personnel. Such a situation has arisen from the combination of a hiatus in basic science training during the war and the uniqueness of the problems confronting the Atomic Energy Commission.

It is recommended that an extensive training program be sponsored by the Atomic Energy Commission to facilitate the training of suitable personnel in the various branches of atomic energy. As a result of the crowding of the universities, some building program will probably be necessary. Such a program should embody the following objectives:

1. To increase the usefulness of present project personnel, academic seminars should be instituted and in certain instances, attendance of courses in the basic sciences of physiology, histology, biology, physics, bio-physics, chemistry, etc, should be required as a part of their regular scheduled duties.

2. To acquaint trained project and non-project personnel with new or special techniques relating to present and future programs of the Atomic Energy Commission. Average time one month.

3. To train a backlog of technical and professional personnel in the medical, biological, industrial hygiene and health physics aspects of atomic energy.

The objective would be to accept well qualified doctors of philosophy, physicians and technicians for a training period of not less than one year in the special branches of bio-physics, biology, isotope techniques, toxicology, health-physics, related industrial hygiene and the various technical procedures pertaining to the enumerated subjects.

In order to provide an additional backlog of trained personnel for the future and to promote cordial public relations, facilities and fellowships should be established to encourage suitable post graduate candidates to elect major subjects for their degrees in those fields pertaining to atomic energy. This aspect of the program envisions a training period of one to four years, depending upon the prior qualifications of the candidate.

B. It is recommended that a committee be appointed by the Atomic Energy Commission for the development of an integrated training program for the education of scientific workers in the correlation of atomic energy with the national sciences, biology and medicine.
natural

V. Recommendations on Organization.

A. Administrative creation of a new division of Health-Safety.

1. The responsibility for the health and safety of personnel employed by the Atomic Energy Commission in the conduct of their program extends throughout the entire program. Many of the hazards are not well understood. Frequently new research findings or new production procedures bring to light entirely new problems with unknown hazards and unpredictable safeguards.

2. Careful health and safety planning is necessary in anticipation of predicted hazards. Such planning must be in step with the plans of the four statutory divisions of the Atomic Energy Commission. Biological experimental work is slow, difficult and time consuming. Anticipatory planning and conduct of large scale biological work is mandatory so that results may be available as soon as possible before any exposure of personnel occurs. Thus a large effort, equivalent to perhaps 20-25% of the total research appropriation should be put into a health-safety program.

B. Health-Safety Advisory Board.

1. It is recommended that a Health-Safety Advisory Committee be formed by administrative action consisting of nine members, three to be appointed for two years, three to be appointed for four years and three to be appointed for six years. This Committee should parallel the statuatory General Advisory Committee to the Atomic Energy Committee and should be appointed by the Atomic Energy Committee to advise it in matters relating to medical, biological, industrial hygiene, health physics and related research problems. It is further recommended that the Health-Safety Advisory Committee recommend the appointment of appropriate advisory sub-committees.

2. The following list of fourteen names is recommended for consideration in making the appointments on the Health-Safety Advisory Board to the Atomic Energy Commission:

a. Medical:

Dr. Joseph Aub, M.D. - Harvard (Consultant to Manhattan)
Dr. Hymer L. Friedell, M.D. - Western Reserve University (Manhattan)
Dr. Robert S. Stone, M.D. - University of California at Berkeley (Manhattan)
Dr. Stafford L. Warren, M.D. - University of California at Los Angeles (Manhattan)

b. Biological:

Dr. Austin M. Brues - Argonne Nat'l Laboratory
Dr. Joseph G. Hamilton, M.D. - University of California at Berkeley
Dr. M. H. Jacobs, PhD - University of Penn. (non-Manhattan)
Dr. Hans Muller, PhD - Indiana University (non-Manhattan)

c. Industrial:

Dr. Simeon T. Cantril, MD - Hanford (Manhattan)
Dr. Andrew H. Dowdy, MD - University of Rochester (Manhattan)
Dr. James Sterner, MD - Eastman Kodak Co. (Manhattan)

d. Health Physics:

Dr. G. Failla, PhD - Columbia University
Dr. K. Z. Morgan, PhD - Clinton Laboratory
Dr. H. M. Parker, PhD - Hanford

Note: In this Committee, there is no representation from Los Alamos (Dr. Louis Hempelmann); Brookhaven (unappointed); U.S.P.H.S. (Dr. E. Williams); Army (Colonel James P. Cooney) Navy (Captain George Lyon) nor the small university contractors (no recommendation).

C. It is recommended that a Division of Health Safety be created by administrative action and that its responsibilities and authority be on a par with the four statutory Divisions of Production, Research, Engineering and Military Applications.

The interim period has placed a severe strain on the current health safety program as a result of personnel losses and the critical nature of its function and responsibilities has suddenly increased with the reactivation of the Atomic Energy Commission Research Program.

D. It is recommended that the Director of the Division of Health-Safety be appointed as soon as possible and that he hold the degree of Doctor of Medicine and that if possible, he be familiar with some large portion of the Manhattan District medical program in order to stabilize the future of the current program.

The following list of suitable candidates have been selected and proposed in the order named by this Committee for consideration as the Director of Health-Safety. These men have had extensive executive experience with the Manhattan Project and are Doctors of Medicine except for Dr. Zirkle who was included in the secret balloting of the Committee, and because of his record, warrants consideration for this post.

Name	Age	Title	Background
Dowdy, Andrew H.	42	Prof of Radiology, U of R	Research in medicine, radiology and chemotherapy; cancer and radioisotopes. Clinical training and teaching in Radiology. Director Rochester Manhattan Project.

2 x [illegible]

Name	Age	Title	Background
Cantril, Simeon T.	40	Consultant in Radiology, Hanford Project. Radiology, private practice.	Clinical and research experience in radiology and cancer. Former medical director, Hanford Engineer Works.
Stone, Robert S.	51	Professor of Radiology, U of California	Clinical and teaching experience in radiology research with isotopes and cancer. Director of Health-Safety program, Metallurgical Project, Manhatan Dist.
Wirth, John	(?)40	Principal Investigator, National Institute of Health Baltimore, Md.	Cancer research, clinical service, Clinton Laboratories.
Hamilton, Joseph G.	39	Ass't Professor of Medicine & Radiology, Univ of California	Clinical and teaching experience; biological and medical applications of nuclear physics; radiochemist.
Hempelmann, Louis	37	Medical Research Director, Los Alamos Project	Experience in research in biophysics and chemistry and large scale radiological safety at Alamogordo and Bikini.
Brues, Austin M.	40	Ass't Professor Medicine, Univ of Chicago	Research in cancer and shock and isotopes. Clinical and teaching training in Internal Med.
Sterner, James	42	Director, Industrial medicine Eastman Kodak Co.	Experimental and clinical problems in industrial hygiene and toxicology. Instructor in medicine, Medical Director for electromagnetic process at Oak Ridg
Zirkle, Raymond E.	42	Director of Biophysics Institute Univ of Chicago	Research in experimental biology, radiology and teaching.
Wolf, Bernard S.	35	Probable Medical Director, Brookhaven	Clinical experience in radiology and surgery. Board of Radiology member. Previously a member of Medical Section, Manhattan.

Name	Age	Title	Background
Brundage, Birchard M. (Major, AUS)	36	Chief, Medical Division, Manhattan Dist.	Clinical training and Industrial Medicine.

Other Doctors of Medicine of high caliber with executive experience who either work or are still associated with the Project, are listed in alphabetical order by the Chairmen for consideration. They all have considerable knowledge of the overall program:

Dr. John Ferry - Whiting, Indiana
Dr. Hymer Friedell - Western Reserve Univ., Cleveland
Dr. Joe Howland (Maj, AUS) University of Rochester
Dr. Leon Jacobson - University of Chicago
Dr. Adolph Kammer - Schenley Distributors, N. Y. C.
Dr. J. J. Nickson - Argonne National Laboratory
Dr. James Nolan - Geo. Washington Univ, St. Louis, Mo. -
Dr. C. J. Watson - Minneapolis, Minnesota.

The following are listed for consideration because of their knowledge of the field of radiology research and cancer, but have no knowledge of the project:

Dr. C. P. Rhoades, Memorial Hospital, New York City. -
Dr. Shields Warren, Harvard University.
Dr. Robert Newall, Stanford University.
Dr. John H. Lawrence, University of California

There are undoubtedly others.

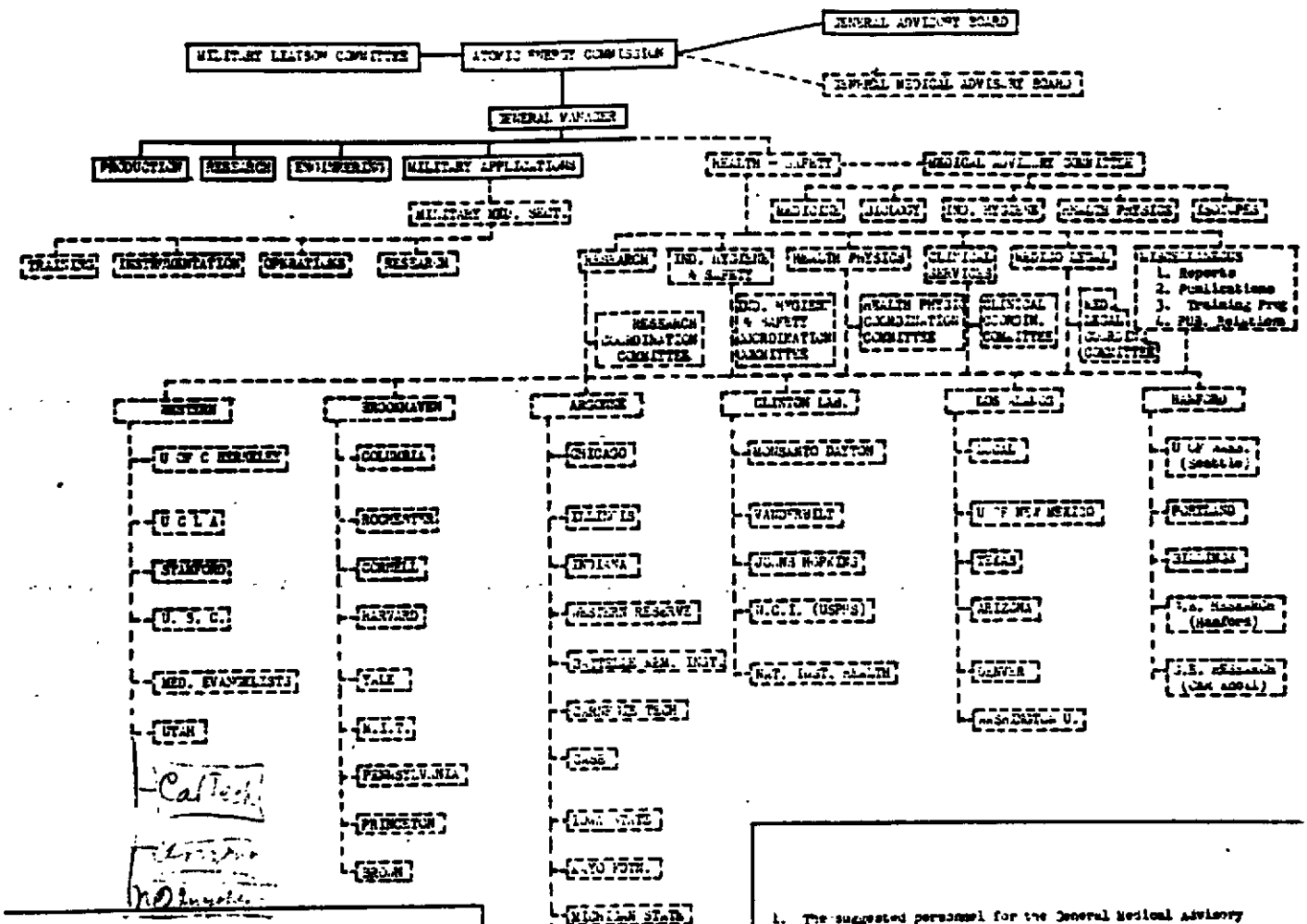
E. The Interim Medical Committee was unable to finish its consideration of other committees within the two days of conferences. In view of the importance of making decisions promptly so that a working force may start in the near future, the Chairman has taken the option of interpreting the partially expressed intent of the Committee and offers the following organization and names for consideration by the Commission, Mr. Wilson and the new Director of Health-Safety as a stop-gap for the period until July 1, 1947. More mature consideration, in the meantime, by the Director of Health-Safety and the Medical Advisory Committee can make the proper realignments with the assistance of experienced advice from appropriate subcommittees formed from the membership of such bodies as the National Academy of Science, The Committee on Growth of the National Research Council, the United States Public Health Service, the various foundations and other appropriate agencies.

The following list of names is submitted for consideration. It was the intention of the Interim Committee to include as many institutions and as many fields of related endeavour as possible. There is no intention of rating the persons named and no attempt was made to segregate as to specialty or institution. It should also be understood that this list of 100 is by no means

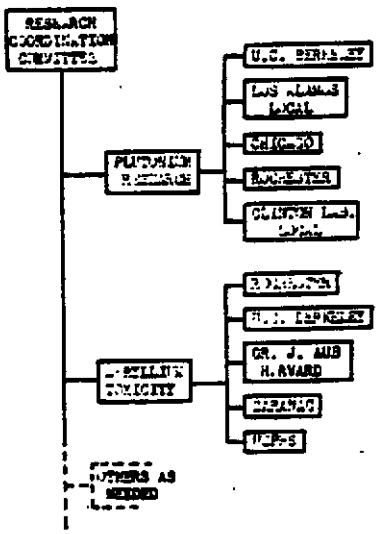
a complete coverage of the field but is a working nucleus.

Name	Location	Specialty
Dr. C. P. Rhoads	Memorial Hosp (Cornell)	Cancer Research
Dr. Robert S. Newell	Stanford University	Radiology
Dr. Frank B. Jewett	Pres. Nat'l Acad. Sc.	Physics
Dr. Wm J. Robbins	NYC Botanical Gardens	Botany
Dr. Eugene P. Pendergrass	Univ of Pa	Radiology
Dr. Perrin Long	John Hopkins Univ	Chemotherapy
Dr. Raymond E. Zirkle	Univ of Chicago	Radiobiology
Dr. Paul Neal	Natl Inst Health, USPHS	Indus. Hygiene
Dr. Geo P. Berry	Univ of Rochester	Bacteriology
Dr. Paul Aebersold	Oak Ridge	Biophysics
Dr. Waldo Cohn	Clinton Lab	Radiochemistry
Dr. H. L. Friedell	Western Reserve	Radiology
Dr. Louis Hempelmann	Los Alamos	Radiobiology
Dr. Wm F. Bale	Univ of Rochester	Biophysics
Dr. J. G. Hamilton	Univ of California	Radiobiology
Dr. Andrew H. Dowdy	Univ of Rochester	Radiology
Dr. G. Failla	Columbia University	Biophysics
Dr. Paul Hahn	Vanderbilt University	Physiology
Dr. J. C. Aub	Harvard	Indus. Medicine
Dr. James Nolan	Washington University	Obs and Gyn
Dr. K. S. Cole	Univ of Chicago	Biophysics
Dr. R. S. Stone	Univ of California	Radiology
Dr. A. M. Brues	Univ of Chicago	Medicine
Dr. David Rittenberg	Columbia University	Chemistry
Dr. E. W. Sinott	Yale University	Botany
Dr. Louis Flexner	Carnegie Institute	Anatomy
Dr. H. S. N. Greene	Yale University	Pathology
Dr. J. W. Fertig	Columbia University	Biostatistics
Dr. A. J. Riker	Wisconsin University	Botany
Dr. W. R. Earle	U.S.P.H.S.	Cytology
Dr. Sewall Wright	Chicago University	Zoology
Dr. Wright Langham	Los Alamos	Biophysics
Dr. A. P. Krueger	Univ of California	Bacteriology
Dr. W. C. Rose	Univ of Illinois	Biochemistry
Dr. Lauren Donaldson	Univ of Washington	Zoology
Dr. L. Carmichael	Tufts Univ	Psychology
Dr. T. M. Rivers	Rockefeller Foundation	Virus Research
Dr. Kurt Stern	Univ of Rochester	Genetics
Dr. L. H. Snyder	Ohio State Univ	Genetics
Dr. E. W. Goodpasture	Vanderbilt University	Pathology
Dr. E. N. Harvey	Princeton Unive rsity	Physiology
Dr. Wm S. McCann	Univ of Rochester	Medicine
Dr. V. C. Twitty	Stanford University	Zoology
Dr. E. V. Cowdry	Barnard Free Skin & Cancer Hospital	Cytology
Dr. Francis O. Schmitt	M.I.T.	Zoology
Dr. D. B. Phemister	Univ of Chicago	Surgery
Dr. Frank Fremont-Smith	Josiah-Macy Foundation	Psychiatry
Dr. Harold Hodge	Univ of Rochester	Pharmacology

Name	Location	Specialty
Dr. Gerhardt Dessauer	General Electric Co.	Biophysics
Dr. Karl Voegtlin	Nat'l Institute of Health	Toxicology
Dr. Wallace O. Fenn	Univ of Rochester	Physiology
Dr. Phillip Drinker	Harvard University	Physiology
Dr. Howard Haggard	Yale University	Industrial Hygiene
Dr. Robert A. Kehoe	Univ of Cincinnati	Industrial Medicine
Dr. James Sterner	Eastman Kodak Co	Industrial Medicine
Dr. Donald D. Irish	Dow Chemical Co.	Industrial Toxicology
Dr. Geo H. Whipple	Univ of Rochester	Pathology
Dr. H. T. Karsner	Western Reserve	Pathology
Dr. Shields Warren	Harvard University	Pathology
Dr. S. Bayne Jones	Yale University	Bacteriology
Dr. Peyton Rous	Rockefeller Institute	Cancer
Dr. M. C. Winternitz	Yale University	Pathology
Dr. Willard Allen	Washington University	Obs and Endrocrinology
Dr. M. B. Visscher	Univ of Minnesota	Physiology
Dr. E. M. K. Geiling	Univ of Chicago	Physiological Chem.
Dr. Andrew C. Ivy	Northwestern	Physiology
Dr. L. T. Fairball	U.S.P.H.S.	Indus. Toxicology
Dr. Adolph Kammer	Schenley Corp	Indus. Medicine
Dr. H. H. Schrenk	U.S. Bureau of Mines	Toxicology
Dr. W. F. VonOettingen	U.S.P.H.S.	Toxicology
Dr. A. J. Lehman	U.S. Food & Drug	Indus. Toxicology
Dr. Alfred Blalock	Johns Hopkins	Surgery
Dr. J. J. Morton	Univ of Rochester	Surgery
Dr. Conrad Elvehjem	Univ of Wisconsin	Physiol. Chemistry
Dr. R. R. Sayers	U.S. Bureau of Mines	Indus. Toxicology
Dr. Alton Ochsner	Tulane University	Surgery
Dr. J. L. Bollman	Mayo Foundation	Physiology
Dr. H. W. Smith	New York University	Physiology
Dr. A. D. Welch	Western Reserve Univ	Pharmacology
Dr. W. D. McNider	Univ of No. Carolina	Pathology
Dr. S. C. Madden	Emory University	Pathology
Dr. J. S. Lawrence	Univ of Rochester	Medicine
Dr. V. du Vigneaud	Cornell University	Biochemistry
Dr. Geo W. Corner	Carnegie Institute	Anatomy
Dr. C. F. Kettering	General Motors Corp	Research
Dr. J. W. Howland	Univ of Rochester	Med and Biophysics
Dr. Wm Gehrman	DuPont Co	Indus. Medicine
Dr. D. D. Van Slyke	Rockefeller Inst.	Biochemistry
Dr. L. A. Maynard	Cornell University	Biochemistry
Dr. Wm A. Noyes	Univ of Rochester	Chemistry
Dr. Joseph Treon	Univ of Cincinnati	Indus. Toxicology
Dr. H. B. Van Dyke	Rutgers University	Pharmacology
Dr. H. S. Gasser	Rockefeller Institute	Physiology
Dr. F. A. Bryan	Univ of Rochester	Indus. Medicine
Dr. Carl F. Cori	Washington University	Biochemistry
Dr. Charles G. King	Nutrition Found Corp	Nutrition
Dr. H. W. Beams	Univ of Iowa	Zoology
Dr. Rene DuBos	Rockefeller Institute	Bacteriology
Dr. Anton Carlson	Univ of Chicago	Physiology
Dr. George Beadle	Calif Inst Tech	Biology



SUGGESTED EXAMPLE OF TYPICAL COORDINATION COMMITTEE AND SUB-COMMITTEES



1. The suggested personnel for the General Medical Advisory Board appears on page 2 of the report of the 23-24 January 1947 Meeting of the Interim Medical Committee of the United States Atomic Energy Commission.

2. The list of names suggested for the position of Director of the Division of Health-Safety appears on page 23 of the 23-24 January 1947 Meeting of the Interim Medical Committee of the United States Atomic Energy Commission.

3. The suggested personnel for the Medical Advisory Committee and its sub-committees of Medicine, Biology, Industrial Hygiene, Health Physics and Isotopes are listed on pages 26 thru 27 of the 23-24 January 1947 Meeting of the Interim Medical Committee of the United States Atomic Energy Commission.

4. It is suggested that the Military Medical Section under the division of Military Application have members representing all Armed Services.

5. The Coordination Committees shown under Research, Industrial Hygiene & Safety, Health Physics, Clinical Services and Medico-legal should each be composed of the 6 regional Directors or their authorized representatives plus 3 outside competent men. The personnel of the necessary sub-committees under each of these Coordination Committees should be proposed by the Coordination Committee as conditions warrant, and be representative of major topics under research for proper horizontal evaluation.

RESTRICTED This document consists of 13 pages.
Copy Series 3 of 3 copies. Series B

APPENDIX A

AGENDA FOR MEDICAL COMMITTEE FOR ATOMIC RESEARCH

JANUARY 23, 24, 1947

I. Review and approval of past program. (Medical summary 1943-46 to be reviewed and approved if possible).

II. Scope of Research Program 1946-47. (Appendix A)

(University of Chicago) Argonne National Laboratories
University of Rochester
University of California
Hamilton
Stone
Columbia University
University of Washington, Seattle
Monsanto Chemical Corp. (Clinton Laboratories) USPHS
Monsanto Chemical Corporation (Dayton)
Los Alamos Western Reserve University

Contracts Awaiting Approval:

University of Virginia
University of Tennessee

III. Recommendations for Future Research Policy

A. Scope of fundamental work (that approved in September meeting) (Appendix A)
B. Human Testing with special materials

IV. Organization of Medical Responsibilities

A. Advisory Committees

1. Advisory Committee on Medical Research and application (Tolerances, Standards and Hazard Interpretations in addition to research programs).
2. Advisory Committee on Industrial Medicine and Toxicology.
3. Advisory Committee on Health Physics.

B. Recommendation for the continuation of operation of the Medical Division at the present level with the available reduced force now in that office as well as salary schedule.

SECRET

CLASSIFICATION CANCELLED
DATE JUN 7 1965
For the Atomic Energy Commission
ROBERT L. JACKSON
Chief, Declassification Branch for the

C. Training Program

1. Statement of the urgent need for qualified trained physicians.
2. Source of physicians.
   A.S.T.P.
   Civilian
3. Recommendations for specific training program.

V. Recommendations for Medical Director and Delineation of Responsibilities.

VI. Representation on Advisory Board to Atomic Energy Commission

VII. Release of Information

Recommendation for a mass meeting of all present and former Atomic Energy Commission medical researchers, at which time a program (4 days) would present accurate information on all medical aspects related to atomic energy then available for security clearance. This meeting would be open to scientific personnel in all parts of the country. The following suggestions are pertinent:

A. Approximately 6-8 months preparation would be required.
B. A central location should be selected to insure a maximum attendance.
C. Abstracts of the program should be circulated at least one month prior to the date of the meeting (similar to that procedure used by the Federated Societies of Physiology, Biochemistry, etc.) These abstracts should be approved by a previously selected editorial board before release.
D. Consideration should be given toward the founding of a new scientific society whose major interest would be based on problems of radiobiology as related to medical interest. The Journal of Radiobiology now being launched could well be made the official journal of this society.

APPENDIX A (Cont'd.)

Types of study include I General Studies in Radiation including (1) physical measurement of radiation, (2) biological effects of radiation (3) methods of detection of minimal radiation damages and (4) methods for the prevention of radiation injuries. II Hazards due to special Materials (for non-radioactive, radioactive and fission materials) (1) degree of toxicity (2) preventative measures. III Special Production Hazards and IV Hazards of Military Uses.

Argonne National Laboratories (University of Chicago)

1. General physiological picture of acute and chronic radiation.
2. Radiation effect on blood clotting, lymphocyte distribution and spread of infection.
3. Toxic effects of external radiation and absorbed radioactivity.
4. Response of blood cells to various types of radiation.
5. Chronic effects of radiation and radioactive materials in animals.
6. Mode of action of radiation in carcinogenesis.
7. Chemical and physiological basis of radiation effects.
8. Metabolism of radioactive elements.
9. Instrument standardization, design, etc.

University of Rochester

Radiation and Radiology Section

1. Instrument design, measurement standardization, industrial monitoring.
2. Biological effect of tracer amounts of polonium, radium and uranium in human and animal subjects. Application of tracer experiments to serve other parts of the project.
3. Physiological effects of exposure to acute and chronic radiations including radio isotopes; search for therapeutic methods of value.
4. Development of possible chemical technique or methods of detection of radiation damage and the mechanism by which such effects are produced.
5. By means of spectroscopic methods to study distribution of uranium and other heavy metals of importance in animal tissue; search for possible clues as to the method of bony deposition of radioactive materials.
6. Study of the time intensity factor in radiation and development of methods of producing instantaneous exposure to radiation (A bomb effect).
7. Study of the metabolism of plutonium, polonium, radium, etc., in human subjects.

Pharmacology

1. Study of the inhalation toxicity of various uranium, beryllium and thorium compounds. Studies in the mechanism of production of inhalation toxicity.

APPENDIX A (Cont'd.)

2. By chemical technique, studies of the mechanism of uranium fixation in bones, uranium complex function, methods of excretion of uranium.
3. Toxicity of uranium, beryllium and thorium compounds by ingestion.
4. Pathological effects of uranium, beryllium and thorium poisoning and mechanism by which produced.
5. Physiological effects of uranium, beryllium and thorium poisoning.

Experimental Surgery

1. Clinical, hematological and pathological effects of acute lethal radiation.
2. Methods of bone marrow transplantation.
3. Studies in bone marrow reserve and radiation effect.
4. Tissue culture studies related to bone marrow production.
5. Effect of folic acid and rutin on marrow regeneration.
6. Studies in metabolism of iodine by thyroid (15%).

Experimental Hematology.

1. Comparative study of blood histamine and hematological effects in cells.
2. Studies on life cycle of blood platelets.
3. Studies on life cycle of WBC leukocytes.
4. Studies on marrow reserves after radiation.
5. Evaluation of coagulation defects following irradiation.
6. Techniques for early detection of hematological changes resulting from ionizing radiation.

Genetics

1. Continuation of studies of effect of chronic radiation on mice.
2. Continuation of studies on effect of acute and chronic radiation (X-ray) on Drosophilia.
3. Histogenetics.

University of California

1. Studies of the metabolism of plutonium, uranium and fission products in rats and man.
2. Fission product tracer studies.
3. Metabolism of radium, actinium, americium and curium in animals and man.
4. Studies (pilot) on possibly hazardous artificially induced radioactive elements, i.e. chromium, nickel, etc.
5. Beryllium tracer studies.
6. Treatment of plutonium poisoning.

APPENDIX A (Cont'd.)

7. Behavior of fission products in soils.
8. Biological effects of fission recoils.
9. Search for other U compounds which will localize in organs other than liver and spleen (15%).
10. Biological effect of disintegration products of boron and lithium of the neutron irradiation (15%).
11. Study of element 85 in the thyroid (15%).
12. Training of Crossroads personnel.
13. Studies in whole body radiation of human subjects.
14. Studies on metabolism of radioactive iodine in animals and man.

Columbia University

1. Studies on the measurement of fast neutrons for biological dosage.
2. Development of a method of measuring neutron dose by chemical means.
3. Measurement of radioactive isotopes for biological and medical application.
4. Correlation of tissue doses and biological effects produced by external irradiation and by radioactive isotopes internally administered.
5. Exploratory biological experiments to extend use of radio-active isotopes as tracers on therapeutic agents (15%).
6. Studies of the fundamental biological action of ionizing radiation.
7. Measurement of the radiation of radioactive isotopes to provide data for the protection of personnel and films in transit.

University of Washington (Seattle)

1. Acute and chronic effects of external radiation on fishes.
2. Breeding studies on salmon following radiation.
3. Studies on the effects of Hanford effluent on salmon and trout.
4. Effect of internally deposited radioactive materials on fishes.
5. Field studies on the effect of possible Hanford pollution on fish life of the Columbia River.
6. Plankton experiments -- effect of radiation on higher forms (new).
7. Feeding experiment on deposited radioactive materials (new).

Monsanto Chemical Corp. (Clinton Laboratories) USPHS

1. Continuation of studies on the biological effect of slow fast and thermal neutrons on rats and mice.
2. Continuation on studies on the comparative biological effect of penetrating radiation.
3. The effect of internally deposited plutonium on bone healing.
4. Cytological program on the biological effect of radiation on simple cells and tissue.
5. Instrumentation and techniques of radiation monitoring.

APPENDIX A (Cont'd.)

Monsanto Chemical Co. (Dayton) New program being organized.

1. Biological effects following chronic exposure of animals to polonium by inhalation and parenteral administration.
2. Correlation between chronic exposure of workers and polonium excretion rate.
3. Mechanism of action of polonium toxicity.
4. Development of special health physics technique for specific use in polonium purification.

Los Alamos

1. Fundamental studies on the effect of acute radiation exposure.
2. Treatment of acute radiation disease.
3. Methods of detecting early radiation changes.
4. Metabolism of plutonium, U^{235} and other radioactive materials.
5. Detection of accumulated plutonium in the lungs.
6. Biochemical studies of nucleoproteins and the effect of radiation on the fundamental physiology of the cell.
7. Detailed study of absorption of plutonium from contaminated wounds.
8. Any special problems arising from medical hazards peculiar to this project.

Western Reserve University

1. Investigation of the toxic effects of thorium and its isotopes.
2. Comparative studies on the biological effect of external radiation and that from internally deposited radioactive materials.
3. Use of radioactive isotopes in fundamental biological research.

These general titles are given inasmuch as a program has not been actively formulated.

Contracts Awaiting Approval:

University of Virginia - Dr. Alfred Chanutin

Study of the effects of various types of radiation (alpha, beta, gamma & neutrons) on the circulating blood proteins by electrophoresis and protein fractionization technique. To determine whether means of early detection of radiation damage can be accomplished in this way.

University of Tennessee - Dr. Henry Wills

Study of the mechanism of toxic effects of uranium and other heavy metal compounds on the kidney. This is a continuation of Dr. Wills' work with the Rochester Manhattan Project during the war and contributes to that general study.

APPENDIX A (Cont'd.)

University of California, Los Angeles - Dr. Stafford L. Warren

1. The mechanism of blood vessel injury by radiation.
2. Bone marrow injury by radiation, its repair and treatment.
3. Mechanism of "metal" deposition in bone and mechanism of removal from bone.
4. Protein degradation following radiation and chemical injury.

I General Studies of Radiation

The radiations encountered in nuclear fission as well as those encountered from naturally radioactive substances divide themselves into the following types: Alpha rays, beta rays, gamma rays and neutrons. Information available from the literature on previous studies indicates a rather extensive knowledge of the biological effects of X-rays and gamma rays and very little information on alpha and beta rays and neutrons.

The programs were and are organized using the following basic outline:

A. The Physical Measurement of Radiation of various types - Here it is necessary to develop methods of accurately measuring and standardizing the dosage of radiation to be used in the biological experimentation and measurement of the extent of any hazardous radiation which might be found in a plant area.

B. The Biologic Effects of Radiation. Because of the known deleterious effect of radiation on the animal organism, it becomes necessary to determine the effect of controlled dosages of the various types of radiation on various animal species, so that such observations can be used in the control of possible human exposure.

The types of biological effect possible to study are:

(1) The Survival Time or percentage that the effect of a given dose will reduce the normal life span of different animal species.

(2) The Genetic Effects of radiation as manifested in the development of abnormal individual types from changes in the hereditary mechanism.

(3) Histopathological Changes as demonstrated by abnormal changes in the make-up of the various body tissues.

(4) Physiological Changes produced by the alteration of the normal functioning of animal tissues following radiation.

(5) Biochemical and Enzymatic disturbances which are the potential source of these physiological abnormalities.

SECRET

C. Methods for the Detection of Minimal Radiation Damage are developed directly from observation of the above types and are applied to study of the human individual or worker. These include studies on:

(1) Biochemical and Enzymatic Changes which may be detected and which, if measurable, can be corrected before irreversible damage has taken place. Examples of such change would be effects on the metabolism of coproporphyrins, excretion of abnormal substances in the urine and the like.

(2) It has been known that radiation depresses the function of the hematopoetic system and detailed study is indicated to detect early changes under controlled dose radiation with all blood elements under continuous observation.

(3) The Production of Anatomical Changes such as epilation, skin erythema, and alterations in the integrity of the skin and the like must likewise be studied under controlled dosage.

D. Studies are likewise indicated on methods for the prevention of radiation injuries. These include:

(1) Methods of physical detection of external radiation by the development of sensitive direct reading instruments capable of the detection of amounts of radiation well below those necessary for demonstrable injury to the animal subjects.

(2) Methods for the determination of harmful amounts of radioactive dusts and gases in air, in water and the like. Many radioactive materials like radium are deposited in the body and in such locations produce injury to tissue. Methods based on the determination of dangerous amounts of these substances by examination of the excreta and direct measurements of the body itself are necessary.

E. Protective Measures. Studies on the efficiency of shielding against radioactive materials, the efficiency of exhaust and ventilating systems against dangerous amounts of dusts, the development of protective clothing and devices, and the development of remote control processing methods have been extremely important in the Manhattan District protection program to date and will continue into the future.

F. The possible therapeusis of radiation damage by the use of replacement therapy for the damaged bodily elements, as well as the reduction in the exposure following deposition of radioactive materials in the body deserves considerable study. Replacement of the damaged hematopoetic elements destroyed by severe radiation exposure offers one possibility; detection and neutralization of unknown toxic substances produced by radiation and other such difficult problems deserve consistent and detailed study.

All the above studies are necessary on alpha, beta and gamma rays and neutrons of varying intensity. In addition, the radiation from the radioactive substances to be discussed has likewise to be considered. Also, the effects of acute and chronic exposure must be determined because of their dissimilarity.

II Hazards Due to Special Materials

For brevity it is preferable to discuss the potential toxicity of special materials by first indicating the type of study to be carried out, followed by the presentation of these materials on which studies have been necessary.

A. First, an actual determination of the toxicity of a substance must be made indicating how poisonous it may be in both acute and chronic exposure. In this way the toxic levels may be avoided in laboratory and plant environments.

(1) The mode of entrance into the body by ingestion, inhalation and skin absorption must be studied as different manifestations and degrees of toxicity may be produced by each route employed.

(2) A careful analysis must be made as to the character of the biological changes with the production of physiological, histopathological and biochemical evidences of damage incurred.

(3) The nature of these injuries and the mechanism by which they occur must likewise be studied inasmuch as this affords information as to the necessary protection and indicated therapy after exposure.

B. Preventative measures require study.

(1) The effectiveness of physical methods for the removal of hazardous dusts, reduction in skin contact and prevention of ingestion must be measured, and methods for accurate determination of such hazards must be developed and used. The use of certain chemicals, ointments, and the like as protective measures must be studied as to their efficiency.

(2) Protective devices such as respirators and clothing must be tested on required substances against which they will be used.

(3) Finally, appropriate investigation of therapeutic measures to be used in the treatment of both acute and chronic poisoning states should they occur in industrial exposure must be made.

Completion of all phases of the above program on a variety of substances provides complete information as to the medical aspects necessary to be considered in protection of the worker, prevention of injury and treatment of injury should it occur.

C. Substances on which studies of this type are necessary are:

(1) Uranium and its compounds

a. Uranium metal and its chemical compounds, oxide, nitrate, chloride, bromide, tetra and hexa-fluoride, sodium and ammonium sulfates.

b. Uranium chain of heavy metals

Uranium X1
Uranium X2
Radium
Polonium

c. Fission products of cleavage of U-235 and plutonium.

d. Artificial isotopes of uranium - 232, 234, etc.

(2) Thorium and its chain

(3) Plutonium

(4) Special Accessory Materials

a. Fluorocarbons

b. Fluorine

c. Beryllium

d. Others

III Production Hazards

The results of studies made on the materials discussed above are applied for the prevention and control of industrial hazards arising in the large manufacturing areas where these materials are used in large amounts.

A. In the Electromagnetic and Diffusion Methods for the isolation of uranium 235 the major hazards are from the uranium compounds, the concentration of uranium X1 and X2, and the special accessory materials and by-products formed in the process of manufacture.

B. In the graphite pile where plutonium (239) is produced on a large scale, the hazards are from the alpha, beta and gamma rays, neutrons, the plutonium metal and its compounds, the various radioactive fission products resulting from the pile operation.

C. The chemical isolation of polonium following its formation in the pile incorporates hazards from alpha radiation following absorption into the body.

D. Study of the medical aspects of plant programs aside from the determination of the effect of radiation and chemical toxicity, include additional information obtained from plant investigations as from:

(1) Clinical survey of all exposed personnel.

(2) Monitoring of hazards by special instruments and methods.

(3) Surveys of new types of graphite piles and production equipment.

IV Hazards of Atomic Catastrophe in Production Areas.

A. Immediate Effects

(1) Radiation - the radiation occurring at the time of the explosion coupled with blast and heat causes biological effects which may differ from those occurring following other acute known effects from gamma and neutron radiation, and demand study.

(2) Blast - the blast of atomic explosion is so intense and may have totally different types of shock waves, recoil waves with other unique biological effects which should be investigated.

(3) Heat - The intense burns from actinic type of radiation have not been studied. This also includes the combination effect of all three items in this group: blast, radiation and heat.

(B) Delayed Effects

(1) Protective Devices - study of methods of protection against the radioactivity deposited at the time of blast.

(2) Decontamination - methods of decontamination of soil and the like must be worked out for cleaning up active areas.

(3) Investigative Equipment - special equipment must be developed and tested for use in investigating bombed areas.

(4) Study of casualty effects - field study of fission clouds, possible injury to water supply, soil and the like, human damage by population surveys.

(5) Study of treatment of all immediate effects such as radiation, heat and blast.

(C) Preparation of pertinent information in proper form for use by catastrophe units in production areas.