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From: Chief of Naval Operations.

Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

Ref: (a) OPNAV ltr Op-360/emf, Serial:002203P36, (SC)A-23, dated 10 December 1948 (SECRET).

1. In accordance with reference (a) a tentative list of proposed biologic projects has been prepared for the Atomic Bomb Tests to be held in 1951. These plans have been formulated in collaboration with the Naval Medical Research Institute and the Naval Radiological Defense Laboratory in San Francisco. They also include joint projects with the Chemical Warfare Service, U.S. Department of Agriculture, the Smithsonian Institute, the U.S. Public Health Service and University of Rochester. (Pearse) Also ONR

Coordinated w/ AFSWP.

2. The following is a list of proposed projects together with justification and comments.

Project No. 1 A study of the early pathological changes in radiation illness.

Objective: The objective of this project is to obtain animal tissues for pathological study during the first 24 hours following exposure to intense ionizing radiation.

Experimental Design: The experimental design anticipates the use of equipment developed under Project 7.1-17/RS(EM)14 Eniwetok during Operation SANDSTONE. Four (4) animal tanks suitable for pigs or dogs were tested on land and on floats off-shore during tests X-Ray and Yoke. The tanks on rafts were least damaged and most readily recovered. It is planned to place about 24 animals per test in 12 tanks on floats to be anchored off-shore at distances from about 400 to 700 yards. These tanks are to be recovered as soon as possible after detonation and the animals autopsied at predetermined time intervals during the first 24 hours.

Justification: We have little information regarding the early pathological changes in radiation illness. It cannot be obtained either the Japanese or Bikini data or in the laboratory except with great difficulty. The contemplated experiments will furnish information in this phase of the radiation illness problem.

Eniwetok

~~SECRET~~

Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

Liaison Officer: Captain R. H. Draeger, MC, USN.

Project No. 2: The relation of distance and physical data to morbidity and mortality in animals exposed to an atomic bomb explosion in air: very interested in this.

Part a. Air blast study.
Part b. Thermal radiation study.
Part c. Ionizing radiation study.
Part d. Combined effects.

Objective: The objectives of this project are essentially four-fold and relate to the subdivisions of the title, Parts a, b, c and d. An attempt will be made to determine the relative importance of blast, flashburns and ionizing radiation with regard to morbidity and mortality in several animal species such as mouse, rat, guinea pig, rabbit, dog and pig. The individual objectives are as follows:

a. To study direct air blast injuries in several animal species with regard to peak pressure and duration of shock wave, also mechanism of injury.

b. To study the relation of mortality to surface area and degree of burn. To correlate the pathological skin changes with the intensity and quality of the thermal radiation. To compare the physiological changes in skin produced by atomic bomb flashburns with laboratory produced flashburns.

c. To study the effects of ionizing radiation upon several animal species at various distances from the bomb explosion and to correlate these effects with intensity and quality of the radiation. Also to compare the known mortality of the various animal species from 1000 k.v. X-rays to that of atomic bomb ionizing radiation.

d. To investigate the combined effects of blast, thermal and ionization radiation upon similar groups of several animal species as used in Parts a, b, and c. An attempt will be made to determine the contribution of each of these factors to morbidity and mortality by differential comparison.

Experimental Design: It is planned to expose large groups of several animal species to give statistically reliable data under the following four experimental conditions.

a. Exposure to primary air blast injuries in cages designed to give protection against thermal and ionizing radiation.

b. Exposure to thermal radiation in cages designed to protect against blast and ionizing radiation.

c. Exposure to ionizing radiation providing complete protection against blast and thermal radiation.

d. Exposure to the combined effects of air blast, thermal and ionizing radiation in cages designed to give indirect blast injury protection only.

After exposure the various groups of animals will be removed as soon as possible and returned to the breeding colony (see Project 6) for study and disposition. Most of the animals will be autopsied at predetermined intervals to follow the physiological and pathological changes related to the several types of injury. It is anticipated that few, if any, animals will be returned alive to the United States. However, a very large number of tissue specimens will be preserved for study. It will be necessary to autopsy a rather large number of dead animals immediately upon recovery. It is considered that this can best be done aboard the laboratory ship (see paragraph 4).

Justification: Carefully controlled and statistically reliable tests correlating animal morbidity and mortality with type of injury and distances are indicated in order to relate laboratory and field test data. The Bikini tests are inadequate for this purpose since too few animals were located at any one station and factors other than distance varied markedly from station to station.

Liaison Officers:

Part a. Lt. C. M. White. — engineer - NAMRL
Part b. Dr. H. E. Pearse (University of Rochester).
Part c. LCDR E. P. Cronkite, MC, USN.
Part d. CDR John L. Tullis, MC, USN.

Planning:

Part a. Cages suitable for the exposure of animals to direct air blast effects were developed at Inyokern under the direction of Captain R. H. Draeger prior to Bikini. Modifications to isolate the injurious factors are planned together with further testing of the equipment.

Part b. The thermal studies at Bikini and Eniwetok form the background for this investigation. Collaboration has also been arranged

Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

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with Dr. W. R. Pearse, University of Rochester, who will assume the major responsibility of the Flashburn study and supply several assistants.

Parts c and d. The extensive studies of the Nikini animals and lethal dose studies in various animal species at NMRI will be invaluable in these phases of the radiation illness study. A strain of mice is being bred at the NMRI which is hardy, prolific, and presents a uniform response to 1,000 k.v. X-rays. Comparable rat, guinea pig, rabbit, dog and pig breeding stock can be obtained.

Project No. 3 The effects of atomic bomb ionizing radiation on the viability and mutation of selected biochemical warfare agents.

Objective: To study the reaction of B.W. agents to atomic bomb ionizing radiation with respect to survival and genetic changes.

Experimental Design: Selected B.W. agents will be prepared by the Chemical Corps, Camp Detrick, for exposure to atomic bomb ionizing radiation. This material will then be exposed in containers similar to those used during Operation SANDSTONE. Upon recovery this material will be removed to an isolated laboratory (see paragraph 3) for study.

Justification: Since B.W. agents and A.W. agents might be employed together, it is important to determine the effects of ionizing radiation upon B.W. agents. It is known that a heavy dose of ionizing radiation (25 to 50,000 r) will kill a large percentage of most bacteria. However, little is known regarding the virulence of the surviving organisms or the effect of smaller doses of radiation on the particular organisms under consideration.

Liaison Officer: Dr. O. G. Woolpert, Camp Detrick, Md.

Comment: Experience with the packaging of biologic materials both at Bikini and Eniwetok make possible the exposure of this material without hazard. None of the containers used at Eniwetok were broken open in spite of having been placed very near to the bomb explosion.

Project No. 4 The effect of ionizing radiation on resistance of experimental animals to B.W. agents.

Objective: To study the reactions of experimental animals receiving sublethal amounts of ionizing radiation to B.W. agents with respect to resistance to infection and pathological changes.

Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

Experimental Procedure: Normal experimental animals will be exposed to sublethal doses of atomic bomb ionizing radiation and then exposed to B. W. agents in the isolated laboratory (see paragraph 3).

Justification: It is known that the susceptibility of laboratory animals to certain bacterial infections is increased by total body irradiation. Also one of the serious complications of radiation illness is secondary infection. These facts suggest that B.W. agents may be more effective if combined with sublethal doses of ionizing radiation. It is possible that small doses, producing little or no symptomatology, may exert a marked effect on susceptibility to comparatively non-virulent organisms. This project is planned to investigate these problems.

Wolfpert #16

Liaison Officer: Dr. C. C. Woolpert, Camp Detrick, Md.

Project No. 5 The effect of atomic bomb ionizing radiation on oral tissues and structures in experimental animals.

Objective: To determine the pathologic effects of ionizing radiation on oral tissues and structure including the jawbone, teeth, dental periosteum, dental pulp of experimental animals on a normal and cariogenic dietary regime.

Experimental Design: It is planned to study the oral structures of animals exposed to ionizing radiation as outlined in Projects No. 1 and 2. Some animals kept on a cariogenic diet will also be exposed and studied.

Justification: Since oral tissues are known to be affected in radiation illness, it is desirable to make an extensive study of these pathologic changes.

Liaison Officer: [redacted]

Project No. 6 To evaluate the effectiveness of various therapeutic agents upon radiation illness in experimental animals.

Objective: To evaluate the effectiveness of various therapeutic agents upon the histologic changes and mortality in animals exposed to atomic bomb ionizing radiation.

Experimental Design: It is planned to utilize part of the animals exposed under Part e of Project No. 2 for the evaluation of therapeutic agents of possible value in radiation illness including antibiotics, intestinal antiseptics, dietary factors such as high

and low vitamins, etc. Also, additional therapeutic agents which may be demonstrated to be of value during the next two years. The untreated animals of Part c, Project No. 2 will serve as the controls for this study.

Liaison Officer: LCDR E. P. Cronkite, MC, USN.

Project No. 7 A study of the hemorrhagic phase of radiation illness.

Objective: To evaluate the relative importance of vascular injury thrombocytopenia, circulating anticoagulants and toxemia in the production of the hemorrhagic syndrome of radiation illness.

Experimental Design: Animals irradiated under Part c of Project No. 2 will be used for this study. This investigation will include the usual clinical procedure for the study of hemorrhatic disease and in addition special techniques such as plasma fractionation for the isolation of plasma anticoagulants.

Liaison Officer: LCDR E. P. Cronkite, MC, USN.

Project No. 8 The establishment of an animal breeding colony at Eniwetok.

Objective: To rear laboratory animals habituated to the tropical environment of Eniwetok for the forthcoming atomic bomb tests (see Projects Nos. 1 to 4).

Experimental Design: It is planned to establish and animal breeding colony on one of the islands near Eniwetok island perhaps Japtan during the summer of 1949 for the purpose of raising laboratory animals of several species for the atomic bomb tests in 1951. The species contemplated are the mouse, rats, guinea pig, rabbit, dog and pig.

Justification: Experience at Bikini has shown that the transportation of laboratory animals into the tropics produced marked physiological changes such as variation in the white and red blood cell counts which make the interpretation of experimental data very difficult. Animals raised under tropical conditions would be more satisfactory; also steps could be taken to habituate the animals to the particular environmental exposure to which they would be subjected during the exposure to atomic bomb effects.

Liaison Officer: Captain R. H. Draeger, MC, USN.

do not think that acclimatization would be

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Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

Project No. 9 The effects of atomic bomb thermal radiations upon the flora and fauna of the island.

Objective: To study the effects of atomic bomb thermal radiation upon the animal and plant life such as birds, insects, and various plants.

Experimental Design: In order to implement the objective of this project arrangements have been made with agencies such as the Smithsonian Institute and Department of Agriculture to furnish qualified personnel to survey various forms of life before and after the bomb detonations. To be included are Invertebrate Biologist, Botanist, Entomologist, Ornithologist, etc.

Justification: Marked effects were noted upon certain of the plant and animal life at Eniwetok. For example, hundreds of birds were grounded due to the singeing of the wings and the leaves of plants and trunks of trees were scorched in varying degrees. It appears likely that a survey of the effects of atomic bomb thermal radiation upon plant life would serve as a valuable guide to the location and tonage of an atomic bomb explosion. No systematic study of these effects has, as yet, been made.

Comments: Liaison officer will be nominated from the Smithsonian Institute and U. S. Department of Agriculture.

Project No. 10 The exposure of selected biologic material to atomic bomb ~~medicine~~ radiation.

Objective: To expose selected biologic material such as seeds, insects, moulds, enzymes, hormones, etc., to atomic bomb ionizing radiation.

Experimental Design: It is planned to construct containers similar to those used at Eniwetok to expose a variety of biologic material as above enumerated.

Comments: This project will include material from the [illegible], the [illegible] and USDA. Space will be available to expose material desired by other groups for study as was done for various deliberators at Bikini and Eniwetok.

Liaison Officer: Captain R. H. Draeger, MC, USN.

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Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

Project No. 11 A study of external radiation hazards following the contamination of an area by a shallow water atomic bomb explosion.

Objective: To study the effects of external irradiation from an area contaminated by a shallow water atomic bomb explosion in experimental animals.

Experimental Design: It is planned to expose experimental animals at various distances both during and after the underwater explosion protected from fission product contamination in order to evaluate the external radiation hazard.

Justification: Little is known regarding the hazards due to the contamination of a land area following the detonation of a shallow water atomic bomb explosion.

Liaison Officer: To be appointed from NRDL.

Project No. 12 Uptake of radioactive material by plants and animals following a [shallow water] atomic bomb explosion,

Objective: To determine the amount of uptake of radioactive material by plant and animal life in an area contaminated by a [shallow water] atomic bomb explosion.

Experimental Design: It is planned to study various forms of plant and animal life in the contaminated area with respect to uptake of radioactive substances. This will be accomplished by the sampling of the naturally occurring forms of life such as plants and insects and also by the placement of experimental animals.

Comment: The responsibility for certain phases of both projects 11 and 12 will be assumed by the USDA who will supply several personnel.

Project No. 13 A study of area contamination and decontamination following a [shallow water] atomic bomb explosion.

Objective: To study the physical contamination of an island area exposed to a nearby [shallow water] atomic bomb explosion.

Experimental Design: It is planned to study the radioactive contamination of a land area exposed to a [shallow water] atomic bomb explosion. This study is to include:

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Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

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a. A study of soil contamination and rate of disappearance of contamination other than decay of fission products.

b. A study of radioactive content of dust samples collected over a period of time.

c. A study of the radioactive content of water and its relation to removal of soil contamination.

d. An evaluation of the effectiveness of different methods of decontamination.

Justification: The contamination of a land area by fission products following an atomic bomb explosion is one of the serious hazards of the atomic bomb. Very little is known regarding the degree of contamination which might be obtained under these circumstances or the rate of its disappearance.

Liaison Officer: To be appointed from NRDL.

Project No. 14 Physical measurements of atomic bomb blast, thermal and ionizing radiation intensities.

Comment: Plans for the measurement of physical quantities at the various animal locations have been formulated in cooperation with the NRDL and will be submitted by the Chief, BuShips. Since these plans have been outlined in some detail they will not be repeated here.

Project No. 15 The exposure of nuclear emulsions to the atomic bomb ionizing radiations and neutrons. (?)

Objective: To expose certain nuclear emulsions to atomic bomb ionizing radiations and neutrons in order to measure the neutron and gamma ray energies at the animal locations.

Experimental Design: It is planned to use emulsions loaded with lithium borate to measure the neutron energies and emulsions loaded with deuterium for hard gamma ray energies.

Justification: Measurements of the above type have not heretofore been made during field tests.

Comments: The special measurements are to be made by Dr. Herman Yagoda of the U.S.P.H.S. This would be in addition to routine physical measurements made by other groups. It is hoped that accurate physical measurements will be made as close as possible to the animal exposure stations.

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Subj: Preliminary Planning for Atomic Bomb Tests to be held in 1951.

3. In order to implement the projects outlined in paragraph 2, the following facilities will be needed. It is expected that these facilities will be jointly used by NRDL, NRSL and other collaborators mentioned in connection with the various projects. These facilities would also be available to other investigators desiring to extend the scope of these studies.

a. Animal breeding colony. See Project No. 8.

b. Biological laboratories on same island as (a).

c. Laboratory ship - this laboratory would include both physical and biological laboratories and be shared by NRDL, NRSL and other collaborators.

d. Isolated laboratory - this laboratory is to be used by the Chemical Corps for projects 3 and 4. There is no plan to contaminate this island the isolation being merely a safety precaution since B.W. agents will be handled.

4. It is desired that a shallow water atomic bomb test be made similar to that of Test BAKER at Bikini. This explosion should be near one end of a large island covered partially by vegetations. This will provide a contaminated area suitable for the investigation of Projects 9, 10 and 11. It is presumed that the degree of contamination will vary from heavy to light, from one end of the island to the other. It should be pointed out that no experimental work has been possible to date in an area so contaminated. The Bikini islands were too far away to receive significant amounts of radioactive material.

5. It is considered that the comprehensive program above outlined together with the proposed facilities including animal breeding colony, laboratory ship, shore laboratory and isolated laboratory for bacteria work would provide the essential nucleus for the investigation of all Biologic work requested. Biologic projects for phases of work not covered by the above projects might conceivably be implemented by these facilities.

W. L. [illegible]
Rear Admiral, MC, USN.
Acting Chief of Bureau.

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This document consist of 1 page(s)
1 3 of 5 copies.
Serial: 005SR

Addendum to BuMed Letter BUMED-74-B-jw, A-23, Serial: 005000 dated 2 February 1949 (SECRET) to Chief, Naval Operations.

MAR 3 1949

BuMed Project No. 3: Under experimental design following (b) add, "These studies will include the susceptibility of flashburns complicated with ionising radiation to various organisms as staphylococci, streptococci, and Clostridium species."

Under experimental design following (d) add, "Studies will also be made of the normally occurring bacterial flora of the respiratory, gastro-intestinal and mucous membrane surfaces of these animals."

Under experimental design at the end of last paragraph add, "These studies to include the bacterial examination of the respiratory and gastro-intestinal tracts."

BuMed Project No. 3: Correct title to read, "biological warfare agents", instead of, "biochemical".

BuMed Project No. 5: Under experimental design add, "This study to include biochemical studies of the salivary secretions."

BuMed Project No. 9: Under experimental design following "ornithologist" add, "bacteriologist and microbiologist."

BuMed Project No. 11: Cancel.

BuMed Project No. 12: Strike out "shallow water" from title and objectives. Under experimental design, change the second sentence to read, "This will be accomplished by the sampling of the naturally occurring forms of life such as plants, insects and birds."

BuMed Project No. 13: Cancel.

BuMed Project No. 16: Atomic bomb effects upon B.W. agents - simulants. (This a new project)

Objectives: To expose simulated B.W. agents to the effects of an atomic bomb explosion (blast, thermal and ionising radiation).

Experimental Design: It is planned to expose simulated B.W. agents (harmless organisms) as a contamination of building surfaces, plants, soils, etc., to atomic bomb effects at several distances and afterwards collect samples for culture. A minimum of effort will accomplish this project. No complicated logistics are involved.

Justification: This project supplements the information expected from projects 3 and 4. It is desired to emphasize the possible important relations between A.W and B.W. These projects should be rationally considered and not dismissed because of fear of B.W. agents. It certainly is not B.W. agents in hands of our Camp Detrick experts that we have to fear.

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MAR 7 1949

Addendum to BuMed Letter BUMED-74-3-jw, A-23, Serial: 005000 dated 2 February 1949 (SECRET) to Chief, Naval Operations.

BuMed Project No. 17: The genetic and cytological effects of atomic bomb ionizing radiation on Indian corn (maize).

Objective: To expose Indian corn pollen to atomic bomb ionizing radiation and study the mutations resulting from the fertilization of corn plants by this pollen.

Experimental Design: It is planned to plant a selected strain of maize, for several weekly intervals, two months before the test. This will furnish ripe pollen for exposure in the containers provided in Project 10. Immediately after the test this pollen will be used to pollinate corn plants. When this corn is ripe it will be collected and returned to the California Institute of Technology.

Justification: Maize is one of the plants being extensively studied by the geneticists. Considerable work has been done with corn seeds exposed at Bikini and Eniwetok. This experiment will provide mutants derived from irradiation of the germ cell of one parent.

Comments: This project has been planned in collaboration with Dr. G. W. Beadle, Chairman, Division of Biology, California Institute of Technology. A qualified corn geneticist will be furnished during the collection, irradiation and pollination period.

This document consist of 1 page(s)
Number 3 of 6 copies.
Serial: 0056A

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