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Washington, D.C.  
June 10, 1949

Dr. Shields Warren, Director  
Division of Biology and Medicine  
U. S. Atomic Energy Commission  
Washington 25, D. C.

Dear Doctor Warren:

1. In your letter of May 10, 1949 you appointed an Ad hoc Committee "for planning biologic aspects of future atomic bomb tests." This Committee was charged with "the important responsibility of setting up the protocol for observation in the field of Biology and Medicine which it is desirable to make in future tests."

2. The Committee met in Washington on June 7, 8 and 9 to evaluate proposals for tests submitted by the National Military Establishment and certain facilities of the Atomic Energy Commission. We now submit to you our selection from these proposals, arranged into a series of eleven projects which, in our opinion merit investigation. To complete the protocol requested we are also submitting a tentative recommendation for the laboratory facilities that this program will require, as well as a statement of the estimated logistic effort as regards personnel.

3. Our findings and our plans are contained in the attachments to this letter, as follows:

- A. Agenda: A short description of each of the several proposals, with an excerpt of its relevant features.
- B. The complete minutes of the three day session.
- C. The program of tests approved by the Committee after consideration of the proposals.
- D. A tabulation of the minimum physical facilities required to provide adequate conditions for the conduct of the program.
- E. A tabulation of the personnel who will be available for the conduct of the tests.
- F. A summary of the estimated logistic effort as regards personnel.

4. We would like to call your attention to three resolutions that were passed unanimously by your Committee:

- A. Resolved: That it is desirable to conduct atom bomb tests on animals whose response to ionizing radiation is well known from laboratory studies.

- B. Resolved: That an animal breeding colony should be established on Eniwetok Atoll to provide an adequate supply of acclimatized, calibrated animals.
- C. Resolved: That the biological and medical research laboratory should be on the same island as the animal colony.

5. The Committee is pleased to acknowledge the many kindnesses of your associates in the Division of Biology and Medicine.

Respectfully submitted,

W. D. Armstrong,	University of Minnesota
S. L. Clark,	Vanderbilt University
D. B. Dill,	Edgewood Arsenal
R. H. Draeger,	Naval Medical Research Institute
Jacob Furth,	Oak Ridge National Laboratory
L. O. Jacobson,	University of Chicago
W. J. Langham,	Los Alamos Scientific Laboratory
F. K. Sparrow,	Brookhaven National Laboratory
R. E. Zirkle,	Argonne National Laboratory
G. V. LeRoy,	Northwestern University
Chairman	

Attachments:  
 not attached - A. Agenda B. Minutes  
 Attached { C. Approved Tests  
 D. Facilities Required  
 E. Personnel Required  
 not attached - F. Logistic Estimate

Att. C: THE PROGRAM OF TESTS APPROVED BY THE AD HOC COMMITTEE

Proposal\*  
Number                      Project 1: Animal Colony

3.1                      Responsible Agency: National Military Establishment (NMRI)  
Objective: To provide an adequate number of mice, dogs and pigs. These animals would be acclimatized to the total environment. Their LD<sub>50</sub> for 250 KV x-ray would be determined after acclimatization. It is planned to provide 5,000 - 10,000 mice of the CF-1 strain; 500 dogs, preferably the Rochester beagle strain; and 500 pigs of the U. S. Department of Agriculture "hairless" strain.  
Procedure: If approved, a Naval party will establish the colony at once to permit approximately 18 months of breeding. A veterinarian, indoctrinated in genetics, will accompany the party. New animals will not be introduced into the colony later than one year before the expected date of the tests. Sufficient animals will be bred to provide adequate controls. A reserve colony of equal size will be developed at the NMRI, in case of accidents. After the tests, representatives of the species, and survivors of the tests will be returned to NMRI for further study.

Project 2: Study of Acute Radiation Injury

3.2.1.1                Responsible Agency: National Military Establishment  
Objective: To expose enough animals in enough positions to obtain valid statistical data for a study of acute lethality, vs distance and dose; LD<sub>50</sub> vs distance and dose; and survival vs distance and dose.

Procedure: Mice, dogs and pigs will be placed in containers suitably shielded from heat and blast. These will be placed in the water and on land at predetermined distances from zero point; and are to be located so that they may be retrieved promptly. Animals will then be observed, sacrificed serially, etc.

3.2.1.4                Responsible Agency: Argonne National Laboratory  
Objective: To attempt to separate the effects of prompt nuclear gamma radiation, neutron radiation, and gamma radiation from the fireball.

Procedure: Mice will be placed in heavily shielded containers with collimating slits directed toward the detonation point, and toward the estimated location of the fireball. Acute lethality, LD<sub>50</sub> and survival will be studied.

3.2.4.1                Responsible Agency: National Military Establishment  
Objective: To obtain animal tissues at the earliest

possible time after exposure, and serially thereafter, for detailed histologic and hematologic study. There is a lack of information from Japan and Bikini on this early period. Procedure: Animals exposed as in 3.2.1.1 will be retrieved at once. Some will be sacrificed at once, others serially at appropriate intervals thereafter. The tissues would be fixed and preserved for study in the Naval Medical Research Institute, the Army Medical Center, and the Army Institute of Pathology. Blood studies would be made in the Island Laboratory.

3.2.4.2 Responsible Agency: National Military Establishment  
Objective: To obtain animal tissues at the earliest possible time after irradiation, and serially thereafter for histochemical studies. Such studies are being performed on tissues irradiated by conventional means, but none have been done on tissues exposed to atom bomb radiation.  
Procedure: Tissues as obtained in 3.2.1.1 and 3.2.4.1 will be quick frozen at  $-55^{\circ}\text{F}$ , and stored and transported in this condition to the Army Medical Center for histochemical study.

3.2.4.4 Responsible Agency: National Military Establishment  
Objective: To obtain animal tissues at the earliest possible time after irradiation, and serially thereafter for studies of tissue enzyme systems. Such studies have been performed with x-radiation; none with the intense atom bomb radiation. Knowledge of pattern of change of tissue enzyme systems is sought.  
Procedure: Tissues obtained as in 3.2.4.2 will be quick frozen at  $-55^{\circ}\text{C}$  and transported in this state to the Army Medical Center for enzyme system studies.

NCI\*\* Responsible Agency: National Cancer Institute  
Objective: To study the effects of the atom bomb radiation on the hematopoietic system, on longevity, as a source of genetic effect, and as a carcinogenic agent for mice.  
Procedure: Animals would be exposed as in 3.2.1.1 at distances where sublethal doses could be expected. Long term follow-up, and breeding studies would then be conducted after returning the animals to the National Cancer Institute.

\*Refers to  
 Agenda

\*\*Proposal submitted too  
 late for action by Committee

Project 3: Study of Thermal Injury

- 3.2.3.1 Responsible Agency: National Military Establishment  
Objective: To study the relation of the mortality to surface area burned and to the degree of the burn.  
Procedure: An attempt will be made by suitably timed shields to separate the majority of the thermal exposure from the ionizing radiation exposure. Suitably shielded pigs will be placed where burns of varying severity can be anticipated. The influence of the burn on mortality, and as a complication of radiation injury will be studied.
- 3.2.3.2 Responsible Agency: University of Rochester  
Objective: To compare atom bomb flash burn with material from Bikini, and with flash burns produced in the laboratory.  
Procedure: Suitably shielded pigs will be placed where burns of varying severity can be anticipated. The histological character of the burns, and related phenomena will be studied in an attempt to evaluate other atom bomb flash burns, and laboratory flash burns.
- 3.2.3.5 Responsible Agency: Argonne National Laboratory  
Objective: To analyze histologic changes in the skin of pigs exposed to thermal radiation, for comparison with the findings in the skin of the victims of the Los Alamos accident.  
Procedure: Young pigs would be exposed, suitably shielded from blast, and by timing devices from some of the ionizing radiation. Specimens of skin would be removed, fixed and returned to the U. S. for study.

Project 4: Study of Blast Injury

- 3.2.3.3 Responsible Agency: National Military Establishment  
Objective: To study blast injury using improved containers based on experience at Inyokern and Bikini. There were serious discrepancies at Bikini between the degree of injury and the estimated overpressure, with lethal effects from peak pressures that are not lethal with H.E. Further study of this is desired.  
Procedure: Small animals, shielded from thermal radiation would be exposed in various positions related to blast measuring devices. They would be sacrificed as soon as recovered for study of blast effect.

Project 6: Study of Hematology of Radiation Injury

- 3.2.4.5 Responsible Agency: National Military Establishment

Objective: To perform certain routine hematologic examinations for comparison with results obtained at Bikine and in the NMRI. To study the nature and the course of the hemorrhagic tendency in irradiated animals.

Procedure: Routine, complete studies of the hemogram will be made in the surviving large animals. The studies of the hemorrhagic state will be confined to histologic examination of appropriate tissues, and to biochemical studies of plasma, quick frozen at  $-55^{\circ}\text{F}$ , and returned to NMRI for fractionation, etc.

Project 7: Study of Particulate Fission Products

3.2.2

Responsible Agency: University of Rochester

Objective: To study the distribution in lungs and other tissues of radioactive fission products, of dust containing induced radioactivity; using animals exposed at various sites.

Procedure: As amended, selected tissues from animals exposed in 3.2.1.1 would be available for preservation for radioautography, microincineration, and other suitable studies. (See original proposals 3.2.2.2; 3.2.2.3; 3.2.2.4; and 3.2.2.41)

3.2.2.5

Responsible Agency: National Military Establishment

Objective: To study the distribution in animals of fission products inhaled and ingested in areas of fall-out.

Procedure: Where fall-out is expected shielded laboratory animals would be exposed for varying intervals of time; and in known areas of fall-out laboratory animals and indigenous forms would be collected after exposure and studies for the distribution and variety of fission products in the lungs and body.

UCal\*

Responsible Agency: Crocker Laboratory, University of California

Objective: To investigate the behavior of radioactive aerosols produced by nuclear detonation, using experimental animals (rats); to evaluate and estimate the possible hazards to humans inhaling radioactive dusts and mists.

Procedure: Animals would be placed down-wind, suitably shielded from bomb radiations. If possible others would be placed in drone aircraft. Studies of chemical species of radioactive aerosols, their distribution, etc., would be performed using alpha, beta and gamma counters, electroscopes, etc.

\*Submitted  
too late for  
action by Committee

Project 8: Biological Dosimetry

Objectives: This series of proposals involves the use of certain biological agents as dosimeters, on the basis of extensive laboratory studies.

Procedure: The dosimeter material would be placed in suitable containers, and in all the animal exposure containers. It would also be placed behind experimental shields, and in the high dose range. It is planned that the dose range: 20-600r would be monitored by Tradescantia; 50-600r by the CF-1 mice; 500-5000r by Neurospora; 5000-20,000r by Aspergillus; and 5000-50,000r by Zea.

3.3.3

Responsible Agencies:

3.3.4

Tradescantia Oak Ridge National Laboratory, and NME

3.3.5

Zea U.S. Department of Agriculture, and NME

Aspergillus Oak Ridge National Laboratory, and NME

3.3.9

Responsible Agency: Los Alamos Scientific Laboratory

Objective: To use alterations of the size of spleen, thymus, and changes in the ratio; white pulp/red pulp after 250 KV x-ray as an indicator of equivalent radiation. It is proposed to attempt biological monitoring of atom bomb radiation in certain localities by taking advantage of this effect.

Procedure: Mice whose response to 250 KV x-ray is well known would be exposed in the approximately 50-600r range in locations where integrated dose measurements are desired, as behind shields, in drones, etc. Approximately 5 days after exposure the animals will be sacrificed and the measurements made.

Project 9: Genetical Effects of Atom Bomb Radiation

Objectives: This series of proposals involves the exposure of biological material whose genetic response to conventional forms of ionizing radiation and to atom bomb radiation is known. It is hoped to extend and complement earlier studies of mutations, mutations rates, etc. In the case of Neurospora, reversal of mutations obtained at Bikini will be sought, and additional chemical mutants will be looked for. The problem of the high incidence of chlorotic kernels in corn exposed at Bikini will be studied further.

Procedure: Most of these materials will be exposed also as biological dosimeters; but also samples will be placed in the very high dosage range. Most of the materials will be returned to the U. S. for further study. Aspergillus and Neurospora will be cultured in the Island laboratory before

the tests.

Responsible Agencies:

- 3.3.4 Zea and others U.S. Department of Agriculture, and NME  
cereals
- 3.3.5 Aspergillus terreus: Oak Ridge National Laboratory, and  
NME
- 3.3.6 Neurospora cressa: Oak Ridge National Laboratory, and NME

Project 10: Effect of Atom Bomb on Local Fauna and Flora

- 3.4.1 Responsible Agency: U.S. Department of Agriculture, and NME  
Objectives: To study the thermal and blast effects of atom  
bomb blast on local fauna and flora, to extend observations  
at Bikini and Eniwetok. Naturalists, qualified in a number  
of fields: birds, insects, plants, etc. may be available.

Project 11: Dosimetry with Mineral Substances

- 3.4.2 Responsible Agency: National Military Establishment  
Objectives: To conduct further studies on certain minerals:  
Vikor glass, activated halides, etc. which are affected by  
ionizing radiation. Preliminary studies at the NMRI and  
at Bikini suggest that these agents may be useful, rugged,  
integrating dosimeters for personnel, and other purposes.  
Procedure: Samples of these calibrated radiation-sensitive  
materials will be placed in all animal containers; and at a  
number of other stations where very precise physical  
measurement by other means are being made; and at stations  
where high intensity is expected.

Att. D. PHYSICAL FACILITIES REQUIRED FOR THE BIOLOGICAL AND  
MEDICAL LABORATORY TO ASSURE SATISFACTORY  
WORKING CONDITIONS FOR THE PROGRAM

1. Buildings:

a. Laboratory: Two (2) units, 24' x 80' placed side by side. Each of these units should have a corridor 4' wide on one side of the building; and each should then be divided into 5 basic laboratory units, 20' x 16' each. The purposes for which the small rooms would be used are collection and sample preparation, hematology, biochemistry, x-ray therapy unit, counter and calibration of instruments, office and storage.

b. Mouse Colony: One unit 24' x 80', without subdivisions to house the animals, in proper cages, on proper racks; and one shed, 24' x 20' equipped as wash house with running sea water for washing, cleaning and sterilizing the cages.

c. Storage Building: One unit, 24' x 40' for general storage of dried food, equipment, etc.

d. Shed to cover diesel generators

e. Shed to cover walk-in refrigerators.

2. Services:

a. Two (2) 75 KW, 3 phase, 220 VAC, diesel generators.

b. Fresh water supply system: a storage tank of at least 2000 gals capacity, with a distribution system; and facilities for pumping water from water barges.

c. Salt water supply system: a heavy duty pump and piping to provide sea water for washing animal facilities.

d. Two (2) 900 cu. ft. walk-in type refrigerators: one for storing specimen carcasses; the other for fresh feed; capable of holding contents at 35 - 40°F.

e. Three (3) Carrier deep-freezes, 9 cu. feet, capable of holding a full load at -55°F.

f. X-Ray therapy, 250 KV apparatus.

g. Incinerator: diesel oil operated, flash type for disposal of excreta-soaked shavings, etc.

h. Sewage system: for disposal of laboratory and human wastes.

i. Water distillation apparatus, for drinking water: Capacity of 500 - 1000 Gal/day.

j. Runways, wire fencing, and half-shelters for large animals.

3. Communications:

a. Three telephones connected with the inter-island telephone system are required.

4. Transportation:

a. Two (2) jeeps with trailers, and one weapons carrier.

b. Two (2) LCVP type boats.

There is no plan to have living quarters or messing facilities on the island with the laboratory and animal colony.

Att. E

ESTIMATE OF PERSONNEL AVAILABLE/REQUIRED FORBIOLOGICAL AND MEDICAL PROGRAM

Project	Proposal	Proposer	Scientists	Technicians	Man Days	Time on Islands*	
						Pre WKS	Post
1	3.1	NME	2	37	20,000	72	10
2	3.2.1.1	NME	6	12	1,620	12	6
	3.2.1.4	ARG	2	4	420	8	6
	3.2.4.1	NME	**				
	3.2.4.2	NME	**				
	3.2.4.4	NME	**				
	NCL	NCI	1	2	210	6	6
3	3.2.3.1	NME	1	2	240	8	6
	3.2.3.2	ROCH	1	2	240	8	6
	3.2.3.5	ARG	1	2	240	8	6
4	3.2.3.3	NME	1	4	450	12	4
5	3.3.7	NME	1	2	120	4	4
6	3.2.4.5	NME	2	8	1,000	12	6
7	3.2.2.2 <sup>o</sup>	ROCH	1	2	210	6	6
	3.2.2.3 <sup>o</sup>	HAN#	-	-	-	-	-
	3.2.2.4 <sup>o</sup>	ARG	1	2	210	6	6
	3.2.2.5	NME	**				
	UCal	UCAL	1	4	350	6	4
8,9	3.3.3	OAK	2	4	420	8	4
	3.3.4	USDA	1	4	200	4	4
	3.3.5	OAK-NME**	2	4	360	6	4
	3.3.6	OAK-NME**	2	4	360	6	4
	3.3.9	LA	1	4	300	8	4
10	3.4.1	USDA-NME**	1	2	240	8	6
11	3.4.2	NME					
Totals		8	31	107	27,400		

References: \* Maximum estimated time, weeks  
 \*\* Personnel included in other estimates  
<sup>o</sup> No commitment of personnel

<u>Sources of Personnel:</u>	<u>Sci-Off</u>	<u>Tech-EM</u>
A.E.C.	12	28
N.M.E	16	71
Other US Govt	3	8
Administrative	4	22