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Washington 25, D. C.

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January 10, 1951

Honorable Robert LeBaron  
Chairman, Military Liaison Committee  
P. O. Box 1814 ..  
Washington 25, D. C.

Dear Mr. LeBaron:

As you know, one of the important problems that would confront us in the event of a war in which nuclear weapons were employed would be the amount of external radiation from radioactive materials that military personnel could tolerate and still effectively carry out their assigned duties and missions in the Armed Forces. This problem was a principal subject of discussion at the November 10, 1950 meeting of the Atomic Energy Commission's Advisory Committee for Biology and Medicine. In attendance at this meeting were Rear Admiral F. C. Greaves and Captain C. F. Behrens of the Bureau of Medicine and Surgery, Brigadier General William H. Powell, Jr., of the Office of the Surgeon General, Air Force, and Brigadier General James P. Cooney, Army Medical Corps, and Chief of the Radiology Branch, Division of Military Application, Atomic Energy Commission. It was suggested at this meeting that it would be helpful to the Armed Forces to have the opinions of an ad hoc commission, composed of physicians and radiologists whose recommendations would be recognized as authoritative, to advise the Armed Services of the permissible levels of radiation to which troops could be exposed and still be expected to be effective as fighting forces.

In order to obtain an accurate and authoritative answer to the question raised at the meeting, the Division of Biology and Medicine of the Atomic Energy Commission has consulted with a group of the physicians and scientists of this country whose experience in this field has been broadest and most extensive, and whose reputation for clear thinking and good judgment renders their advice and opinions of very great value. This group includes clinicians and radiologists experienced in the use of X-ray and radium in the treatment of human patients and who have had occasion to radiate the human body in such treatments; it includes physicians and scientists who were in Japan at the close of the last war and carefully studied bomb victims at Hiroshima and Nagasaki, the physician who treated the victims of the three accidents involving acute radiation injury in the history of the Manhattan Project and the Atomic Energy Commission; scientists who have conducted and are well acquainted with the results of experiments on the effects of radiation on

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various species of experimental animals, including the genetic effects of radiation; and physicians who were members of the Medical Board of Review which appraised the medical work of the Manhattan Engineering District.

On December 8 these men met as a group in Washington at the request of the Atomic Energy Commission. Attending and taking part in this meeting were:

Dr. Alan Gregg, Director of the Division of Medical Sciences Rockefeller Foundation, and Chairman of the AEC Advisory Committee for Biology and Medicine, who acted as chairman of this meeting.

Dr. Austin M. Brues, Associate Professor of Medicine, University of Chicago Medical School, and Senior Biologist and Director of the Division of Biological and Medical Research, Argonne National Laboratory of the AEC.

Dr. Simeon T. Cantril, Radiologist with the Tumor Institute of the Swedish Hospital, Seattle, Washington, Consultant to the Atomic Energy Commission and to General Electric Company in their operation at Hanford Works during the last war full time with the Manhattan Project.

Dr. Andrew H. Dowdy, Professor of Radiology and Chairman of the Department, Medical School of the University of California at Los Angeles, formerly Professor of Radiology at the University of Rochester Medical School and head of the Atomic Energy Commission research laboratories located there.

Dr. Louis H. Fempelmann, Associate Professor of Radiology at the University of Rochester Medical School, Special Assistant to the Director of the Division of Biology and Medicine of the AEC, formerly head of the Health Division, Los Alamos Scientific Laboratory.

Dr. Robert F. Loeb, Bard Professor of Medicine, College of Physicians and Surgeons, Columbia University. Specialist in Pathology and Internal Medicine, Chairman, Medical Board of Review, Atomic Energy Commission, 1947.

Dr. Curt Stern, Geneticist and Professor of Zoology, University of California, member of AEC Advisory Committee for Biology and Medicine, formerly Chairman of Division of Biological Sciences, University of Rochester, and geneticist with the AEC Atomic Energy Project located there.

Dr. Shields Warren, Professor of Pathology, Harvard University Medical School, Division of Biology and Medicine, Atomic Energy Commission.

Brigadier General James P. Cooney for the Army, Admiral Thomas C. Anderson and Dr. Robert Flynn for the National Security Resources Board, and Major Gerrit L. Hekhuis for the Air Force.

The last-mentioned group attended this meeting for the purpose of presenting to the group in further detail the problems in this field already raised by the armed forces and to obtain personally the conclusions and recommendations of this committee on the subjects of importance to the armed forces and civilian defense agencies.

Members of the Division of Biology and Medicine of the AEC acted as staff to this committee in collecting and summarizing pertinent available research data and clinical information and presenting it to the committee for their consideration.

As a supplement to information gained personally by armed force and civilian defense representatives at this meeting, the Committee has asked me to write this letter summarizing their views on the pertinent questions asked them.

This letter was submitted to each of them for any suggestions or corrections they cared to make, and I can now tell you that the members of this committee were in unanimous agreement that what follows is a correct summary of their joint conclusions.

Question 1: Assume that troops are acutely exposed to penetrating ionizing radiation (gamma rays). At what dosage level will they become ineffective as troops?

Answer of the Committee: Uniform dosage of 50r to a group of armed force personnel will not appreciably affect their efficiency as a fighting unit.

Uniform acute dosage of 100r will produce in occasional individuals nausea and vomiting, but not to an extent that will render armed force personnel at any time ineffective as fighting units. Troops receiving an acute radiation dose of 100r and above ought to be given, as soon as feasible (within a week, if possible), a period for rest and individual evaluation.

Uniform acute dosage approximately 150r or greater can be expected rapidly (in a few hours) to render armed force personnel as a group ineffective as troops through a substantial incidence of nausea, vomiting, weakness and prostration. Mortality produced by an acute dose of 150r will be very low and eventual recovery of physical fitness usually may be expected.

Field officers should therefore assume that if substantial numbers of their men receive acute radiation doses substantially above 100r, there is grave risk that their commands will rapidly become ineffective as fighting units.

Question 2: What dosage will render an air crew inefficient, that is, unable to complete a mission, during a flight of one to three hours, four to twelve hours, twelve to forty-eight hours?

Answer of the Committee: In all three cases if radiation dosage to flight crew members is held below 75r, radiation exposure will be unimportant in determining the success or failure of a mission provided the crew members had not previously received an appreciable amount of radiation. In all three cases radiation doses substantially above 75r, combined with human stresses associated with military aviation missions in wartime, are considered to very seriously reduce the odds for successful completion of a mission.

Question 3: How often may an aircraft crew accept an exposure of 25r per mission and still be a reasonable risk for subsequent missions?

Answer of the Committee: It is probable that at least eight missions can be carried out at weekly or longer intervals, with exposure of 25r per mission, before the chance of mission failure becomes large due either to illness during the mission or significant general deterioration in health and ability. More missions may be feasible, but personnel should be carefully checked and evaluated before each mission and particularly before a decision to permit greater exposure than 200r total in these divided doses is made.

The possibility should not be ignored that cumulative radiation doses to the entire body above 200r may substantially reduce the life expectancy of the irradiated individual.

Question 4: A submarine crew are receiving 25r per mission. How many missions should they be allowed to make?

Answer of the Committee: The answer is substantially the same as to question 3. It is probable that at least eight missions can be carried out. Personnel ought to be carefully checked and evaluated after each mission. The possibility of substantial reduction in life expectancy by radiation doses totaling over 200r should not be ignored.

As indicated earlier, in arriving at these conclusions the Committee took into account the results of extensive animal experiments, the response of patients treated for disease by X-ray and radium, observations on the effect of radiations from the atom bomb detonated over the Japanese cities of Hiroshima and Nagasaki, and accidental radiation exposures within the Manhattan Project and the Atomic Energy Commission.

I believe you can accept these values as realistic appraisals that can be used in planning with the convictions that their predictions will be closely fulfilled in practice.

We are sending copies of this letter to the Chief of the Bureau of Medicine and Surgery, Department of the Navy, and the Surgeons General of the Army and Air Force.

Sincerely yours,

Marion W. Boyer  
General Manager