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DATE: January 12, 1954

FROM : John C. Bugher, M.D., Director, Division of Biology and Medicine

SUBJECT: MONTHLY STATUS AND PROGRESS REPORT, DECEMBER 1953 -
DIVISION OF BIOLOGY AND MEDICINE

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Transmitted herewith is the Monthly Status and Progress Report for this Division covering the month of December 1953.

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MONTHLY STATUS AND PROGRESS REPORT

Division of Biology and Medicine

MONTH OF DECEMBER 1953

Research Activities

Somatic Mutation Program. (UNCLASSIFIED) Brookhaven National Laboratory has extended the somatic mutation program which was initiated in December 1952 to test the feasibility of producing useful mutations in plants by means of ionizing radiations. The major agricultural experiment stations in the east are taking part in this research work. The main emphasis in the program is on the production of somatic mutations in plants, shrubs, and trees which are normally propagated asexually. The experiment stations select the material to be treated, and after irradiation at Brookhaven the material is screened for usefulness at the originating station. Most of the material in this program is grown in the gamma field, where careful observations are made of abnormalities. The cobalt source in the gamma field used for these experiments has been increased from 260 curies to 2,200 curies. In addition, the location of the source in the field has been changed and the field enlarged. The increase in size is an indication of the usefulness of the field in the biology program, and such numbers of plants are being used that a positive answer to the applicability of radiation as a tool in plant breeding should be available in a few years.

Also at Brookhaven, use is being made of the thermal neutron facility for mutation production in plants; it has been shown that thermal neutrons are more effective in producing mutations for a given amount of damage than other forms of radiation. It is also becoming clear from other studies that thermal neutrons produce radiation damage in biological material by quite a different mechanism than do X-rays and are thus providing another effective research tool. An example of recent work with neutrons has led to some findings on inducing disease resistance in plants. Rust diseases bring annual losses of millions of dollars to the oat crop, which is the nation's second largest cereal crop (after corn). Investigators at Brookhaven exposed several hundred oat seeds of the Mohawk variety to thermal neutrons. After the first crops were harvested, seeds were planted in the summer of 1953 and a second-generation group grown. Artificial inoculations of oat stem rust fungus (Race 7A), to which the Mohawk strain is particularly susceptible, were given to these plants. The rust fungus spread uniformly throughout the oats nursery, affecting all but a few plants. In those where infection had taken place, it was demonstrated that the plants had a resistance which prevented any damage. In the few not infected, seeds were taken and planted in the fall. Resultant plants were inoculated with

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the rust disease but continued to show resistance against it. As far as is known, the new strains have the desirable characteristics of the original Mohawk variety, including high yield. Further experiments will be continued to determine applicability to other varieties and crops.

Calorimetric Evaluation for Radiation Units. (UNCLASSIFIED)

Modern radiation dosimetry is largely based on the Bragg-Gray principle which permits the measurement of the amount of energy absorbed by tissue from ionizing radiations. Although the analysis and interpretation of radiation experiments require that the radiation flux and its "dose" (absorption) be known in ergs/cm² and ergs/gram, respectively, the actual calibration measurements are usually made with ionization chambers rather than directly by a calorimetric method. This procedure has been customary since ionization measurements have been convenient and reproducible, whereas the direct calorimetric measurement has appeared difficult. The necessary conversion of the ionization measurement into absolute units is simplified with the assumption of the Bragg-Gray relation but is not always simple or certain. By the calorimetric method which Sloan Kettering Institute has developed recently, it is now possible to quantitatively determine the relation between ionization and absorbed energy as a function of atomic number of absorber and energy of X-ray to examine any limitations of the Bragg-Gray relation that might exist.

Scientists working on this project suggest that this calorimetric method of flux determination be adopted as the fundamental calibration of the output of the roentgen-ray generators, particularly for generators above 1 Mev.

Radiogermanium Inhalation Studies. (UNCLASSIFIED) The usefulness of radioisotopic materials in evaluation of industrial hazards is exemplified in a recent report from the Medical Department of Brookhaven National Laboratory on a collaborative study with the U.S. Naval Hospital at St. Albans, New York. The study involved the use of pile-activated germanium (Ge^{71}) to trace the fate of this element after inhalation of germanium dusts, such as might be met during the production of various electronic devices which employ germanium crystals.

Rats were exposed for one hour to atmospheres containing the activated germanium (as the metal itself or as the oxide, GeO_2). The lungs, liver, and kidneys were then removed and examined at varying intervals after exposure. The gamma-radiation (11.4 day half-life) of the Ge^{71} permitted tracking of the elimination of the element from the lungs and through the other organs. The oxide is rapidly excreted, and the removal of the elemental germanium depends primarily on the rate at which it becomes oxidized upon standing in the lung. No irritation,

gross pathological changes, or other adverse effects were noted as a result of the contact of germanium with the tissues. The findings show that this type of exposure to germanium does not constitute a significant industrial health hazard.

Mechanisms of Heavy Metal Toxicity. (UNCLASSIFIED) Heavy metals, such as lead, mercury, and uranium, whether radioactive or not, tend to be toxic and provide industrial hazards during their handling. However, the toxicity of each of these substances differs somewhat and may have several facets. A full understanding of this problem requires knowledge of the reactions of these materials with the vital materials of the cells and the resultant upsets of functions at the cellular level.

A series of studies are being performed at the University of Rochester Atomic Energy Project on toxicity effects in micro-organisms and organs such as the diaphragm and intestines of higher animals. In experiments with mercury, it has been found that small traces inhibit the metabolism of living tissues. The inhibition was studied in excised rat diaphragm muscle in terms of total oxygen consumption and glucose utilization. Glucose utilization was completely inhibited within a few minutes in the presence of certain dilute concentrations of mercuric chloride. However, using a sensitive histochemical method at that time, no mercury could be detected in the diaphragm muscle cells. A few hours later, as the mercury appeared within the cells, the respiration became progressively depressed. Thus, it appears that the mercury-sensitive reactions involved in glucose utilization are at the cell surface and are concerned with the passage of sugar from the outside to the cell interior. The mercury-sensitive respiratory reactions, however, occur within the cell, and this imposes a time lag before appearance of the inhibition.

Radiation Instruments Program

Film Badge Calibration. [REDACTED] At the request of the Radiation Instruments Branch, the National Bureau of Standards has recently completed a study of the various film dosimeters used within the AEC. This study was divided into two parts. First, a laboratory study of the minimum range, quality dependence of the dosimeters, and second, a cross calibration consisting of an evaluation of the ability of the site to determine doses that were applied to the dosimeters by the National Bureau of Standards. The cross calibration data collected by NBS is now being analyzed by the Instruments Branch.

It has been suggested, in view of differences reported by the Canadians and Knolls Laboratory of dosages received by U. S. personnel

who worked in Canada on the reactor cleanup, that an invitation be extended to the Canadians to participate in a similar cross calibration study. Word has been received from Canada that they would be happy to participate in the study, and it is expected that this work will be completed during the month of January.

Civil Defense Activities

Emergency Radiation Monitoring Program. (UNCLASSIFIED) Recently, revision was approved in the directive governing the 18 emergency radiation monitoring teams established in February 1950 at Operations Offices and 12 supporting locations to (1) monitor any on-site or AEC-connected radiological emergency or disaster; and (2) secondarily, to provide monitoring services in event of a civil defense emergency resulting from atomic attack.

The revision relieves the Operations Offices administering this program of responsibility for civil defense monitoring and restricts use of the teams to AEC service. This action was taken after consultation with the Federal Civil Defense Administration and recognizes the general improvement in radiological defense capabilities of the various state and local civil defense organizations. Certain of the teams established at university-contractor locations will be discontinued, and new teams may be established at Operations Offices not originally included in the program.

Speech by Chairman before White House Conference of Mayors. (UNCLASSIFIED) The Chairman addressed the White House Conference of Mayors on December 14 at the invitation of Administrator Peterson of the Federal Civil Defense Administration. Approximately 175 Mayors and City Managers of municipalities in excess of 75,000 population attended this two-day conference sponsored by the White House and having strong civil defense overtones.