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UNITED STATES ATOMIC ENERGY COMMISSION

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REPORT

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Part VI

Biology and Medicine

(UNCLASSIFIED)

An important part of the Commission's research in biology and medicine is necessarily concerned with the biomedical effects of radiation, particularly that produced by the detonation of nuclear weapons. Some of the more significant information recently developed in several approaches to this general problem is reported in the following pages. Additional information on a wide variety of unclassified research projects in biology and medicine may be found in the Seventeenth Semiannual Report to the Congress. (End of UNCLASSIFIED section.)

Medical Resurvey of Marshall Islands Residents

Data have been received on the first periodic medical follow-up study made in September 1954 of the Marshall Islands residents exposed to radiation during the March 1 detonation in the Pacific test series. A team from the technical staffs of the Naval Radiological Defense Laboratory and the Naval Medical Research Institute making the survey for AEC found that all skin lesions had healed and that normal regrowth of hair had occurred. In individual cases it was found that counts of the various cell types in the blood are still below those of persons in the control group, but the mean values for each cell type are within the normal range for individual counts. This slow recovery is consistent with data obtained from the Hiroshima and Nagasaki studies and from various radiation accidents. Bone marrow studies and examination of chest and bone X rays have revealed no significant abnormalities attributable to radiation. There is at present no reason to believe that any of the Marshall Islanders will suffer any permanent physical impairment, but periodic surveys will be made in the future, to assure their continued recovery.

Fall-out Data

Results of the Pacific test series early in 1954 have required a reevaluation of the effects of atomic weapons and consequently of defensive measures against them.

Earlier tests indicated that the lethal effects of nuclear weapons were limited to an area within several miles from the point of detonation. Under these conditions it was possible to analyze weapon effects in terms of four major factors: heat, blast, direct radiation, and the nearby fall-out of radioactive debris.

The new factor introduced by the large-yield thermonuclear weapon is the possibility of relatively heavy fall-out of highly radioactive debris a hundred miles or more from the point of detonation. For example, the very large thermonuclear weapon exploded on March 1, 1954

heavily contaminated an area extending approximately 220 miles downwind and about 30 to 40 miles in width. (These results were illustrated by the map on page 44 of the preceding Program Status Report.)

The number of casualties which would result from such a situation is difficult to estimate because so many variable and complex factors are involved. These include not only a whole complex of meteorological phenomena but also such intangibles as the number of people exposed out of doors, the length of the exposure period, the types of structures in which the sheltered population take refuge, and the extent to which the population is able to use civil defense techniques.

For example, if we make the highly unlikely assumption that the people in the area would be subjected to maximum exposure, that they would be without shelter of any kind, and that they would ignore even the simplest protective measures, the number of casualties would be very high. On the basis of data on the March 1 detonation, it is now estimated that there was sufficient radioactivity in a narrow belt about 140 miles long and approximately 20 miles wide to have caused the deaths of nearly all persons remaining there from 24 to 48 hours without shelter of any kind, or any other protective measures. At about 130 miles downwind from the point of detonation the level of radioactivity would have been fatal to about half of the persons so exposed out of doors for 24 to 48 hours. At the outer edge of the elongated area, or approximately 190 miles downwind, it is estimated that the level of radioactivity was sufficient to have caused the death of 5 to 10 percent of any persons who might have remained out of doors for 24 to 48 hours. At a point more than 220 miles downwind no deaths would have occurred from radioactivity, even if persons there had remained exposed indefinitely and had taken no safety measures.*

These and other similar weapons effects data from the CASTLE tests in 1954 were discussed at several meetings with the Federal Civil Defense Administration, which was also provided with a report prepared on this subject by the Armed Forces Special Weapons Project.

Effects of Atomic Explosions on Weather (UNCLASSIFIED)

In 1953, the Commission requested the U. S. Weather Bureau to investigate all possible relations of atomic explosions to weather. The Weather Bureau explored the problem by determining whether (1) weather conditions and the incidence of tornadoes have been abnormal during weapon test series, and (2) any practicable hypothesis could be established relating bomb detonations or their debris to weather changes.

The most important factor in explaining the record-breaking 532 tornadoes reported in 1953 and the more than 600 reported in the first nine months of 1954 appears to be substantial improvements in the tornado-reporting system.

It has been most frequently suggested that weather conditions are affected by dust thrown into the atmosphere by tower or low-altitude detonations. These suggestions assume that the dust would increase the amount of rainfall by a cloud-seeding process. Laboratory experiments, however, show that dust from the Nevada Test Site is a very inefficient nucleating

*A statement is in preparation for public release on radioactive fall-out from high-yield nuclear devices, including estimations of areas of contamination and evaluation of the biological effects.

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agent for producing rain. Suggestions that widespread weather changes are caused by the heat or convection resulting from the explosion cannot be substantiated by any meteorological theory or data.

The question of long-range effects on world climate needs more study. Any possibility of such an effect depends upon whether the quantities of dust thrown into and retained by the atmosphere would be sufficient to affect the amount of heat reaching the earth from the sun.

None of the data examined indicates that atomic weapons have any weather effects which can be directly observed outside the test site.

High-Altitude Balloon-Rocket Flights

A cooperative project has been initiated by the Commission with the Department of the Navy and the State University of Iowa to study the extent and nature of radioactivity at very high altitudes in the northern latitudes. This project is a part of the Commission's efforts to ascertain as fully as possible world-wide effects of background radiation in the atmosphere, soil, and water.

Observations were made by launching high-altitude rocket-balloon flights in the upper atmosphere. As the balloons reached an altitude of about 50,000 feet, the rockets containing radiation detection instruments were fired by radio. High-intensity radiations were recorded, but these probably result from cosmic rays rather than from suspended radioactive dust particles. Analysis of the data obtained is not yet complete, and further investigations will be made.

Conference on Genetics

A genetics conference including 14 of the most eminent scientists in this field was held at the Argonne National Laboratory on November 19 and 20, 1954. The entire field of research in genetics was reviewed to determine in which areas greater emphasis may be needed.

As atomic energy has become more important in modern life, the genetic effects of radiation have become a matter of growing interest in biomedical research. This interest is based upon the knowledge that radiation may cause mutations within the germ cells of plants and animals. Equally important is the belief that the effects of radiation on germ cells is cumulative—that is, small doses of radiation over a long period of time may be expected to have the same genetic effect as the same total dose delivered in a short time.

The discussions were devoted to four major areas of genetic research: mutation rate studies, cytogenetics, physiological genetics, and population genetics. Population genetics in particular is a research area of increasing importance to the Commission. All natural populations adequately studied to date have been shown to harbor a considerable degree of genetic variability. The exposure of such populations to irradiation will almost certainly increase their genetic variability. The question at issue, from the Commission's standpoint, is whether this increase is a matter of concern. The conference made it clear that the increase should be a matter for further exploration. The discussions also indicated that it is difficult to formulate generalizations about the genetic effects of radiation on populations. A wide range of opinion is clearly admissible. The only views that seem not to be admissible are the two extremes: the one, that any increase in the mutation rate is certain to be disastrous; the other, that genetic effects of ionizing radiations are not a source of concern.

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Medical Research Reactor

The University of California at Los Angeles is planning to purchase a medical research reactor to support its well established biomedical research program carried on for the Commission. The reactor will be especially useful in this work and priority of use for AEC purposes will be assured. It will be the first reactor specifically designed for medical purposes and will be used primarily for research, cancer therapy, student training, and incidentally for the production of short-lived isotopes.

The medical reactor has been designed by North American Aviation Corporation and it is estimated that it will cost \$150,000. The University has appropriated funds to house it in a building which will constitute a wing of the new UCLA medical center and hospital. The AEC proposes to support the research studies and student training which the University will agree to undertake under the contract now being negotiated. The measure of this support will be \$75,000 or one-half the cost of the reactor, whichever is the lesser. When this contract and a definitive contract between the University and North American are signed, a public release announcing the project will be made. (End of UNCLASSIFIED section.)

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