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# PROGRAM STATUS REPORT

to the  
JOINT  
COMMITTEE  
on ATOMIC  
ENERGY

*Excerpt*

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Part VII

Biology and Medicine

Project SUNSHINE (UNCLASSIFIED)

Summary statements on the status of research on the fallout of radioactive materials from nuclear detonations have been presented in the Quarterly Progress Report, July-September 1956, in the Twenty-first Semiannual Report to the Congress, and in speeches by AEC officials.\* Present work on Project SUNSHINE (the study of the long-range effects of fallout) includes the activities described below.

Stratospheric sampling. Techniques are being developed to make possible the monitoring of radioactive fission products in the stratosphere. Such measurements would provide important information on quantities of weapon debris reaching the stratosphere, the distribution and retention of such materials in the stratosphere, and their release to the lower atmosphere. In experiments now being conducted with the Department of Defense, balloons are being used to carry sampling equipment to altitudes of 50,000 to 90,000 feet, where radioactive particles are filtered from a defined volume of air. Balloon-launching sites are at Minneapolis, Minnesota; San Angelo, Texas; France Air Force Base in the Panama Canal Zone, and a point in the Southern Hemisphere.

Radiochemical analyses of the samples are being made on a pilot scale by the AEC Health and Safety Laboratory, New York, until arrangements can be made with commercial laboratories to perform this work. Results of these studies will be useful in planning a worldwide network for the stratospheric monitoring of long-lived radioisotopes.

Studies of strontium 90. Strontium 90 is considered to be a hazardous fission product for three reasons: (1) its radioactivity is relatively long-lived; (2) it is readily transferred by way of the "food chain" from soils to humans; and (3) a large proportion of the strontium 90 ingested is deposited in the bone and is only slowly eliminated from the body. The occurrence of strontium 90 in humans is being given greater attention in research projects in order to determine the importance of such factors as geographic location, calcium content of soils, and local dietary habits. The biological effects of strontium 90 on large animals, particularly dogs, are being studied in expanded research projects at the University of Utah and the University of California at Davis. These experiments with animals may permit more precise estimates of the effects which various concentrations of strontium 90 may be expected to have in human populations when maintained in the skeleton for long periods of time. Even preliminary results from these studies cannot be expected in the near future, and complete results may not be available for as many as 15 years.

\*Speech by Commissioner Willard F. Libby before the American Association for the Advancement of Science, Washington, D. C., October 12, 1956. Speech by Merrill Eisenbud, Director of the AEC Health and Safety Laboratory, New York, before the Washington Academy of Sciences, Washington, D. C., November 15, 1956.

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53  
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BIOLOGY AND MEDICINE

Studies of cesium 137. Studies of fission product fallout are being extended to include the occurrence of cesium 137 in food products and humans. Measurements show that in humans the radioactivity of cesium 137 produced by weapons tests to date is considerably less than that of natural potassium in the body.

Cesium 137 emits beta and gamma radiation with a half-life of about 27 years. Like potassium, it is found in the human body primarily in muscle tissue and in the blood. Apparently the occurrence of cesium 137 in the body, unlike that of strontium 90, depends almost entirely upon the rate of fallout rather than upon the quantity of the fission product present in the soil. On the basis of current studies, the hazard from cesium 137 in fallout from weapons tests appears to be less than one-tenth of the hazard from strontium 90. On the other hand, cesium 137 is believed to be the principal source of the small genetic effects to be expected from stratospheric fallout. Cesium 137 may also prove to be a convenient index of the rate of fallout from the stratosphere. As a gamma emitter it can be measured in foods without destructive analysis and in humans with little inconvenience.

Genetic Research

AEC research projects on the genetic effects of radiation were described in the Quarterly Progress Report, January-March 1956, and in the Commission's Twenty-first Semiannual Report to the Congress. These reports also summarize the broad generalizations about genetic effects on which many geneticists are in agreement.

Three other reports published in 1956 presented significant information on genetic effects of radiation. Two of these were summary reports on radiation effects in general, published in June by the National Academy of Sciences in Washington and the Medical Research Council in London. These reports, prepared independently by geneticists in the United States and the United Kingdom, contained current information on the genetic effects of radiation on different species of plants and animals. From these data, the probable effects on humans were predicted and estimates were made of the amounts of radiation which humans could receive without serious genetic consequences.\*

The third report was a genetic study on children of Hiroshima and Nagasaki survivors, published in December by the National Academy of Sciences as part of its activities in operating the Atomic Bomb Casualty Commission in Japan under AEC contract.

The results of this study were inconclusive in several respects. They did not establish, on the one hand, that the first generation effects were large; nor did they establish, on the other, that these effects of radiation were insignificant. The results were conclusive, however, in showing that the genetic effects on humans were not appreciably greater than predicted from animal experiments. Further discussion of the results is presented in the Twenty-first Semiannual Report to the Congress.

The AEC plans to increase its support of genetics research in areas which may provide better estimates of the genetic effects of radiation on humans. More work on human genetics will be conducted at the University of Michigan Medical School, Argonne National Laboratory, and other institutions. More use will also be made of tissue-culture techniques developed at the University of Colorado School of Medicine. These experiments permit direct comparisons between cells of humans and those of other animal species and may thereby make possible better estimates of human effects from animal experiments. In any case many years of experimentation will be necessary in collecting data on genetics, particularly for species like man which have long generation times.

\*Results have been summarized in the Twenty-first Semiannual Report to the Congress.

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BIOLOGY AND MEDICINE

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The AEC will participate in the Third Meeting of the United Nations Scientific Committee on Effects of Atomic Radiation, to be held in Geneva, Switzerland, in April 1957. Information will be presented on radiological data, genetics research, and methods used in measuring radiation and its effects.

Marine Radiological Survey

The amount and distribution of radioactivity in water and plankton in the vicinity of the Eniwetok Proving Ground during operation REDWING was measured in an extensive oceanic survey from on board the USS *Walton* in June 1956. A second survey was made on the USS *Marsh* during the period September 1-20, 1956. Samples were taken at 74 positions in an area of about 450,000 square miles, from 50 miles east of Bikini westward to Guam and between 9 and 15° North Latitude.

The fact that the radioactivity of the samples decreased toward the survey boundary lines suggests that the area surveyed included the major area of contamination from Operation REDWING. Values of radioactivity for plankton ranged from 30 to 21,000 disintegrations per minute per gram, wet weight. The lowest value was obtained from a station near Guam and the highest from a station 100 miles north of Eniwetok. In the Guam area, the values from this survey and from Operation TROLL (March-April 1955) were similar and were three or more times greater than those of samples obtained from Puget Sound and the coastal waters of British Columbia, an area relatively free from radioactive contamination from fallout. The gross activity in beta radiation for three tuna fish caught near the western boundary of the survey area was only slightly greater than background radiation.

• Other observations made during the survey were that:

1. The activity is being carried westward by the North Equatorial current. Although some radioactive water had reached Guam by September, the greatest amount was found 500 or more miles east of Guam.
2. The activity decreases rapidly east of Bikini.
3. Activity in the surface water moves somewhat ahead of the activity in the plankton.
4. The range and average values are about one-fiftieth of those measured in June 1956 during the test series.
5. The average plankton value was about 1,000 times the average of surface water samples, but this value varied considerably from station to station. (End of UNCLASSIFIED section.)

Radiation Shielding and Correlative Biology [REDACTED]

Efforts to develop a direct relationship between radiation dose and radiation effects in medical terms are being continued.

Radiation effects. A large body of data have been developed over the years on radiation effects through continuing medical observation of the victims of the Hiroshima and Nagasaki bombings. Soon after the attacks, such surveys were started by the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan and by the U. S. Strategic Bombing Survey. An authoritative treatise interpreting these medical findings was published in 1956, as noted in the Quarterly Progress Report, July-September 1956.

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Radiation dose. Much more difficulty has been encountered in attempts to determine the amount of radiation actually received by Japanese individuals for whom data on medical effects have been collected. In the first place, proper instrumentation for measuring radiation dose was not possible under conditions of warfare. Secondly, although the location of many persons at the time of exposure has now been established, the type of shielding then present is not known with sufficient accuracy to determine precisely the radiation dose received.

Present research plans. It now appears that the development of better instrumentation and measurement techniques has made it possible to determine more accurately the relationship between radiation dose and effect. Plans have been made for a series of field tests which will include the following:

1. Studies of the characteristics of radiation from atomic weapons, including the ratio of neutron to gamma dose and the angular distribution of neutron and gamma radiation;
2. Studies of the shielding effects of terrain, nearby objects, and typical Japanese-type structures;
3. Duplication of representative shielding conditions and, if necessary, use of the types of weapons detonated at Hiroshima and Nagasaki; and
4. Animal experiments designed to tie together biological studies made in the laboratory with medical data on Japanese survivors.

Tests in Operation PLUMBBOB. The first phase of the field test planned for Operation PLUMBBOB, to be conducted at the Nevada Test Site in the spring of 1957, will contain physical and biological experiments related to determining the angular distribution of radiation, shielding effects of terrain, and the gamma-to-neutron ratio. The field tests will be conducted cooperatively by several AEC and Department of Defense laboratories. The AEC laboratories at Oak Ridge and Los Alamos will share the major responsibility for the program, with Oak Ridge doing most of the physical studies and Los Alamos most of the biological studies.

#### Civil Effects Tests for Operation PLUMBBOB

The civil effects tests proposed for Operation PLUMBBOB would include about 40 scientific and technical projects. A wide variety of tests will be sponsored by AEC, the Federal Civil Defense Administration, other Federal agencies, State civil defense groups, United States industry and two NATO-member nations, France and West Germany. Objectives of these tests include: the development of radiation dosimetry techniques for use in determining human exposure to radiation, the study of the delayed or long-term effects of bomb radiation, the collection of information on ecological aspects of fallout, the testing of new shelter designs, the development of countermeasures and decontamination techniques and procedures, and the improvement of meteorological techniques used in making predictions of fallout.

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#### Training Programs (UNCLASSIFIED)

In addition to supporting special fellowship programs in radiological physics, industrial medicine, and industrial hygiene, AEC has undertaken or planned new training activities in the biomedical sciences.

A series of radiobiology courses was offered for high school science teachers during the summer of 1956 at Duke University, Harvard University, and the University of New Mexico

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BIOLOGY AND MEDICINE

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under the auspices of AEC and the National Science Foundation. Because of the success of the program last summer, the course will be offered during the summer of 1957 at two additional universities, Wayne State University, Detroit, and the University of California at Los Angeles.

Questionnaires returned by teachers who participated in the 1956 program are being used in improving the course, particularly by the use of additional teaching aids such as posters, slides, movies, "do-it-yourself" kits, and isotopes. AEC plans to operate the 1957 program at a cost of about \$125,000; the National Science Foundation will provide about \$100,000 for stipends and family support. An additional \$75,000 would be used for improved kits which will be provided free of charge to those teachers who successfully complete the course.

AEC will sponsor visiting lectureships in radiobiology at small colleges and universities as a part of a program established by the American Institute of Biological Sciences. In an effort to stimulate student interest in scientific careers, AEC will provide about 20 scientists from its laboratories to lecture on radiobiology and the use of isotopes in research. Lecturers will be assigned to institutions in nearby states to reduce travel costs and the loss of time.

Brookhaven Medical Research Center

The first nuclear reactor designed exclusively for medical therapy and research is under construction as part of the new medical research center at Brookhaven National Laboratory. Construction of the reactor by the Daystrom Nuclear Division, Daystrom, Inc., was 12 percent complete on December 31, 1956. Construction of the entire medical center, including the reactor, is scheduled for completion early in 1958.

The reactor will be used in part for treating certain types of brain tumors by neutron capture therapy. In this type of treatment, the patient is given an injection of a boron compound which tends to localize in the tumor and capture neutrons. A neutron beam from the reactor will be directed at the tumor and the radioactivity generated in the boron by this beam will destroy the tumor cells with little or no effect on the surrounding healthy tissues. In addition to this use, the reactor will provide a supply of short-lived isotopes which can be used for the investigation of fundamental body processes. (End of UNCLASSIFIED section.)

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5  
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