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PROGRAM STATUS REPORT

to the JOINT COMMITTEE on ATOMIC ENERGY

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SINGLE REVIEW AUTHORIZED BY: Smigelli 11/2/94
REVIEWER (ADC): NAME: N R Schmidt DATE: 12/9/94
DETERMINATION (CIRCLE NUMBER(S))
1. CLASSIFICATION RETAINED
2. CLASSIFICATION CHANGED TO:
3. CONTAINS NO DOE CLASSIFIED INFO
4. COORDINATE WITH:
5. CLASSIFICATION CANCELLED
6. CLASSIFIED INFO BRACKETED
7. OTHER (SPECIFY):

pp 58-65 only

[redacted]

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December 31, 1957

UNIQUE DOCUMENT # SAA20005146000O

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Part VIII

Biology and Medicine

PROJECT SUNSHINE (UNCLASSIFIED)

Project SUNSHINE is the study of worldwide radioactive fallout from weapons testing and evaluation of its hazard to man. While these studies are not directly concerned with evaluating the hazards of local fallout in the vicinity of an explosion, data obtained from local fallout studies are useful in the SUNSHINE studies. Project SUNSHINE includes worldwide sampling and monitoring activities and research projects on fallout problems and radiation effects. Some of these studies are made at test sites; many others, in universities and laboratories throughout the country, are remote from any weapons testing activity. Studies of the occurrence and behavior of strontium 90 form an important part of Project SUNSHINE.

The AEC sponsors considerable research on the biological hazards of radiation that is not part of Project SUNSHINE but that nevertheless provides helpful data for the fallout studies. Table 1 summarizes the actual and estimated expenditures for Project SUNSHINE and these related research projects for fiscal years 1957 and 1958, as compared with the estimate of

Table 1—Expenditures for Studies and Research Projects on Fallout Problems and Related Research on the Biological Hazards of Radiation

	Estimated* FY 1957	Actual FY 1957	Estimated FY 1958
Project SUNSHINE			
Sampling and analysis of radioactive fallout	$ 1,193,000	$ 969,000	$ 2,275,000
Research on the biological hazards of radioactive fallout	4,424,000	3,511,000	3,940,000
Subtotal (Project SUNSHINE)	$ 5,617,000	$ 4,480,000	$ 6,215,000
Related research on the biological hazards of radiation	$14,524,000	$14,900,000	$18,353,000
Total	$20,141,000	$19,380,000	$24,568,000

*Taken from page 1393 of the printed hearings.

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expenditures for fiscal year 1957 given in the hearings on "The Nature of Radioactive Fallout and Its Effects on Man," held before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy during May and June 1957.

The bulk of the added expenditure for Project SUNSHINE for fiscal year 1958 over fiscal year 1957 is the result of new programs for stratospheric air monitoring, coastal fallout surveys, and broad soil-climate-vegetation studies.

Monitoring and Sampling

The scope of the strontium 90 monitoring and sampling program is as follows:

- Stratosphere: United States and foreign
- Earth's surface
  - Gummed film: United States and foreign
  - Rainfall pots: United States and foreign
  - Air filters: United States and foreign
- Soils: United States and foreign
- Pasture program (soil, vegetation, animal bone): United States and foreign
- Milk: United States and foreign
- Tap water: New York
- Canned ocean fish
- Sea water: Pacific
- Food: United States and foreign
- Human bone: United States and foreign

Some of these programs are discussed briefly below.

Stratospheric monitoring. Samples of stratospheric particulate matter are being collected in an effort to determine the amount, latitudinal distribution and movement, and rate of fallout of radioactive material retained in the stratosphere. Through contracts with General Mills, Inc., and Nuclear Science and Engineering Corporation, and through a cooperative arrangement with the Air Force, a schedule of routine stratospheric balloon flights has been established at Minneapolis, Minnesota, San Angelo, Texas, the Panama Canal Zone, and a location in the southern hemisphere. At each station, efforts are made to obtain one sample each month from each of four altitudes ranging from 50,000 to 90,000 feet. The samples are obtained by filtering a determined volume of air through a large filter paper mounted in a cylindrical housing which gives the program its title, "Project Ash Can." A volume equivalent to at least 1,000 cubic feet of air, if it were compressed to standard density, must be filtered in order to obtain a sample of particulate material large enough for radiochemical analysis. Because of the great expense and difficulty involved in obtaining these samples, an attempt is made to learn as much as possible about their origin and history by analyzing them for two long-lived fission products, strontium 90 and cesium 137; one relatively short-lived one, barium 140; and three with half-lives of intermediate length, strontium 89, zirconium 95, and cerium 144. Samples for the first six months of operation have been analyzed, but interpretation in terms of radioisotope concentrations in the stratosphere awaits the results of filter efficiency tests in progress.

Because of the difficulties of collecting particles of the extremely small size found in the stratosphere at pressures of 1/100 to 1/10 atmosphere, it is necessary to conduct further research and development leading toward more efficient and reliable methods of collection. In the search for an accurate sampling method for calibration purposes, the Chicago Midway Laboratories of the University of Chicago, under contract with the AEC, have developed, constructed, and ground-tested a cryogenic device for liquefying air at altitudes up to 60,000 feet.

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Improvements in design of the "Ash Can" filter system to increase efficiency and reliability are being developed by General Mills, Inc. Proposals for the development of several other fundamentally different methods of collection are being reviewed.

The cost of the entire stratospheric sampling program during fiscal year 1957 was approximately $300,000. In fiscal year 1958 both sampling operations and research were expanded. The total cost for fiscal year 1958 is expected to be approximately $1,000,000.

Food collection. Representative samples of the foods that are the major sources of calcium in the diet are being collected through the cooperation of teams of the Interdepartmental Committee on Nutrition for National Defense. Samples already received from Turkey, the Philippines, and Libya are being analyzed by the Health and Safety Laboratory of the New York Operations Office.

Another food collection program is under way in Latin America. Arrangements have been made with persons engaged in national nutrition and food programs in Argentina, Chile, and Peru for the collection of samples of the foods providing the major sources of calcium in the diet of people of those countries. The samples will be analyzed for strontium 90 content, total radioactivity, total strontium, and total calcium. In some instances, samples will be taken from locations where gummed-paper collection stations exist, and correlation of analytical results will be attempted.

A similar collection program established through the efforts of Dr. J. L. Kulp, Lamont Geological Observatory, Columbia University, will provide, in addition to food samples, samples of bone from the more primitive areas of Bolivia, Ecuador, Guatemala, and Venezuela. The low calcium content of the soils of these tropical and subtropical areas may result in greater uptake of strontium 90 by vegetation and man. It is possible that the maximum concentration of strontium 90 in humans may be determined from studies of samples from these countries and that the high end of the distribution curve for strontium 90 in the world population may be estimated.

Soil sampling. In the spring of 1958, representatives of the Department of Agriculture will revisit most of the sites of earlier soil sampling in foreign countries to collect additional samples for analysis. A similar program was conducted in the United States in the fall of 1957 and the samples of soil collected at that time are being analyzed.

The AEC has had translated a report of the U.S.S.R. Academy of Science entitled, "On the Behavior of Fission Products in Soil, Their Absorption by Plants and Their Accumulation in Crops." The studies reflected in this report closely parallel those being conducted in the United States.

Strontium 90 monitoring results. Analyses performed at the Health and Safety Laboratory of the New York Operations Office on samples collected in rainfall pots and on milk samples show the following trends in strontium 90 levels:

1. From the beginning of 1957 to the fall of 1957 the cumulative strontium 90 values for the rainfall collection pots in New York, Pittsburgh, and Chicago increased about 10, 6, and 7 millicuries per square mile respectively. By the fall of 1957 the cumulative values for these pots were as follows: New York, 37-39 millicuries per square mile (collection started in February 1954); Pittsburgh, 23 millicuries per square mile (collection started in February 1955); collection in Chicago started in December 1956.
2. Monthly values for dried milk from Perry, New York, for the first eight months of 1957 were between 3 and 4.75 strontium units (micromicrocuries of strontium 90 per gram of calcium). These values are lower than the peak values for 1956.

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3. Values for powdered milk from Mandan, North Dakota, were from 4 to 17 strontium units in the first seven months of 1957. These values correspond to the range of values observed in 1956.

U. S. Public Health Service milk monitoring program. The U. S. Public Health Service, which keeps in close contact with the milk industry, has started a milk monitoring program, similar to the one conducted by the Commission, to keep informed regarding the contamination of milk by radioactive fallout.

Care is being taken to obtain representative samples. Areas with predictable and constant dairy husbandry practices are selected for sampling. Only fluid milk samples are collected; these are composited from small herds and from areas containing a predetermined number of farms. Samples are now being routinely received from areas in California, Missouri, New York, Ohio, and Utah; additional stations are expected to be set up in the next few months. Analytical work is performed at the Public Health Service's Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

The program of the Public Health Service was described to representatives of the AEC and the Food and Drug Administration at a meeting held on December 13, 1957.

Soil and Plant Research

The AEC sponsors a number of research projects on the behavior of fission products in soils and plants. Such behavior is investigated in the field, in the greenhouse, in the growth chamber, and in the laboratory.

Experiments with different soils containing varying amounts of exchangeable calcium (i.e., calcium replaceable by other cations and not fixed in the soil) show that the uptake of strontium by plants decreases somewhat with an increase in the amount of exchangeable calcium present. The same rule was found to apply to barium uptake. The uptake of cesium and rubidium, as would be expected from the periodic table of the elements, was more closely related to the amount of acid-soluble potassium, a commonly used index of available potassium.

A distribution factor, defined as the ratio of strontium to calcium in the plant, or plant part, divided by the ratio of available (to the plant) strontium to available calcium in the soil or nutrient solution, was determined for certain situations. This factor serves as a measure of the relative availability of strontium and calcium, and also can be applied to other pairs of chemically similar elements. The experiments with nutrient solutions yielded an average strontium-calcium distribution factor for the entire plant of slightly above 1, for roots much higher than 1, for stems, petioles, and leaves progressively less than the root values.

The average distribution factor for natural, stable (nonradioactive) strontium versus calcium in wheat and alfalfa for a large number of sites in the United States was about 1. Ten crop plants grown on four soils in a greenhouse experiment had an average value of 0.7 for the same factor.

The effects of liming and tilling on the uptake of strontium 90 from an acid soil were investigated in a field experiment. When four tons of lime per acre were applied to the surface of the soil there was no appreciable change in the ratio of strontium to calcium in either soybean plants or bluegrass. When the same amount of lime was rotary-tilled into the upper six inches of the soil, the uptake of strontium was reduced in soybean plants but not in bluegrass. Burial of both the lime and the strontium to a depth of 15 inches reduced the uptake of strontium by soybeans even more effectively than rotary tilling.

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Experiments have been conducted to find out what happens when strontium is applied to various leaves of a plant. Strontium appears in other aboveground parts of the plant, and measurements can be made of the relative amounts.

The extent to which strontium 90 is fixed (made relatively unavailable to plants) in soils in nonexchangeable forms is under investigation. Samples taken in 1955 of one soil from Ohio exhibited fixation values ranging from zero to 20 percent of the total strontium 90 content. Comparable samples of a different soil collected nearby showed values ranging up to about 10 percent. Incomplete data on soil samples from North Carolina indicate a maximum value of 35 percent, higher than the Ohio values.

A leaching experiment with five soils showed that dilute solutions of calcium salts are much more effective in the leaching of radiostrontium than are sodium salt solutions (common table salt is one sodium salt) or plain water alone. In general, the coarser the soil, the greater the downward movement of strontium when the rate of flow of the water and solutions is not excessive. For neither strontium or cesium, on which experiments were also conducted, is the rate of movement fast enough to suggest leaching with dilute solutions as a rapid method for decontaminating soil.

Experiments with a fine sandy soil show that relatively large amounts of hydrochloric acid applied to the surface of the soil are effective in leaching out strontium. Other chemicals applied in equivalent amounts, ferric chloride, calcium chloride, and strontium chloride, were not so effective, and sulfuric acid, aluminum chloride, and sodium chloride were even less effective. In all cases except hydrochloric acid, an appreciable fraction of the strontium remained in the soil where the chemicals were applied, indicating that some of the strontium had become fixed.

Field studies on soil decontamination have been carried out using some of the chemicals listed above. The chemicals were applied to the soils which were then irrigated with water to a depth of five feet; the distribution of strontium 90 and salt to a depth of three feet was then determined. Hydrochloric acid again was most effective, and ferric chloride also was effective in removing strontium from surface layers. It was concluded that decontamination of soils by any of these treatments would be expensive.

For this reason, physical removal of surface deposits of fission products has been studied. One method involves spraying the soil first with a material to enclose and hold onto the contaminants and surface soil. It was found that 97 percent of the radioactivity could be removed by spraying the soil surface with asphalt emulsion and peeling off the resulting crust. When the crust was mixed throughout the soil, as plowing would do, the strontium 90 eventually became more available to barley plants. In another experiment, the crust was mixed with the top six inches of soil, and the soil was irrigated and planted to barley. At the time of harvest, three months later, it was found that this treatment had effected a 30 percent reduction in strontium uptake as compared with the untreated soil.

RADIOBIOLOGICAL SURVEYS OF THE MARSHALL ISLANDS AND WESTERN PACIFIC

Radiobiological surveys have been made in the Marshall Islands since the initiation of the Pacific testing program in 1946. In March 1954 the fallout on several atolls in the Marshall Islands, including Rongelap, was greater than had occurred from previous tests. For this reason surveys have been made frequently at Rongelap; there were 12 surveys made between March 1954 and July 1957. Determination of the amount of radioactivity and of the radioisotopes present has been made for plants, animals, soils, and water. The results of the findings of the

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first 10 surveys were published in August 1957 in a report entitled, "Radioactive Contamination of Certain Areas in the Pacific Ocean from Nuclear Tests."

The report mentioned above also includes data collected by teams of medical experts who examined and cared for the Marshallese following their exposure in March 1954, and returned to examine the Rongelapese at about six months, one year, and two years after exposure. Another medical reexamination of the Rongelapese was scheduled for February 1958.

Radiobiological surveys have been conducted on many other atolls in the Marshall Islands and also on five islands (Saipan, Guam, Ulithi, Yap, and Palau) which are up to 2,000 miles west of the test site. Four collections were made in the far western Pacific islands between June 1956 and June 1957, and the radiochemical analyses were nearing completion in December 1957.

An ecological survey of Rongelap Atoll was to be initiated in February 1958. Rongelap offers a unique opportunity to study the role of radiation in an environment and its effect upon a community of living organisms. Use will be made of the knowledge gained from previous surveys, but many more surveys will be necessary over the years to obtain information about subtle effects of the introduction of radiation into the environment.

ATOMIC BOMB CASUALTY COMMISSION

A continuing search for delayed radiation effects among the survivors of Hiroshima and Nagasaki is being made by the Atomic Bomb Casualty Commission (ABCC). Radiation-induced abnormalities thus far identified by this group are leukemia, cataracts, and possibly an embryological defect, microcephaly associated with mental retardation. Although there is every reason to believe that some genetic damage was induced by the atomic radiation, it could not be demonstrated in the studies of the ABCC, which were performed over an 8-year period and used data from more than 75,000 offspring. A 241-page report describing this investigative work was published by the National Academy of Sciences and the National Research Council in January 1957.*

The Director in Japan of the ABCC, Dr. Robert H. Holmes, resigned in June 1957. Dr. Holmes contributed greatly to the development of sympathetic relations with the Japanese Government, Japanese medical groups, and the Japanese people in general. His place was taken by Dr. George Darling, Professor of Human Ecology, Yale University.

The most significant development during the past year has been the understanding reached with the Ministry of Health and Welfare of the Japanese Government. Several conferences were held with representatives of the Ministry, and there were continuing informal conversations directed toward the development of a program of mutual interest in which the Ministry would cooperate even more closely than in the past. It has now been agreed that the Ministry of Health and Welfare will sponsor, jointly with ABCC, a unified program for medical study of A-bomb survivors. The program calls for the establishment of a fixed population, extrinsic comparison groups, a morbidity and mortality detection network, and a continuous flow of data from representative patients through the clinics at a rate that would provide for a reexamination every 3 to 5 years. The Ministry, through the Public Sanitation Bureau, will participate actively in the mortality survey, on the design of which agreement has already been reached. The Bureau is ready to cooperate in the proposed morbidity survey when a mutually acceptable plan has been developed.

*"The Effect of Exposure to the Atomic Bomb in Pregnancy Termination in Hiroshima and Nagasaki," by J. B. Neel and W. J. Schull.

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The importance of this agreement to pool the resources of ABCC and of the public health facilities of the Japanese Government in a common enterprise can scarcely be overemphasized. Sources of vital statistics and means of tracing migrants that ABCC alone could not command will now be available to investigators. Advice in the design and conduct of the studies will be freely offered by the leaders in public health in Japan, and the local and national prestige of the program will thereby be enhanced. The studies in Hiroshima and Nagasaki are of international interest; their international repute will undoubtedly grow as it becomes recognized that they are truly a joint enterprise of Japanese and American scientists.

BONE MARROW TRANSPLANTS IN HUMANS

The possibilities of bone marrow transplantation in man and the results of experiments with mice were discussed in the Quarterly Progress Report, April–June 1957. Marrow transplants from another animal of the same species (homologous transplants) have apparently been effective in monkeys as well as mice. Homologous transplants in man have been tried thus far only on a few patients with aplastic anemia, a disease which results in the loss of ability of the marrow to produce new cells; no successful transplants have been reported to date.

The feasibility of bone marrow transplants in humans remains an intriguing problem that is being attacked by a number of scientists in different fields of biology, medicine, and chemistry. A bone marrow conference was held October 10–11, 1957, in Boston, Massachusetts. Another conference was planned for January 11, 1958, in Gatlinburg, Tennessee.

PROCEDURES FOR HANDLING NUCLEAR INCIDENTS

Coordinated organizational plans and operating procedures are being established in preparation for emergency actions to deal with nuclear incidents. A procedure has already been set up through the joint effort of the AEC and the Department of Defense for coping with specific emergency situations that might arise in transporting, storing, and handling nuclear weapons. This capability is being extended to relate to all AEC and licensee incidents, and plans are being made for the training of AEC and other Federal, state, and local groups, such as law enforcement and public health agencies. These plans will provide for the training and equipping of emergency teams and will establish procedures to facilitate their prompt dispatch to the site of an incident. Existing field procedures for handling on-site and off-site incidents are being reviewed to permit the full utilization of existing capabilities in these coordinated plans. (End of UNCLASSIFIED section.)

CIVIL EFFECTS EXERCISE 57-1 [redacted]

A civil effects exercise for radiological assessment and reclamation of contaminated areas was conducted at the Nevada Test Site December 10–11, 1957. An excellent setting for the exercise was provided by the safety shot fired December 9, which deposited fallout on three houses remaining from the 1955 civil effects tests (Operation TEAPOT) amounting to about 50-60 milliroentgens 30 hours after the shot. These structures and contaminated areas were utilized to obtain information on decontamination techniques, and areas with low-level contamination were used for the orientation and training of personnel. (End of [redacted] section.)

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EDUCATION AND TRAINING (UNCLASSIFIED)

On September 19, 1957, the AEC announced the establishment of a program of financial assistance to colleges and universities in acquiring specialized radiation equipment and teaching aids for courses in radiobiology and the use of radioisotopes. Since the initiation of the program, 21 grants have been made: 11 in biology and agriculture; 8 in medicine; and 2 in health physics. The states represented are Alabama, Arkansas, Illinois, Massachusetts, Michigan (4 grants), Missouri, New York (2 grants), North Carolina (3 grants), Ohio, Oklahoma, Pennsylvania, Tennessee (2 grants), Texas, and Washington.

Summer training courses in radiobiology and the use of radioisotopes were given to 101 high school science teachers during the summer of 1957 at 5 universities. An additional 7 colleges and universities will be brought into the program for the summer of 1958; each of the 12 summer institutes will be able to accommodate 20 high school teachers.

It has been tentatively agreed that the School of Public Health of the University of Michigan and the University of Puerto Rico will be designated as alternative centers that may be selected by fellows in the radiological physics fellowship program. Already participating in this program are the University of Kansas, the University of Rochester, Vanderbilt University, and the University of Washington.

Under the joint program with the American Institute of Biological Sciences which provides lecturers in radiobiology to small colleges and universities, scientific personnel from AEC laboratories have visited a number of colleges. A number of requests has been received for lecturers during the spring semester. (End of UNCLASSIFIED section.)

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