16th Semi Annual Report

40054

MAJOR ACTIVITIES

IN THE

ATOMIC ENERGY PROGRAMS

January–July 1954

UNITED STATES
ATOMIC ENERGY COMMISSION
JULY 1954

of considerable theoretical interest because of their bearing on the new Bohr-Mottleson theory of rotational energy levels in nuclei.

The program of this group also involves precision determinations of the physical constants and precision X-ray spectroscopic measurements some of which have a bearing on nuclear physics and some on pure research in the lower energy field.

Neutron and Alpha Sources Available

Neutron and alpha sources made from polonium 210 are offered for sale by the radioisotope sales department of Oak Ridge National Laboratory.[17]

Neutron sources are made by mixing polonium with any of the neutron-yielding elements, principally beryllium, boron, fluorine, and lithium. Certain neutron spectra are now produced by mixing target elements in neutron sources. When spectra determinations now in progress are completed, it will be possible to produce neutron spectra which will conform more closely to desired specifications. The use of neutron sources for starting reactors, calibrating instruments, logging of wells, and in research has increased materially.

Alpha sources are made with or without covers absorbing 10 to 60 percent of the alpha energy. The sources are made to specifications for individual needs in research and industry.

Biology and Medicine

The biology and medicine program of the Commission includes research activities relating to the establishment of control measures against harmful exposure to radiation, and to the utilization of radiation sources. Application of close and careful safeguards to control radiation hazards involves the integration of protective procedures and techniques to safeguard the health of workers and the Nation in case of an emergency. Utilization of atomic energy is directed toward exploration and development of the beneficial effects of radiation in medical, biological, and agricultural studies.

During the current period, progress was reported on studies of the effects of all types of ionizing and nonionizing radiations on man, animals, and living plants. In particular, emphasis was given to the investigation of the relative biological effectiveness of high energy particles as compared with X- and gamma rays. Data are also included on the development and present status of instrumentation re-

[17] Inquiries should be addressed to the U. S. Atomic Energy Commission, Isotopes Division, Post Office Box E, Oak Ridge, Tenn.

search for improved dosimetry and methods of radiation detection and measurement.

Radiation Exposures in Recent Weapons Tests

Prior to the recent weapons tests a danger zone was established surrounding the proving grounds; within this area a hazard from radiation might exist to shipping or aviation. Appropriate notices on the boundaries and the establishment of the danger zone were carried in marine and aviation navigational manuals. Before each shot of the series, a careful survey was made of the winds at all elevations up to many thousands of feet, and survey aircraft searched the area for shipping. The purpose was to take every precaution against radiation exposure of inhabitants of the area, the task-force personnel, and crew or passengers of vessels or aircraft.

During the tests, radiological monitoring teams were set up and the monitoring network of stations as usual was in operation to collect and measure fall-out—radioactive particles from the explosion descending to the lower atmosphere, the sea, or the earth. Measurements were made of airborne, ground, and water activity. The only fall-out of consequence was that which followed the first detonation of March 1, when a shift of the winds occurring after the detonation carried radioactive particles toward the islands of Rongelap, Rongerik, and Utirik. Thirty-one American test personnel, and 236 Marshallese were exposed to radiation. A Japanese fishing trawler, the *Fukuryu Maru* (Fortunate Dragon) was also in the path of fall-out.

Evacuation of Test Personnel

The 31 Air Force, Army, and Navy test personnel were evacuated to Kwajalein for physical examinations and observations. None of the men experienced any symptoms of radiation illness, and medical observations to date do not indicate that any permanent harm has resulted. All of the men included in this group were returned to military duty following complete physical examinations at Tripler General Hospital, Honolulu, T. H.

Inhabitants of Marshall Islands

The Marshallese from the islands of Rongelap and Utirik within the area of fall-out following the first detonation were evacuated promptly by the Task Force to Kwajalein. It was found that of the 236 evacuated, 74, all from Rongelap, experienced radiation burns, principally

on the scalp or the neck. These burns are now almost completely healed. Hair from the heads of about 39 of these had fallen out in patches. However, normal hair regrowth is taking place. Urinalysis tests for radioactivity indicated that the exposed persons had inhaled or ingested small amounts of fission products. Preliminary data show that in no case did the body burden for the various radioactive isotopes exceed the permissible limits.

Every possible effort was made to provide for the immediate comfort and well-being of the Marshallese at Kwajalein. Routine sick call and medication, physical examinations, and serial blood counts were continued throughout their stay. The medical observations to date indicate that there is no reason to expect any permanent after effects on the general health of these people. The residents of Utirik have returned to their homes. The Rongelap residents were moved to Majuro Atoll for temporary occupation of dwellings built for them. These are of a new and improved type, better adapted to the comfort and the needs of the people than the usual type of island houses. It is expected that occupation of Majuro will be for approximately 6 months to a year, after which the natives can be reestablished on their original homesites in their new-type homes which will be moved from Majuro. During their temporary occupation, they are being furnished with livestock, provisions, and other supplies in order to maintain living standards at least equivalent to those prior to their initial evacuation from Rongelap.

Japanese Vessel Exposed to Fall-out

The Japanese fishing vessel, *Fukuryu Maru,* was reported by its captain as being located at approximately 50 miles northwest of Rongelap Island (11° 53¼′ North latitude and 166° 35¼′ East longitude) at the time of fall-out in that area. Following return of the ship to Japan on March 14, a report by the Japanese authorities stated the crew members were ill and showed skin burns from radiation. Japanese physicians gave the crew members medical treatment. Medical assistance was offered the Japanese by the United States through the American Embassy at Tokyo. The Japanese have not yet called for such assistance. However, they did request United States aid in making chemical analyses of some urine samples. These were performed at Commission laboratories. The injured men are reported by the Japanese physicians to be improving satisfactorily.

It is regretted that the crewmen of the *Fukuryu Maru* were injured as the result of being exposed to radiation from the first detonation of the recently concluded series. The welfare of the patients will continue to be of interest to the United States, and the negotiations for settle-

ment of this incident are being handled through the Department of State and the American Embassy in Tokyo. In this connection Ambassador Allison informed the Japanese Government that the United States would pay just compensation and also would reimburse the injured fishermen for reasonable expenses for current medical care and family relief, including wages.

Reports on Contaminated Tuna Fish

Fish aboard the *Fukuryu Maru* were reported by the Japanese press to be grossly contaminated with radioactive materials. Quantitative data on the degree of contamination are few. It appears probable that observed contamination consisted largely of radioactive materials on the exterior surfaces of the fish from contact with fall-out material on the ship. United States representatives in Japan were not afforded an opportunity to verify the fact or the degree of radioactivity reported for this or later for other cargoes.

Subsequent to the return of the *Fukuryu Maru*, a number of other Japanese fishing vessels and their cargo were reported to involve sufficient radioactivity to require destruction of the fish. In one instance a single specimen fish was made available for study. Analysis of this specimen at an AEC laboratory showed the radioactivity of the edible portions to be well within acceptable limits for food and water for continuous use by humans.

The amount of activity in Bikini and Eniwetok lagoons would make it unwise to eat fish from these areas, at least for the present, without having them monitored prior to human consumption. Information presently available indicates that the fish in the lagoons of Rongelap, Rongerik, and Utirik are suitable for consumption. The activity in the lagoons other than Bikini and Eniwetok and in the open sea is so small that no deleterious effects may be expected to the fish themselves nor will the edibility of the fish be impaired.

Informed scientific opinion, borne out by recent continuous monitoring by the Federal Food and Drug Administration of tuna fish coming to the west coast from the Pacific fishing grounds, and further supported by several years' results of AEC marine biological studies, provides no basis for alarm as to the consumption of tuna caught in the Pacific.

Fall-out in the United States

Following nuclear detonations, radioactive debris is distributed by normal air currents over large areas and with sufficiently sensitive instruments may be found to encircle the globe. Small amounts were

deposited widely over the United States during the Pacific tests and in some areas resulted in transitory rises of the normal background radiation levels.

Transportation of the radioactive materials to the United States took only several days. Thus some of the shorter half-life radioisotopes, such as iodine 131 (8-day half-life), were still present in the fall-out. Although the amounts of radioactivity deposited were biologically insignificant, it was possible, by special techniques, to demonstrate radioiodine in the thyroid glands and in the urine of grazing animals. Extremely minute quantities of iodine 131 were also detectable in the urine of some humans for a short time.

The radioactive isotopes to be found normally in the body are potassium 40, carbon 14 and radium 226. The radiopotassium and radiocarbon are distributed throughout the tissues while the radium is almost entirely located in the skeleton. In addition to this internal irradiation, man is subjected to cosmic rays from without and to the gamma rays from radium in the soil. To this natural exposure, the radiation from bomb products is added. The point of interest in terms of health lies not in the mere presence of radioisotopes, but in the amounts and more specifically in the quantity of radiation doses delivered by these radioisotopes. The levels of activity from fall-out, outside the area surrounding the Pacific Proving Ground, have been far less than any required to produce detectable injury either from the radioisotopes within the body or from external radiation, or from a combination of the two.

Civil Defense

In its cooperative program to furnish technical advice and information relating to national civil defense preparedness, the Commission participated in a number of special meetings and discussions. A White House Conference for State Governors, arranged by the Federal Civil Defense Administration included an address by Chairman Strauss outlining AEC civil defense activities common to the national security program. Sessions were held with staff members of FCDA and the Department of Defense to determine current needs of FCDA and the feasibility of future civil defense experiments during test operations.

The AEC expressed a willingness to cooperate in all ways possible in a civil effects test program comprising: Structures and associated services and equipment; industrial participation; civil defense training exercise; and observers and public media participation. Proposals have been submitted on certain parts of the total program by FCDA. These are being reviewed for feasibility pending official action on

future AEC developmental tests. Staff members also reviewed design criteria for protection construction standards to be released by FCDA to guide Federal agencies and the public in erecting structures in or near designated target areas. Assistance was also given to the Bureau of Ships, Department of the Navy, on design criteria and materials necessary for construction of adequate shelters. A classified briefing was held for the Civil Defense Committee of the Life Insurance Association of America to acquaint them with the responsibilities of civil defense.

Emergency Radiation Monitoring Teams

Pending establishment of civil defense organizations with definite assigned functions for radiological defense, the Commission acted in 1949 to establish emergency radiation monitoring teams in about 20 locations throughout the United States, to operate under the jurisdiction of 5 AEC operations offices. These teams were composed of AEC and contractor personnel experienced in radiation detection work at atomic energy installations, and stood ready to monitor any radioactivity resulting from enemy attack or disaster, using radiation detection instruments stockpiled by the Commission.

In the period since establishing this emergency monitoring network, civil defense organization and training have made appreciable strides forward, with the result that on January 4, 1954, after consultation with the Federal Civil Defense Administration, the AEC teams were relieved of responsibility for civil defense radiological monitoring operations. AEC continues to serve as scientific and technical adviser to FCDA and to State and local civil defense bodies in this area and wherever AEC experience and competence apply.

Also, AEC continues to make available, on a loan basis, radiation detection instruments and certain radioisotopes for civil defense radiological training use by States and cities, upon endorsement of their applications by the FCDA. Loans to the following were made in the current 6 months period: Texas and Arkansas—instruments; Florida and Texas—radioisotopes.

Dissemination of Information from Civil Effects Tests

Information compiled from weapons test reports of the spring 1953 series at the Nevada Proving Ground was issued as public information by FCDA. It includes data on air-zero locators, identification tags, typical frame residences, and home shelters.

The genetics experiments in the spring 1953 test series were of particular scientific interest. Unclassified extracts from the weapons test reports were given at several scientific meetings, and 14 articles on

803584—54——5

the results of the exposures of genetic materials to nuclear radiation were reviewed for publication in scientific journals.

Declassification of Operation IVY Film

The declassification and public release of "Operation IVY"—the official film of the test of a thermonuclear device at the Pacific Proving Ground in 1952—was a major contribution to national civil defense.

Research Investigations

Increased emphasis continued to be given to integrated research studies on various types of radiation, providing data on the effects of radiation on biological systems. Particular attention was centered on the biological effects of neutrons. These effects are more difficult to study, and consequently, less well-known than those of X- and gamma rays. This is true because it is difficult to produce neutron irradiation without significant exposure to other types of radiation, and because of difficulties of measurement of neutron dose in the presence of other types of radiation. Neutron effects are important not only in research applications, as discussed here, but to the weapons development program and in civil defense activities.

Somatic Mutation Program

Studies at Brookhaven National Laboratory of the effects of radiation on plant growth and reproduction utilize both gamma and neutron sources developed in the reactor. Under the somatic mutation program, a cobalt source is used for experiments in a "gamma field" where plants of several varieties are planted in concentric circles at various distances from the center in order to receive varying radiation exposures throughout the growing season. This program, started in 1952 on a small scale, was expanded recently with the major agricultural experiment stations in the East cooperating in the project. The objective is to test the feasibility of producing useful mutations by means of ionizing radiations in plants, shrubs, and trees normally propagated asexually.

The experiment stations select the material to be treated, and after irradiation at Brookhaven Laboratory, any mutations produced are screened at the originating station for usefulness. Most of the material sent in is grown in the "gamma field" and careful observations are made of the effects produced. Continuous radiation upsets the normal growth of the plants, and it appears that each variety responds

in a different way. At certain dosage rates, some plants grow more rapidly. The leaves of others grow in peculiar ways, and the coloring of some flowers changes. Many mutations are produced and careful analyses are made both for fundamental causes and in searches for useful new varieties. It is hoped that this research may supply positive answers concerning the usefulness of radiation as a tool in plant breeding in the near future.

In addition to the cobalt source, the Brookhaven National Laboratory is making use of thermal neutron facility for mutation production in plants. It was shown that thermal neutrons are more effective in producing mutations than other forms of radiation. Also, it is becoming clear from other studies that radiation damage to biological material from neutrons is produced by quite a different mechanism from that which occurs following X-ray or gamma irradiation.

Recent work with neutrons led to findings on inducing disease resistance in plants. Rust diseases bring annual losses of millions of dollars to the oat crop—the Nation's third largest cereal crop (after corn and wheat). 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. Seeds from the few uninfected plants were taken and planted in the fall. Resultant plants were inoculated with the rust disease but continued to show resistance against it. As far as is known, the new strains have all the desirable characteristics of the original Mohawk variety, including high yield. Further experiments to determine applicability to other varieties and crops will continue.

Radiation Effects on Tobacco and Potato Plants

Experiments in the Brookhaven "gamma field" [18] also included radiation of a species of tobacco plants. Results showed that irradiation produced a moderately high rate of induced tumors. The tumor-induction rate at fairly high dosages (300 roentgens, *r*, per day) in the gamma field was greatly increased over the control lot, not only in numbers of tumors per plant but in size of individual tumors. The significance of this response is not yet understood. However, it is the first report of a tumor in plants induced by gamma radiation, although radiation-induced tumors have been recognized in animals for many years.

[18] See pp. 75-80, 11th Semiannual Report.