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UNITED STATES
ATOMIC ENERGY COMMISSION

Biology and Medicine

Recent progress in biological and medical sciences as related to atomic energy were reported at the United Nations Second International Conference on the Peaceful Uses of Atomic Energy, and abstracts of United States papers presented orally are given in Appendix 13 of this report. The year's activities in areas of special interest to industry are described in Chapter VI, Part One.

BROOKHAVEN MEDICAL RESEARCH REACTOR

The Brookhaven Medical Center at Brookhaven National Laboratory with its Medical Research Reactor⁵ was dedicated December 16.

Commissioners Willard F. Libby and John F. Floberg addressed the guests at the ceremony. Shields Warren, Pathologist at New England Deaconess Hospital and Professor of Pathology, Harvard University Medical School, who was the first Director of the Commission's Division of Biology and Medicine, delivered the dedicatory address.

The newly completed Center, under construction for two years, includes a tank-type reactor, a 48-bed hospital, laboratories for studies in biochemistry, medical physics, microbiology, pathology, and physiology. The reactor, the first to be designed for medical research purposes was 99 percent complete, and final work on the reactor building was completed as of December 31. The reactor is scheduled to go critical early in 1959 and, later in the year, will be ready for use with patients.

SAFETY AT WEAPONS TESTS

Operation Hardtack; Pacific Phase

During the Pacific phase of Operation *Hardtack* at the Eniwetok Proving Ground, the health and safety precautions⁶ taken were successful in limiting exposures to planned limits.

Radiation exposures. The highest off-site whole body radiation exposure resulting from fallout caused by Operation *Hardtack* detonations was at Rongelap Atoll but the total dose there from all *Hardtack* tests will be less than one-half roentgen (0.5r). Except for a few cases where the need to collect data justified acceptance of somewhat higher doses, exposures of Joint Task Force personnel were within

⁵ See pp. 158-159, Twenty-fourth Semiannual Report to Congress (January-June 1958).

⁶ See Appendix 10, Twenty-fourth Semiannual Report to Congress (January-June 1958).

the maximum permissible exposure of 5 *r* for the operation. The highest individual exposure for specific personnel authorized additional exposure was 12.4 *r*.

During the tests, two Japanese International Geophysical Year ships reported contamination from fallout and sickness among the ships' crews while cruising near the Island of Truk. A medical team dispatched by the Joint Task Force to examine personnel and ships confirmed earlier reports by Japanese scientists that the maximum exposure might have been about 100 milliroentgens, and probably was nearer 20 milliroentgens. The medical team reported no evidence that any crew member suffered from radiation exposure.

Radiobiological surveys of the Pacific. Results of surveys during the Pacific tests to monitor radioactivity in water and marine organisms included the following activities and findings:

A post-operation marine radiobiological survey was conducted before the danger area was disestablished.

A similar marine survey was conducted from Eniwetok Atoll to Guam and return during September. Sea water and plankton samples obtained during this survey indicated radioactivity levels of the same order of magnitude as that during a similar post-test survey in 1956.

By the end of September numerous samples of tuna had been sent to the Laboratory of Radiation Biology, University of Washington, for counting and analysis. Catches were made in the Western Pacific in an area about equal to the size of the United States surrounding the Pacific Test Site restricted zone. Counting of the first half of these samples has been completed. The little radioactivity found can be accounted for almost entirely by the naturally occurring radioisotope potassium 40.

Rongelap ecological studies. The first phase of a long-term ecological survey of Rongelap Atoll in the Marshall Islands was carried out during February and March and again in the July-December period. Initial studies were made of various types of soil and the distribution of radioactive materials in soils, plants, and ground water. Reconnaissance surveys of Rongelap, Eniaetok, and Kabelle Islands, were followed by detailed examination of soil profiles, collection of samples of soil, fish, corals, rats, birds, plankton, and some invertebrates. The Rongelap ecology study includes monitoring of foodstuffs.

Medical Re-examination of the Rongelap People

At the latest in a series of medical examinations given the people of Rongelap Atoll (February-March 1958) during the 4 years after

their accidental exposure to fallout from a March 1, 1954, test,⁷ the people were found to be generally in good health and their nutrition was satisfactory.

A few residual changes from beta burns still were apparent in the skins of some people. Otherwise, there has been no outward evidence of any radiation effects. There have been no symptoms or diseases related to radiation effects. Incidence of diseases was about the same as in unirradiated Marshallese people. The children are growing and developing at rates consistent with off-island controls.

No long-term effects of radiation have been observed. Body burdens of certain radioisotopes apparently are well below accepted tolerance levels.

Three deaths have occurred in the irradiated group, but were not associated with radiation effects. This death rate appears to be about the same as in the unexposed Marshallese people.

Operation Hardtack: Nevada Phase

Operation *Hardtack Phase II* was conducted at the Nevada Test Site, August 25–October 31, 1958.

Preliminary data on external gamma radiation exposures in communities around the Nevada Test Site resulting from nuclear weapons tests in the *Hardtack-Phase II* series do not substantially change the figures reported in the *Plumbbob* series,⁸ since the estimated highest exposure was less than 0.1 roentgen. A complete summarization of all these data will be made when the evaluations are completed.

The highest concentration of airborne radioactivity measured off-site during *Hardtack-Phase II* was about 8.4×10^{-2} microcuries per cubic meter averaged over a 24 hour period at Lathrop Wells, Nev. Relatively high concentrations also were observed during the following week. The principal point of health in evaluating such concentrations in the air is the potential radiation doses to the lungs. The best estimates are that the total radiation dose to the lungs from inhalation of radioactive debris at Lathrop Wells would not exceed that received every few weeks from naturally occurring radioactive substances in the air. Since several nuclear detonations occurred in this period of time, it is not possible to state the exact contributions each detonation made to the observed concentrations in the air.

The highest fission product radioactivity measured in a water supply was at Reed, Nev., amounting to 8.9×10^{-7} microcuries per

⁷ Earliest examinations were made at 6 months, 1 year, 2 years, and 3 years after their exposure and the reports have been published. See pp. 132-135, Twenty-second Semiannual Report (January–June 1957).

⁸ See pp. 281-284, Twenty-third Semiannual Report to Congress (July–December 1957).

milliliter. It is difficult to give a precise evaluation to these data since the activity was a result of fallout from more than one detonation and thus was representative of mixed fission products of different ages. Prior to *Hardtack-Phase II* all the measurements of activity in water supplies (including Reed, Nev.) were less than 1×10^{-7} microcuries per milliliter. The major portion of the highest activity measured resulted from fallout produced during the fall 1958 tests. Since this activity was the result of relatively fresh fission products containing short-lived isotopes, the water was deemed safe for consumption for a lifetime.

Civil Effects Test Operations

During Operation *Hardtack, Phase II*, conducted at the Nevada Test Site, Civil Effects Test Operations were divided into two major groups. Under the *Civil Effects Test Group (CETG)* there were three programs.

The first program continued engineering studies on the effects of blast on structures and measurements of radiation attenuation. Existing structures were tested and actual performance data were provided for design and construction of future structures.

Under the second program, aerial monitoring was used for measuring radioactive contamination around the site. Pre-series and post-series fallout data were collected to provide a base line for measuring contamination that might result should any other tests be held in the future.

The third program conducted by Oak Ridge National Laboratory continued measurements of the angular distribution of prompt gamma and neutron radiation and tested the shielding characteristics of light frame houses. Seven houses were constructed and used in three shots. These data are expected to advance the combined Oak Ridge National Laboratory-Atomic Bomb Casualty Commission program for determining dose to populations exposed to atomic detonations.⁹

Under the *Office of Civil and Defense Mobilization*—formerly Federal Civil Defense Administration and the Office of Defense Mobilization—there were five projects: (a) testing pre-production models of an airborne radiation detector for civil defense developed by the Commission's Health and Safety Laboratory; (b) obtaining data on effect of blast on civil defense shelters; (c) re-testing anti-blast valves tested during Operation *Plumbbob*; (d) obtaining data on attenuation of radiation by Nevada soil; and (e) air blast phenomena in tunnels.

⁹ See pp. 285-286, Twenty-third Semiannual Report to Congress (July-December 1957).

STUDIES OF FALLOUT

Special Report on Worldwide Fallout

A report entitled "Environmental Contamination from Weapons Tests," HASL-42, prepared by the Commission's Health and Safety Laboratory was issued in October.¹⁰ This report assembles in one document data on deposition and uptake of fallout since systematic monitoring and sample collection was begun. The report updates the information presented in May and June 1957 before the Subcommittee on Radiation of the Joint Committee on Atomic Energy.¹¹

Gummed film data, human bone data, and surface air monitoring are summarized or referenced only. These data comprise many thousands of sample analyses and are available in detail upon request.

Biological Hazards From Carbon 14

Carbon 14, a radioactive isotope of the element existing naturally in the atmosphere as a result of cosmic ray bombardment of nitrogen in the air, also is generated by nuclear detonations. Carbon 14 emits low energy beta particles (0.05 Mev average) and has a half life of about 5,600 years. It mixes with other naturally occurring isotopes of carbon in the atmosphere and is incorporated in organic and living materials.

Estimates of radiation doses to populations, both present and future, from carbon 14 produced by weapons tests have been made, taking into consideration both the characteristics of the weapons tested and the observed increase of carbon 14 in the atmosphere. The subject has been discussed in certain speeches¹² by Commissioner Willard F. Libby and in a paper¹³ prepared by Commission staff members.

Physical Research

Results of physical research programs were reported at the United Nations Second International Conference on the Peaceful Applications of Atomic Energy. Abstracts of United States papers presented

¹⁰ Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., \$3.50.

¹¹ Hearings on "The Nature of Radioactive Fallout and its Effects on Man" before the Subcommittee on Radiation of the Joint Committee on Atomic Energy, May-June 1957.

¹² "Radioactive Fallout," W. F. Libby, Swiss Academy of Medical Sciences Symposium on Radioactive Fallout, Lausanne, Switzerland, March 27, 1958 and "Carbon 14 from Bomb Tests" W. F. Libby, Statement before the Washington Chapter, Federation of American Scientists, Washington, D. C., May 1, 1958.

¹³ "The Biological Hazard to Man of Carbon 14 from Nuclear Weapons," WASH-1008, J. R. Totter, M. R. Zelle, and H. Hollister, Division of Biology and Medicine, AEC, Washington, D. C. Available from Office of Technical Services, U. S. Department of Commerce, \$3.50.

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