

EXCERPTS FROM AEC SEMIANNUAL REPORTS

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Military Application

Immediately following Operation CASTLE, the test series held at the AEC's Pacific Proving Ground in the spring of 1954, the weapons program was directed toward development of weapons whose design was based on results of those tests. During the first 6 months of 1955, weapons produced in accordance with the President's directive included types incorporating such designs.

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Operation WIGWAG

In addition to Operation SAPOD, a joint AEC-Department of Defense test (Operation WIGWAG) was conducted in the Eastern Pacific ocean in mid-May. The principal purpose of the test was to study effects of a deep underwater detonation. The Commission participated in the test by furnishing the device, assisting in its final assembly and placement, and conducting diagnostic measurements. As forecast, indications are that the test involved no health hazard to mainland or island inhabitants or consumers of fish.

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Biological Studies of Coral Reef Communities

Studies are being made at the United States Marine Biological Laboratory of the effects of nuclear contamination on coral reef communities and ecological systems in the Central Pacific Island area. In a recent test operation, the laboratory, recently established by the Commission, is located within the Hawaiian Islands. The study area is a small, shallow lagoon, approximately 20 acres in extent. Many of the corals are covered with tropical vegetation and possess a high degree of excellent growth and growth for biological studies. Work completed in 1954 on the biological aspects of the study area is being reported to the University of Georgia, which is conducting a study on coral reef communities.

Coral reefs represent the ultimate in stable natural communities with millions of thousands of plants and animals dependent on these reefs. The effects of radiation on these reefs cannot be evaluated unless the structure and function

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under normal conditions are known. Thus, the initial work included experimental assaying methods in order to measure the "basal metabolism" and the overall trophic or "food-chain" structure of a coral reef community as a whole not affected by nuclear explosions. This was similar to assaying the metabolism of animals or humans under normal conditions. For example, it was found that a healthy Eniwetok reef had a production rate of about 74,000 pounds of glucose (a sugar) per acre per year. This exceeds man's best agricultural efforts in most parts of the world. The critical assay methods devised can be completed in a few weeks. The significant changes in this measurable "basal community production rate" can readily be observed if important effects are produced.

These assays revealed that corals and the algae growing in the skeleton of the coral colony live together to their mutual advantage (symbiosis). Although observations of skeletal algae were made previously, this is the first study to determine quantitatively the amount of algae present in different species of corals. A very definite ratio between algal (plant) and coral (animal) tissue was found. The amount of plant tissue was greater than the amount of animal tissue per unit of surface area. This marked development of symbiosis between plant and animal components achieves excellent "conservation" and cyclic use and reuse of critical nutrients. This enables the coral reef to achieve a high rate of productivity in waters which in themselves have a very low fertility.

These results are significant in physiological applications to other plants and animals which man requires for food. They provide a fertile field for scientific study of nuclear radiation effects on the "metabolism" of highly integrated systems.

The biological assays will be extended for related research investigations carried on by the AEC. College or university biologists, and the Commission contractors interested in radiological data of this type are invited to participate, using the facilities of the Marine Biological Laboratory.

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. The eyebrows are now about 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 care 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 effect on the general health of these people. The residents of Utrik 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 huts. It is expected that occupation of Majuro will be for approximately 6 months to a year, after which the natives can be re-established 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 Fallout

The Japanese fishing vessel, *Fukuyo Maru*, was reported by its captain as being located at approximately 50 miles northwest of Rongelap Island (11° 53' N. latitude and 166° 35' E. 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 that the United States aid in making chemical analyses of some urine samples. These were performed at Government laboratories. The injured man reported by the Japanese physicians to be improving satisfactorily.

It is regretted that the crewmen of the *Fukuyo 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-

most of this incident are being handled through the Department of State and the American Embassy in Tokyo. In a conversation 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 Rongerik, Rongerik, and Utrik 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 effect 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 alarms 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 structural 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