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QUARTERLY PROGRESS REPORT

to the
JOINT
COMMITTEE
on ATOMIC
ENERGY

Excerpt

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Part VII

Biology and Medicine

TOXICOLOGICAL INFORMATION CENTER (UNCLASSIFIED)

Problems of toxicity of both radioactive and nonradioactive materials have arisen repeatedly within the operations of the Atomic Energy Commission and its contractors. Requests for information on items of toxicology are often made of the headquarters office. In order to obtain assistance and provide for an orderly handling of the requests, the AEC entered into a contract with the Toxicological Information Center, which was recently established in Washington, D. C., within the National Research Council. The center is sponsored by the three armed forces and the AEC. Its function is to collect and correlate information and advise only its sponsors in matters of toxicology.

REPATRIATION OF THE RONGELAPESE

On June 29, the Rongelap people returned to their home island in the Marshall Islands. As a result of a number of radiological surveys since the March 1954 detonation in the Pacific, it was determined that levels of radioactivity had decreased to the point where it was safe for the people to live on their home atoll again. Preceding their return, rehabilitation of the island was completed. This included restoration or construction of houses and cleanup of the water supply system.

PROJECT SUNSHINE

The distribution of radioactive fallout is being studied by a stratospheric sampling program and by a worldwide system of open pots which are measured monthly for strontium 90 content. The soil analysis program continues as does the gummed paper program, though less weight is being attached to results from the latter.

On the human side, marked advances in an understanding of the distribution of strontium 90 and cesium 137 in the human body and the variation from one individual to another are being made through a program of whole-skeleton analysis in the New York City area.

Fallout testimony was given, May 27–June 7, in hearings before the Subcommittee on Radiation of the Joint Committee on Atomic Energy.

Systematic collection of samples of food from foreign countries was continued under the program of the Interdepartmental Committee on Nutrition for National Defense in which the AEC is participating. Data are being obtained on the principal sources of calcium in the typical diet of each country and the average calcium and strontium 90 content of the foods collected in

an effort to determine the extent to which strontium 90 is likely to be ingested by the human population. Samples have been obtained thus far from the Philippines and Turkey, and a team in Libya will collect samples from that country. Plans were under way to expand the program into a number of Latin American countries, and initial contacts were made with officials concerned with nutrition. An AEC representative will visit these Latin American countries during the summer of 1957 to discuss the program and enlist needed participation.

MOUSE GENETICS

A conference on mouse genetics sponsored by the British Medical Research Council was held at Harwell on April 26 to ensure that similar studies of radiation-induced mutations at specific loci in mice being carried out by the United Kingdom and the United States do not overlap but complement one another. The conference was attended by the principal geneticists of the Harwell project and three geneticists prominent in the AEC program.

The results of studies made at the Oak Ridge National Laboratory by Russell and at Harwell by Carter were compared, and the following significant statistics reported:

Investigator	Exposure (roentgens)	Number of Mice	Number of Mutations	Mutation rate per locus ($\times 10^{-6}$)	Induced mutations per locus per roentgen ($\times 10^{-6}$)
Carter (U.K.)	0	63,116	4	9.1	-
Russell (U.S.)	0	164,687	7	6.0	-
Combined	0	227,803	11	6.9	-
Carter (U.K.)	37.5	34,998	4	16.3	25.7
Russell (U.S.)	300	37,189	23	88.3	27.1
Russell (U.S.)	600	72,472	75	147.9	23.5
Russell (U.S.)	1,000	31,816	21	94.3	8.7

NOTE: The apparent drop in the induced mutation rate when the exposure is increased from 600 to 1,000 roentgens is caused by a substantial increase in the death rate at the higher exposure.

The technique used in both the Carter and Russell studies is based on (1) the fact that most mutations are recessive, that is, they must be inherited from both parents to produce a visible effect on the individual, and (2) a "specific locus" test, which was devised to detect such recessive mutations in offspring.

A stock of mice was built up to be pure recessive for seven different mutant genes, each one producing a visible characteristic such as short ears, dilute hair color, or white spotting. Females of this stock were mated to males with all normal genes but which had been irradiated (or not irradiated in the control series). In the resulting offspring a recessive trait of the mother appeared only if there had been a mutation of exactly the same kind in the father's germ cells (i.e., at the same locus in the chromosome) as that responsible for the trait in the mother.

The principal conclusions of the conference were that: (1) mutation rates recorded at Harwell and at Oak Ridge were in agreement as far as the studies went, and (2) studies at exposures between 37.5 and 300 roentgens are needed to bridge the gap between the Harwell and Oak Ridge studies. A similar conference at the Oak Ridge National Laboratory is planned for the summer of 1958, following the Genetics Congress in Montreal.

STATUS OF TREATMENT OR IRRADIATION INJURY

The possibility has recently developed that a more effective treatment can be worked out for persons exposed to doses of radiation in the 200- to 600-roentgen range.

When it was found that irradiated mice could be saved by the introduction of material from the spleen or bone marrow, it was first believed that simple extractives or perhaps pure chemical substances could be found that would modify the lethal course of the radiation syndrome. This idea has not been completely abandoned, but emphasis has shifted to transplantation of the progenitors of the cellular elements of the blood which will grow in the irradiated animal and tide him over the period when the functioning of his own bone marrow is depressed.

Severe depression amounting to failure of blood formation in the bone marrow is responsible for most of the deaths which occur in animals some 7 to 30 days after exposure. Ordinarily, tissues transplanted from one individual to another of the same but not inbred strain, and even more definitely to another individual of a different strain or species, are rejected and destroyed by the recipient. In the animal which has been given a lethal dose of radiation, however, this immune reaction is more or less lost, so that transplants of bone marrow become a novel possibility with practical applications in man.

Experimental work has shown that the irradiated animal will accept bone marrow transplants from different strains and species, but the transplant becomes increasingly less successful the greater the phylogenetic difference between the donor and the recipient. Thus, it is found that the irradiated mouse will readily accept marrow from all other mice, but the transplant of rat marrow is less certain, and dog or human marrow apparently fails to take permanently. Conversely, the greater the genetic similarity between the donor and the recipient, the lower the dose of radiation needed for a successful bone marrow transplant. Prior to this discovery concerning the effects of radiation on transplants, it was the generally accepted belief that transplants in man are possible only between identical tissues.

These marrow transplants are not merely stopgaps, for it has been shown in a number of ways that the transplanted cells continue to live and function in the recipient. For example, some irradiated mice which have received rat bone marrow have recovered from the radiation syndrome and then continue to live out their life span, but with circulating blood cells which were all definitely those of the rat; in some instances the mouse's own marrow will recover sufficiently to suppress the rat cells completely; in others the mouse will have circulating blood cells of both species.

Problems in methods of securing, handling, storing, and preserving marrow are largely technical, and their satisfactory solution can be anticipated with a fair degree of confidence. On the other hand, it is evident from these new findings that knowledge of immunology and the general field of tissue transplantation is deficient.

Knowledge concerning the immune relationships between lower animals is of definite value in establishing the patterns to be studied and explored in developing a practical clinical application of marrow transplantation. Idiotransplants are presently feasible; such a transplant

involves the removal of some marrow from a person, temporarily storing it, and then reinfusing it in the same person. Development of the full scope of marrow transplants into man necessarily will be slow, because the science of human tissue immunology must be further developed, and human material suitable for study is scarce.

The exciting possibilities of marrow transplantation in man have already reestablished interest and research in this field. One result that can be expected is the development of therapeutic procedures which may be useful in several types of blood diseases. Other discoveries made as a result of current and future research in this field will be even more significant.

To this end, the Commission is supporting an estimated 90 percent of the work going on in bone marrow transplantation, and both on-site and off-site laboratories are actively engaged in experimental and clinical research.

SYMPOSIUM ON USE OF RADIOISOTOPES IN MARINE BIOLOGICAL RESEARCH

The Commission, at the invitation of the Italian Committee on Nuclear Research (AEC's counterpart in Italy), will participate in a workship symposium September 15 to 29. The conference will be held at the Naples Zoological Station, one of the foremost of its kind in the world.

Present plans call for seven AEC scientists actively engaged in radiobiological work with aquatic organisms and seven European scientists to give lectures, classroom demonstrations, and laboratory exercises to 20 graduate students. The topics to be covered include: (1) the use of radioisotopes in studies of the foods and feeding activities of marine animals, (2) the determination of oceanic primary productivity using carbon 14 tracer techniques, (3) tritium in biology and hydrobiology, and (4) the movement of radiophosphorus in aquatic communities. Equipment taken to Naples by the participating AEC scientists for the laboratory work will be left at the zoological station on indefinite loan. (End of UNCLASSIFIED section.)

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