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Part VII

Biology and Medicine

FALLOUT FROM ATOMIC DETONATIONS [REDACTED]

The Commission's studies of the fallout problem are in two general categories. The first, called Project Sunshine, is concerned with the long-term secondary fallout effects on people in all parts of the world as a result of the uptake of radioactive strontium 90 from the environment by animals and human beings. The second category involves the serious immediate effects which may result from heavy fallout directly downwind from a near-surface burst. These latter effects are of primary concern in civil defense and military planning.

Project Sunshine

The collection of samples. The long-term hazard of fallout has been studied for seven years. In the last two years a more intensive effort has been made to measure the movement of radioactive strontium from the detonation to fallout, to the soil, to plants, and then to animals and humans. With the help of the Departments of State and Agriculture, samples of soils, plants, and bones of animals and humans have been collected on a classified basis. Approximately 800 samples have been analyzed for strontium 90 and calcium content by the Enrico Fermi Institute of Nuclear Studies at the University of Chicago, by the Lamont Geological Observatory of Columbia University, and by the Commission's New York Health and Safety Laboratory.

Collections of samples are continuing through private arrangements on an unclassified basis from about ten sources in North America and Hawaii, four each in South America, Europe, and Asia, and two in Africa. About 700 samples are now on hand and undergoing analysis and new samples are received at a rate of about 100 per month. The analyses are being performed by the above-mentioned laboratories, by Isotopes, Inc., of New York, and by the Nuclear Engineering and Research Corporation of Pittsburgh. These laboratories have cooperated closely in developing suitable techniques for this precision work.

Sample analysis and experiments. To determine the pattern of strontium transfer, several factors have been considered in the selection of samples:

1. The samples have been collected in groups, each group containing samples of soils, plants, and animal and human bones from the same locality.
 2. Groups of samples have been collected from all parts of the world in order to measure the variation in the amount of fallout.
 3. Groups of samples have been taken from areas having markedly different dietary patterns to determine the significance of fallout in terms of human absorption.
- [REDACTED]

The real significance of absorption as a human hazard (in shortening life or producing bone tumors, for example) can now be only inferred from accessory information, but long-term experiments with animals are being devised to provide more positive data. The research projects with dogs (as relatively long-lived animals) at Argonne National Laboratory and the University of Utah are being extended. A new experiment on the effects of life-long ingestion of low levels of strontium activity by several hundred dogs has been planned at the University of California at Davis, and some experiments with monkeys may be conducted at the University of Rochester. The objective of these experiments will be to measure in the animals the extent to which life is shortened and bone tumors and other debilities are produced by a known intake of radiostrontium.

Results and conclusions. Chemical analysis of the collected samples is now far from complete, but it does show that the highest concentrations of strontium 90 are found in the United States, as might be expected, rather than in any foreign area. Assays show that the highest concentrations in humans are observed in children and amount to about one micro-microcurie (one trillionth of a curie) of strontium 90 per gram of skeletal calcium. It is believed that the skeletal concentration required to produce observable skeletal injury to humans is several thousand times those observed in the United States. Concentrations required to produce serious injury may range from 10,000 to more than 100,000 times those which have occurred. "Injury" may range from a barely detectable striation on the surface of the bone, a condition which may or may not be the forerunner of more serious changes, to areas of brittleness and easy fractures, and to lethal tumors. Individuals vary greatly in their sensitivity to quantities of radioactivity in their skeletons, as is known from several hundred radium cases. We shall, therefore, never be able to say that a certain injury will result from a certain amount of radioisotope deposited. Even much more data will permit us to speak of the probability of injury only with a somewhat greater degree of accuracy.

Presumably then, 1,000 to 10,000 times as many megatons of fission bombs could be exploded as have already been exploded (approximately 40 megatons), without causing ultimate human damage. However, it is not known with precision how much of the strontium 90 produced in these detonations remains in the stratosphere and is dripping slowly to earth with a storage half-life in the stratosphere of from seven to ten years. Although a large fraction of the gross fission activity fails to reach the stratosphere, it is believed that the fraction of strontium 90 reaching the stratosphere may be much larger than the fraction of the gross activity. It is possible therefore that the above estimates of the permissible amount of detonation are several times too large. It must be emphasized, however, that any such idea is based on very incomplete data. Experiments to give better data on the amount of strontium 90 existing in the stratosphere and on the ground are in progress in the United States and in the United Kingdom.

Immediate Downwind Effects

About half the radioactivity from a large ground burst falls out near the point of detonation. Fragmentary data obtained following the March 1 shot of the 1954 CASTLE test series indicated that, under the prevailing conditions of a coral island base and that day's particular wind structure, a pattern of hazardous fallout covered about 25,000 square miles. This particular occurrence, in the absence of any other, has been used as the basis for theoretical fallout models and calculations of what would occur should detonations take place on a large land mass.

The first feasible step in checking results with present estimates is to make careful studies of the fallout from Pacific test shots in the coming REDWING series. Plans are being laid to make such observations on at least two REDWING shots, using aerial survey and water

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BIOLOGY AND MEDICINE

sampling over a wide area, within 12 hours of the detonations. It will still be necessary, however, to extrapolate these results to estimate fallout under different conditions of soil and weather.

For purposes of civil defense and defense mobilization planning, the Commission is studying the effects of weathering and of shielding by houses as factors in decreasing radiation dose within an area of heavy fallout. On the island of Rongelap in the Marshalls, the dose rate after a year is about one-fifth of the rate which would be expected by calculating radioactive decay. The difference is presumed to be mainly due to leaching by rain and wind. Shelters, housing, and other structures, methods of partial decontamination, and the fact that exposures are spread out in time, also contribute to determining the circumstances under which heavy fallout areas might be put back into use following contamination.

Assume, for example, that 50 roentgens of lifetime effective biological dose is as much as people should be permitted. The area in which such a dose is obtained could be shrunk from 25,000 to 2,500 square miles by delaying reoccupation of the contaminated areas for four months. There would be an inner area of perhaps 1,000 square miles in which the effective dose after four months would be 150 roentgens, and reoccupation might have to be postponed except for isolated decontaminated areas. Somewhat uncertain calculations indicate that the lifetime effective biological dose in this inner area could be reduced to 50 roentgens by waiting a year before reoccupation.

It thus appears that reclamation of fallout areas is possible even if inconvenient for urban reoccupation, but contamination with strontium 90, because of its persistence, may pose much more serious difficulties in reclaiming land for agricultural purposes.

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