Symposium on Radioactive Fallout in Relation to Foods

INTRODUCTION

Perhaps no event in the scientific history of mankind has so intimately touched the lives and thinking of so many as the first atomic shot in the desert of New Mexico just 15 years ago.

Out of the literature, both scientific and popular, have come statements and counter-statements, discussions and confusion. Such a state is natural to any new field of endeavor; in a sense it is desirable since it tends to stimulate thought and force experimentation and only in this way can we obtain enough answers, right or wrong, to be able to sift the first inklings of truth.

Food is one of the certain links in the chain of passage for the fallout radionuclide from soil, the initial receptor, to man, the ultimate consumer. If we can control the fallout radionuclide in soil or in the food produced therefrom, we have taken a giant step in the control of the passage of it into man.

It is quite generally believed that the extent of contamination of the biosphere to date is well below a critical point. For example, Browning states that the actual increase in the concentration of strontium-90 in human bone is only 1/1000 of the generally accepted maximum permissible contentration. However—particularly in the absence of a proved threshold effect—all possible avenues of control of radionuclides in the biosphere should be investigated.

Many questions have arisen with regard to soils, food, and water; a review of some of the complexities encountered and the questions which arise may place the problem of fallout in its proper perspective.

If one assumes an accumulated world-wide average fallout of 26 mc. of strontium-90 per square mile as has been forecast for 1965, the concentration of the nuclide per square foot to a depth of 6 inches is in the order of 3×10^{10} molecules or only 10^6 molecules per gram of soil. Assuming a 28-year half life, this is about 3 disintegrations per hour. Since the natural radioactivity will contribute to this small amount, it is necessary to isolate the strontium-90 from the soil. Chemical procedures for the isolation of 10^6 molecules from a complex and variable medium, such as soil, leave something to be desired. Added to this is the fact that some of the nuclide is retained by the foliage of the plant and some of the plant ingested by animals which absorb a part of the nuclide and return a part to the soil in feces and urine. The amount of activity removed from the soil by run-off and by plants is dependent in part upon the frequency and amount of rainfall and whether or not a crop is grown under irrigation. We must not neglect that part of the nuclide which appears in food and is consumed by man. A part of this nuclide is retained on consumption of the food; the remainder is returned to soil and water in sewage sludge and sewage effluent. It is apparent that we can never completely rid the biosphere of such radionuclides as strontium-90 and cesium-137 since they will be continually recycled until they are removed by natural decay.

The next few years should see more of a basic type research on fallout problems; some of this research is underway at present.

Emphasizing the application of basic research are the observations on radioactivity in whole wheat *vs.* that in white flour. New York whole wheat bread collected June, July, and August 1959 contained more than three times as much strontium-90 as white bread. Many seed integuments "select" minerals. Does this mean that the bran coat should be discarded as a human food? If bran is returned only to cattle, should it be confined to the feeding of beef cattle and if so may the bones of such beef cattle be used in the fertilizer industry?

On the other hand, the calcium content of the bran is much higher than that of the endosperm. What is the effect of the strontium-calcium ratio of the bran on strontium uptake in the gut? In fact should we consider strontium-calcium ratios of particular foods or of daily total food intake? What happens in the gut if the total calcium uptake is high? Does calcium from one food exchange with strontium in another food and what are the rates of exchange? Answers to these and similar questions are being sought.

The problems of control of radionuclides in the biosphere are no longer those of an isolated group of specialists such as the radiochemists. A complete picture can be obtained only if and when a complex problem is attacked by many disciplines and their findings are pooled. Such coordination may best be obtained through the establishment of an integrated research program. Certainly a clearing house for most recent information is desirable.

It will be pointed out in the papers to follow that most of the radioactivity deposited in the supra atmospheric reservoir has now reached the earth's surface. A question then might be raised with regard to concern over fallout per se. Although fallout from weapons testing is decreasing, other, less bellicose, projects are being expanded.

With the development of a power reactor program, a potential source of environmental contamination other than fallout becomes evident. It is true that reactor wastes are under control; however, there is the remote possibility that such incidents as the graphite fire in the Windscale, England, reactor can again occur. This incident resulted in contamination of the immediate countryside with iodine-131 and other radioisotopes.

Further, absolute containment of waste is not a reality; even the best practices, such as sealing radioactivity in concrete or in fired ceramic bodies, allow for some leaching. Thus, small amounts of radioactivity may enter the biosphere and eventually the food chain. Fallout, then, is the immediate aspect of a problem of the future. The magnitude of this problem may be more readily appreciated if we again look at a forecast for 1965. By that time, the fission products produced in only 1 year by power reactor operation will be equal to the total amount of fission products which have been produced by bombs over the past 15 years.

The following series of papers survey nuclides from fallout from their advent at the instant of detonation of a device, through the soil, into the plant and its food substance, and eventually into man. We can hope to cover these topics only in a general manner. The authors represent a small, but very important, cross section of the types of research in progress on the general problem.

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