control while the esterified phosphate increased to 119 percent. At a concentration of $1.05 \times 10^{-3}M$, oxygen consumption increased and esterified phosphate increased to 153 percent of that of the control. At the highest concentration reported here, $1.05 \times 10^{-2}M$, there was no further increase in the rate of oxygen consumption, but the esterified phosphate increased to 160 percent of that of the control.

The increase in esterified phosphate at fluoride concentrations above the concentration at which oxygen consumption fails to increase may indicate that fluoride was affecting multiple enzyme systems; this would be in accord with Reiner's (*7*) theoretical mechanism of multiple enzyme inhibition resulting in a stimulation of the oxygen consumption. The application of Reiner's theoretical treatment depends essentially upon the increased esterified phosphate's being adenosinetriphosphate (ATP).

Hackett (*8*) has indicated that the general over-all control of the rate of respiration in plants is dependent upon the concentration of the acceptor, adenosinediphosphate (ADP), rather than the donor, ATP. In addition, Krebs (*9*) has proposed that the control of respiration is dependent upon an interrelationship between inorganic phosphate, ADP, and ATP, ADP or phosphate acceptor being the most significant factor in the control mechanism.

Since there was a significant increase in phosphorylated nucleotides in these experiments, the following interpretation may apply. Fluoride probably disrupts the basic energetics of the cell in some manner and increases the oxygen consumption by increasing the phosphate acceptor or donor or at least by disturbing the interrelationships between inorganic phosphate, ADP, and ATP (*10*).

I. B. McNulty
James L. Lords*
Department of Botany, University of Utah, Salt Lake City

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* Present address: Department of Plant Pathology, University of Wisconsin, Madison.

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Packaged Organic Materials as Monitoring Tools for Radionuclides

Abstract. Pint-size perforated polyethylene bags were used as containers to test preserved tea, spinach, ion-exchange resin, live filamentous green algae, and dead filamentous green algae for the sorption and concentration of radionuclides from natural aquatic habitats and from a variety of laboratory controlled nutrient media. These packaged materials have been used to detect trace levels of radionuclides not found by the usual methods of analysis of the raw water itself for dissolved radionuclides.

In measuring nuclide radioactivity levels in the water environment at points downstream from nuclear-energy facilities, problems are encountered that require large-volume samples for analysis because of the dilution that has taken place. Even if the levels of specific radionuclides released are known, analysis of downstream media is necessary to determine the fate of the radioactive materials in the particular environment and to define parameters of dispersion and diffusion necessary for evaluating the movement of specific nuclides and the time required for their passage through the system in question.

In concentrating trace amounts of nuclides from large volumes of sample, particularly where evaporation, precipitation, or ion-exchange techniques are used, the stable salt concentrations in the diluting medium interfere with the subsequent separation of the specific radionuclides. To avoid these difficulties a technique utilizing dead organic and living biological concentration under natural stream conditions was investigated. Radioanalysis of algae from natural aquatic habitats has shown a greater variety and higher concentration of radionuclides than an analysis of the water in which the algae live.

Considerable data exist in the literature regarding concentration of fission products by organisms (*1*). Phytoplankton are noted for accumulating substances in inorganic form without known metabolic function. Average concentration factors up to 7000 have been reported for fission products (*2*), whereas some induced radionuclides have been concentrated several hundred thousand times or more. This characteristic is particularly noted in lower forms of organisms in media low in metabolically required trace elements, as for example, the high uptake of phosphorous-32 by plankton in the Columbia River, which is low in stable phosphorous. Thus, under certain circumstances, sampling by biological concentration may avoid the need of collecting large volumes of water for radioanalysis. Furthermore, knowledge of the movement of radionuclides into organic materials may reflect useful information necessary to evaluate the disposal of radionuclides into the hydrosphere.

High concentrations of potassium and calcium were found not to interfere, respectively, with the uptake of cesium-137 and strontium-85 by many nonliving organic materials in laboratory trials. Several kinds of biological material were selected for study under field conditions and in the laboratory, including preserved materials—tea, spinach, and filamentous algae—and living filamentous algae. Because the filamentous green alga, *Pithophora oedogonia,* grows easily in the laboratory and has a high concentration factor for many radionuclides, it was selected as the living test organism. It was grown free of silt and interfering radionuclides and in low concentration of stable nuclides. Thirty grams of blotted wet algae, about 2 g by dry weight, were placed in a pint-sized polyethylene bag having 400 evenly spaced pores about 0.8 mm in diameter. About 200 of these packaged sampling materials have been tested by

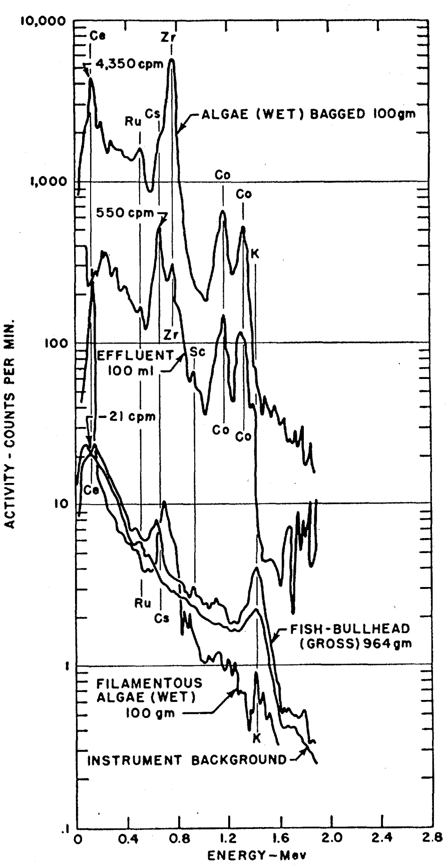

Fig. 1. Uptake of radionuclides from the Mohawk River, New York, at 17°C in September 1959 after 72 hours, by *Pithophora* in perforated polyethylene bags, compared with activity of fish (bullhead) and an indigenous filamentous green alga, *Cladophora*, taken from the river. Uptake of these radionuclides by *Pithophora* was nonmetabolic, since the alga had been killed with chlorine.

tying them submerged in the Ohio, Little Miami, Mohawk, and Clinch rivers for periods of 2 to 7 days, after which the contents showed high concentrations of several radionuclides, including cerium, cobalt, cesium, iodine, zirconium, ruthenium, zinc, and strontium. The presence of most of these radionuclides was not apparent from an analysis of the usual 1-liter volume of water. Packages of preserved tea, spinach, ion-exchange resin, and dead *Pithophora* showed less selectivity in uptake than live algae. In the dead group highest uptake occurred in dead *Pithophora*. Where aquatic environments are unfavorable for metabolism of live algae, these packaged materials could be used.

An advantage of sampling with such concentrators, particularly in the analysis of gamma-emitting radionuclides (all those listed above, except strontium), is that the contents of the polyethylene bag may be placed in a suitable container and counted directly without elaborate preparation of the sample, and sample preparation is made easier for strontium quantitation.

The chemical similarity of K to Cs and Ca to Sr may account, in part, for the ability of algae to concentrate all of them. However, these organisms assimilate only K and Ca. They do not substitute Cs for K or Sr for Ca. Therefore, the presence of nutrient levels of K and Ca are necessary for metabolism, which may permit the algae to accumulate huge amounts of nonmetabolic Cs and Sr. High levels of Ca and K, however, do reduce the accumulation of Sr and Cs (*3*). This has been repeatedly demonstrated in laboratory experiments. This reduction, however, is only apparent in live cells and has not been demonstrated in nonliving organic materials. For this reason preserved tea leaves, which are not as efficient as live *Pithophora* for concentrating Cs and Sr, may be better for quantitating fission products in natural bodies of water because this kind of uptake is not influenced, respectively, by natural levels of K and Ca. For example, at 25°C, preserved tea leaves were found to reach a peak equilibrium in 3 days and to concentrate Sr^{85} about 130 times and Cs^{137} about 80 times from water containing 3 or 30 parts of K or Ca, or both, per million, at several trace levels of these radionuclides. Experimental errors in the logs of counts were found to be approximately constant for this and some other organic material over the wide range of concentrations of these radionuclides, which might be similar to what could be expected from natural aquatic habitats.

Live *Pithophora* for quantitating is impractical, however, because moderate levels of K reduce the uptake of Cs and high levels of Ca reduce the uptake of both Sr and Cs. Both K and Ca concentrations vary widely in natural aquatic habitats; however, the uptake varies with the concentration of these competing ions; this fact may permit some generalizations.

For concentrating, live algae have a marked advantage over ion-exchange resins and dead materials, because they not only adsorb but concentrate ions such as Cs and Sr by active (living) transport into solutions with high concentrations within the cells. Resins can only absorb.

In the laboratory live *Pithophora* has concentrated Cs^{137} and Sr^{85} over 20,000 times. The efficiency of *Pithophora* as a biological indicator and concentrator under river conditions is shown by the gamma scan obtained with *Pithophora* (Fig. 1) compared to an indigenous filamentous alga (*Cladophora*) taken from the Mohawk River. With the exception of cerium, *Pithophora* shows the higher concentrations of these nuclides taken up by the two media and also demonstrates the presence of other radionuclides, notably cobalt. For further comparison, samples of fish and water taken at the same sampling location are included. Similar data, obtained with other organic concentrators immersed in the Clinch River at the mouth of White Oak Creek below the Oak Ridge National Laboratory, are shown in Fig. 2.

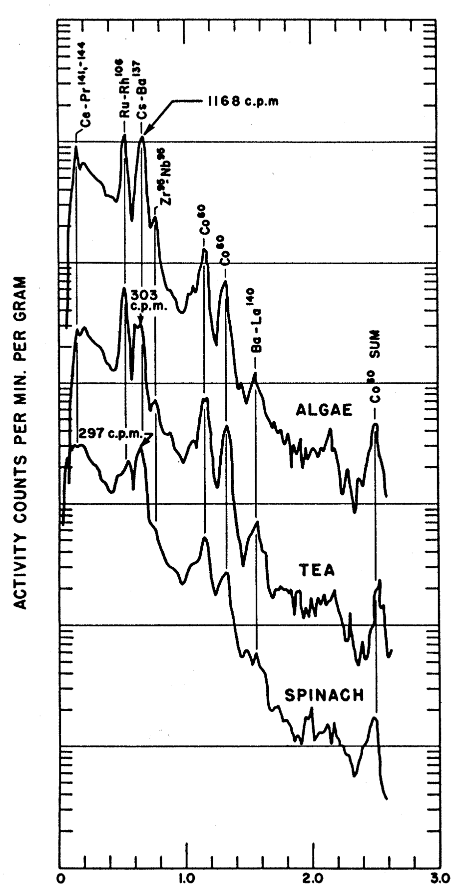

Fig. 2. Uptake of radionuclides in the Clinch River at the mouth of White Oak Creek near Oak Ridge National Laboratory, during 24 hours at 0°C in February 1960 by live *Pithophora*, preserved tea, and spinach packaged in perforated polyethylene bags. Uptake of these gamma-emitting nuclides by live *Pithophora* at this station at 20°C in June 1959 was generally higher by a factor of 10, while Cs^{137} was higher by a factor of 100, in laboratory trials.

The bulk of the information obtained, at least in the initial phases of evaluation, is qualitative, indicating the identity of the specific nuclides accumulated. Laboratory study indicates that quantification may be possible, because the concentration ratio for each medium at these trace levels, regardless of the nuclide, varies directly with the concentration of the nuclide in the water at the same temperature. Perhaps these concentrators may be useful in locating release of radioactive materials from waste containers disposed at sea.

Concurrent laboratory studies are in process in conjuction with field studies to identify, collect, and grow, under controlled conditions, selected biological concentrators.

LOUIS G. WILLIAMS
MICHAEL HOWELL
CONRAD P. STRAUB
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio

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Parental Body Build and Developmental Progress in the Offspring

Abstract. Children selected for study according to the body build of their parents were found to differ in rate of growth and in timing of osseous development. Boys and girls with large-chested parents were taller and heavier during the growing period and were more advanced in skeletal development than offspring of narrow-chested parents.

A relationship between "mesomorphic" body build and accelerated sexual maturation in boys has been reported by a number of workers (*1*). However, these findings are open to question because of the subjective nature and poor reliability of ratings on physique during childhood (*2*) and because greater