

Which of the thousands of pollutants should be tested first? What combinations? For how long a time? At what concentrations? Is there a threshold below which there is no effect, or no uptake?

What species? At what stage in the life history?

If oysters containing X parts per million of pollutant "A" are safe for man to eat, are these levels harmless to the oyster?

These questions relate largely to effects on individuals. But the same questions apply, and answers are needed, to populations and to ecological systems as well. It may well be here that our ignorance is greatest, and our needs most intense.

Thank you for your attention. I should be glad to attempt to answer questions.

APPENDIX 1

(To statement by J. L. Buckley before Committee on Science and Astronautics)

ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY RELATED TO POLLUTION ABATEMENT TECHNOLOGY

Better knowledge of scientific laws, basic principles, and environmental processes must form the basis of improved understanding and better control of our environment, including pollution abatement and all other conservation measures. A great variety of basic data must be collected to improve knowledge of our environment. Also, research must be done continuously to understand better the processes which control the complex responses of environmental elements to the stresses of nature and man.

In the field of water resources, the U.S. Geological Survey is the nation's principal basic data collector, and currently is increasing its efforts to collect the data most likely to serve the needs of those who are trying to improve our environment. It also is the principal Federal agency concerned with research on water resources, as such. This entire research effort is aimed at better understanding of fundamental processes which must be controlled or lived with to cope with environmental problems.

BASIC DATA INPUT TO POLLUTION CONTROL

For many years water data have been collected primarily for planners rather than for water managers faced with rapidly changing problems. Therefore, they have been collected carefully, but by rather time-consuming methods. To cope with today's water problems, one must have data essentially on a daily basis in order to predict critical situations, and to deal with them before irreparable damage occurs. The Survey is placing great emphasis on automatic monitoring, better water resources coverage, computer processing of data, and a variety of rapid methods of information release. Achievements in data service will permit increased efficiency in the control of pollution.

THE BEARING OF PROCESS RESEARCH ON POLLUTION ABATEMENT

Failure to cope with certain serious pollution problems, such as algal bloom, often can be traced to lack of knowledge of the controlling scientific principle or process. For example, biological stoichiometry (balance of aquatic organisms) now is known to be the key to blooms of this kind, and it is thought that the basic "law of the minimum" determines whether or not undesirable growths will occur. Unfortunately, analytical methods still are so deficient, and knowledge of biological processes so uncertain, that one cannot predict accurately exactly what set of circumstances will cause algal bloom. Therefore, he cannot devise preventive treatment which is applicable in all cases. Research by the Geological Survey on nutrient cycling processes, solutions geochemistry, and analytical procedures are aimed at filling gaps of this kind.

SIGNIFICANCE OF HYDRAULICS IN QUALITY CONTROL

It generally is conceded that practicable water quality standards are a first step toward improving our water resources. But to set such standards requires knowledge of extremely complex interactions between hydrodynamics and water quality factors. Until this relationship is properly understood, it will be impossible to set any completely satisfactory standards. The Survey is placing