2 November 1973, Volume 182, Number 4111

SCIENCE

Environmental Priorities

Billions of dollars are being spent on construction of facilities designed to stem the flow of pollutants into our continental waters. Tens of millions are being spent on research aimed at matching existing technical knowledge with these national needs. Almost nothing is being spent on research devoted to understanding the ecosystems we seek to save. The reason that such monies are not available to the scientific community is as follows. The research aspect of the National Science Foundation has almost no constituency in this area and is hesitant in times of tight appropriations to divert any of its precious funds to this new area—especially since many millions are being devoted to water research by the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the Atomic Energy Commission, and other groups, including the National Science Foundation's own new division, RANN (Research Applied to National Needs). Unfortunately, these groups are virtually prevented by legislation from funding anything that has the smell of basic research.

Since we cannot afford the cost of totally stemming the flow of all pollutants, we must go the route of partial control of selected pollutants. Which should we select? By how much should their flow be cut? For example, recent research on phosphorus makes it clear that any cut in the rate at which it enters a eutrophied lake will produce a corresponding cut in the standing crop of algae. This does not mean, however, that by eliminating the flow of phosphorus into the lake we can be sure of solving its algae problem. The reason is that almost all the phosphorus previously added to the lake lies buried in sediment. The degree to which this phosphorus will be recycled is not predictable because we lack sufficient knowledge of the geochemistry and biochemistry of sedimentary phosphorus. There is little point in cutting the flow of new phosphorus much below the rate of return of the old.

By contrast, in many rivers and estuaries, phosphorus and its fellow nutrients go unused by plants. For some reason, plants do not respond to the presence of these basic building blocks in rivers and estuaries as they do in lakes and oceans. Is it the high silt load of rivers, their toxicity, or their rapid rate of flow that prevents response? Until we have the answer, it is not clear whether the steps we are taking to clean up these ecosystems will succeed.

The fate of toxic metals, reactor radioactivities, intestinal bacteria, and organic wastes are even less understood. For every 100 questions that could be asked about the fate of any of these substances, answers exist for only one or two. Even the techniques needed for studies are yet to be developed. Means of measuring the rates of turbulent mixing are yet to be perfected, means of reconstructing chemical histories from the sedimentary record must be devised, and means of monitoring the key dissolved and particular constituents still must be engineered. Computer modeling of these ecosystems is largely without any factual base. Until we know much more about the processes taking place in these ecosystems, the predictive power of these models is at best questionable. A little basic research would bear considerable fruit.

Much could be done if even a modest fraction of the vast research expenditures on these problems were allocated on the basis of the investigator's skill as a scientist rather than on the basis of his willingness to put aside his natural instincts and devote his attention to the immediate needs of some government agency. It is to be hoped that the scientific community will work to correct this problem lest another decade pass and we only then begin to discover how naive our approach has been to the very difficult problem of managing the quality of our waters.—W. S. BROECKER, *Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York 10964*