

WATER POLLUTION CONTROL

WASTE TREATMENT and WATER TREATMENT

**Selected Biological References
on Fresh and Marine Waters**

**UNITED STATES
DEPARTMENT OF THE INTERIOR
Federal Water Pollution
Control Administration**



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**UNITED STATES
DEPARTMENT OF THE INTERIOR
Federal Water Pollution
Control Administration
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FOREWORD

OUR POPULATION has expanded rapidly during the past five decades and will continue to do so for an indeterminable time during future decades. Associated with this expansion has been an increase in the amount and concentration of wastes, both domestic and industrial, that are injected into waterways as an inevitable product of our affluent society. It has become apparent that the same waterways receiving these wastes must be used to provide water for potable, agricultural, industrial, and recreational purposes. Unlike clean waters that serve mankind in many ways, grossly polluted water cannot be used for multiple purposes. Clean waters are precious assets, defiled waters are needless liabilities.

This book of selected references dealing with water quality and use has been prepared for persons interested in and responsible for biological aspects of water pollution control, waste treatment, and water treatment.

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PREFACE

THIS BOOK of selected biological references concerning Water Pollution Control, Waste Treatment, and Water Treatment is a direct outgrowth of previous compilations conceived in 1950 by the second author, Dr. W. M. Ingram, when he served as the first full time biologist assigned to training activities at the Environmental Health Center of the United States Public Health Service in Cincinnati, Ohio. Since that time he has initiated several publications containing selected references on various aspects of water pollution biology. Now out of print the previous publications were:

- (1) Handbook of Selected Biological References on Water Pollution Control, Sewage Treatment, and Water Treatment. Public Health Bibliography Series No. 8 (PHS Publication No. 214), pp. 1-66, 1953.
- (2) Opt. Cite. Public Health Bibliography Series No. 8 (PHS Publication No. 214—Revised 1957), pp. 1-95, 1957.
- (3) Estuarine and Marine Pollution, Selected Studies on Biological, Bacteriological, and Physical Aspects with Major Emphasis on United States Literature. Public Health Service Technical Report W-61-4, pp. 1-30, 1961.
- (4) Water Pollution Control, Sewage Treatment, Water Treatment, Selected Biological References. Public Health Bibliography Series No. 8 (PHS Publication No. 1053), pp. 1-142, 1963.

Most references in the previous publications have been retained in this book, and selected references subsequent to 1962 through 1965 have been added. The revision and additions herein, and the expansion to include the marine aspects with those of fresh water, should be helpful in providing source material under one cover for those engaged in the study of pollution as related to aquatic life.

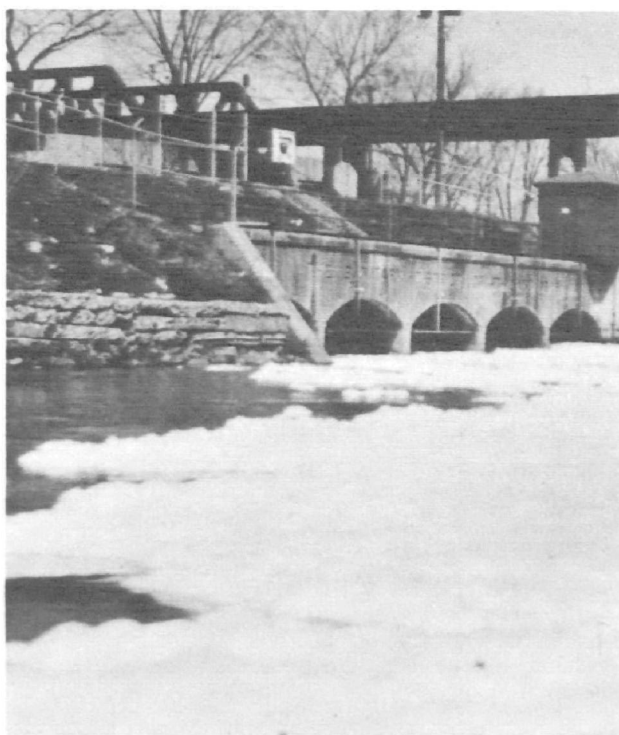
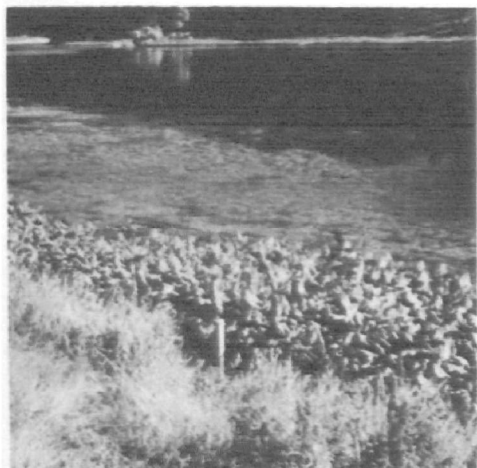
In many regions of the United States, history has illustrated that land was defiled by over-timbering, over-grazing, and the unwise use of the plow. For many years, one could move away from such destroyed, "polluted land," and still subsist; when this was not possible, people became land conservationists, realizing that in the land lay survival. The history of land depredation could, in the future, be repeated in the defilement of our waters. The number of streams and natural lakes is static with a minimal number of future impoundment sites; there is no moving over a ridge to discover a new waterway. All waters must be protected for a variety of uses including the maintenance of a healthy biota. All of us should be water conservationists, realizing that water is limited and that in its wise use lies a great part of this Nation's strength.

Today all water users are becoming more and more interested in the alleviation of pollution. Full realization of population and industrial growth has brought many persons into intimate contact with problems relating to water degradation associated with municipal, industrial, or agricultural wastes, or a combination of these. Most people fully appreciate that streams, lakes, and marine waters remain static in number; it is apparent that problems attendant to waste disposal and water treatment are increasing. Thus, the problems of waste disposal and their reasonable solution are the concern of all.

Multiple use of water is the current trend. If pollution is abated, water can be satisfactorily used for many and varied interests.

With the abatement of pollution, danger from disease is lessened; a better potable water is produced; new industries can be attracted to communities; property values increase; recreation in the form of fishing, hunting, boating, and swimming is more readily available; and current supplies of fishery and shellfishery food products can be sustained. To assure an adequate quality of water for all these purposes, water must be used and managed wisely.

**Aquatic weeds associated
with induced eutrophication.**



Waste outfall

**Slime growths
effected by wastes.**

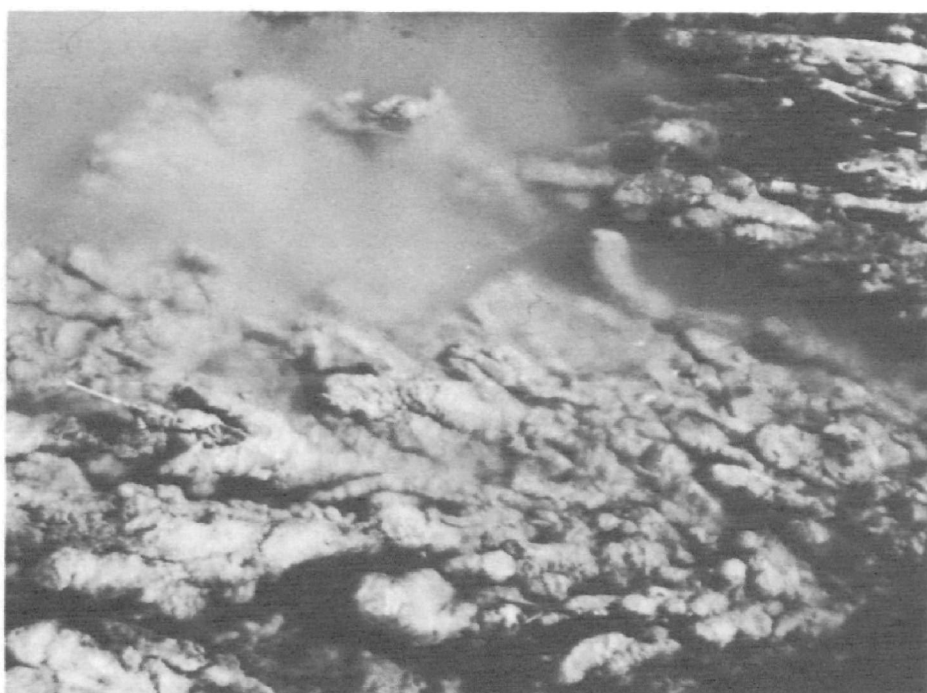


Plate I—Water Pollution Control Aspects: Fresh Waters

PART I

WATER POLLUTION CONTROL ASPECTS: FRESH WATERS

UNLIKE SALINE WATERS, clean fresh-waters are economical sources of water that can be and have been tapped to sustain the domestic, agricultural, industrial, and recreational needs of the nation. Our population has increased from 76,000,000 people in 1900 to 150,000,000 in 1950 and to 180,000,000 in 1960. By 1980 it is expected to increase to 260,000,000. Yet, there has been no change in the amount of available water, and no major additions are anticipated. Ready and economical supplies of clean water are no longer adequate for many burgeoning cities, and most are now faced with finding new and expensive water sources just to keep pace with only the domestic demands. Some cities are transected by large rivers, but many are sufficiently fouled with domestic and industrial wastes that their waters cannot be used for any purpose. Such situations can become very widespread throughout the land, and can seriously affect the general welfare of the nation. It is axiomatic then that with an increasing population and a "fixed" amount of fresh water the control and abatement of pollution is one of the most important means of solving water supply problems.

Along with making water unfit for many uses pollution of water courses has several biological effects. It can foster undesirable plant and animal growths, generate putrid water and odors, eliminate desirable aquatic and other wildlife that provide both food and recreation, taint water supplies and fish flesh, discolor water and make it unsightly, change habitats to favor growth of toxic organisms that decimate livestock and pets as well as cause sickness in man, nurture growths that impede flows in watercourses, create conditions suitable for development of human and animal pests, make recreational waters unusable, and enhance the spread of disease to epidemic levels.

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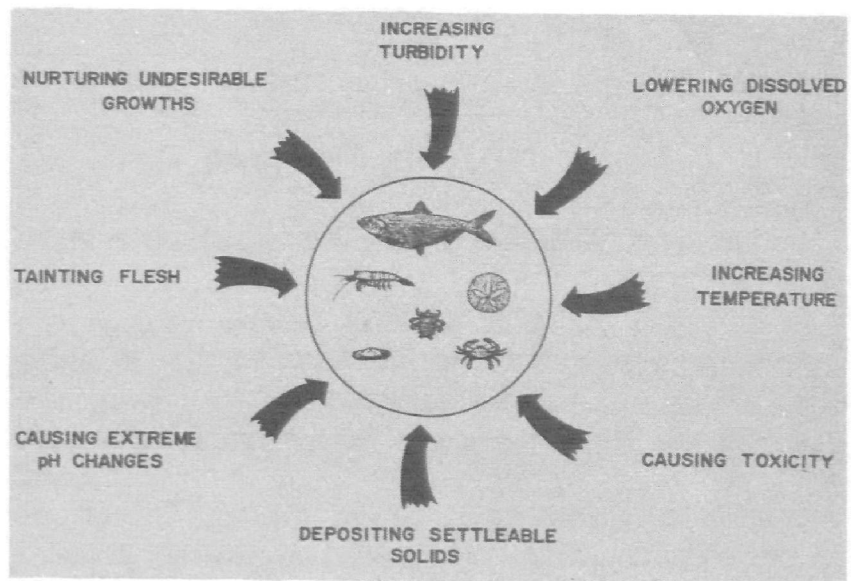
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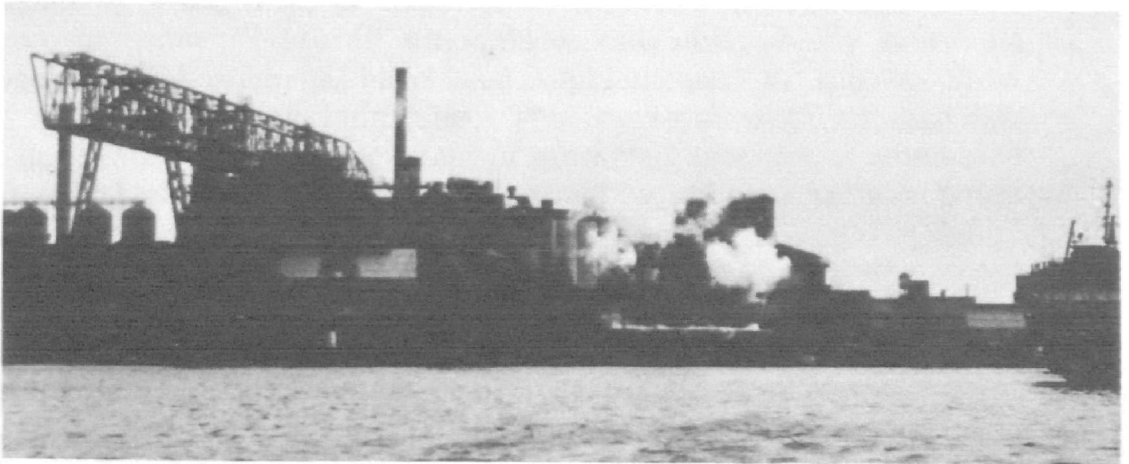
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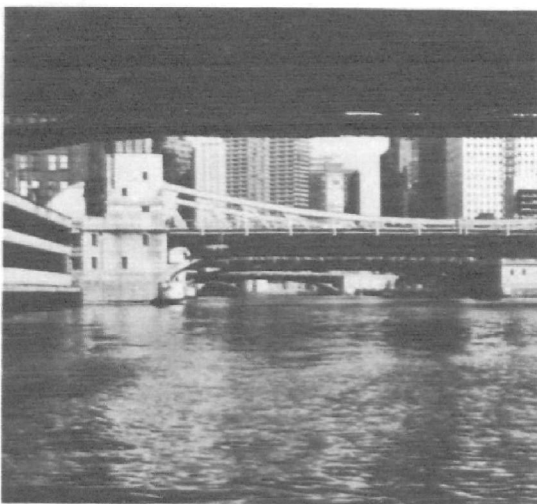
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Ways in which wastes may affect aquatic life.



Industrial waste source



**Municipal
waste
source**

PART II

WATER POLLUTION CONTROL ASPECTS: MARINE WATERS

ACCELERATED ATTENTION to the control and abatement of pollution in fresh waters, expanding populations and industries on lands adjacent to the oceans, and recognition of the potential role of the oceans as sources of food have generated increased concern toward the defilement of marine waters.

Bacterial contamination of shellfish resources by municipal wastes is well documented, as is similar pollution of recreational beaches. Elsewhere pollution and decimation of shellfish and other food resources is associated with drainage and filling of tidal marshes, or diversion of water that is essential to maintain conditions suitable to the organisms. "Natural" amounts of nutrients, chiefly inorganic nitrogen and phosphorus, have been supplemented by sources from some coastal cities and industries. The combined nutrient load has been implicated in the development of massive quantities of unwanted marine plant growths that become deposited by waves or tides on shore reaches where they decay and emit foul odors.

Discoloration and tainting of animal foodstuffs have been noted in estuaries and bays burdened with strong wastes. Toxic materials, including pesticides, can comprise a major threat to the loss of desirable marine life if not carefully controlled. A relatively recent concern is the disposal of radioactive wastes and their long-term effects on marine as well as fresh water organisms.

As in fresh waters, multiple use of marine waters is paramount to any single use; control and abatement of pollution in marine waters is requisite to provide a maximum variety of uses beneficial to all.

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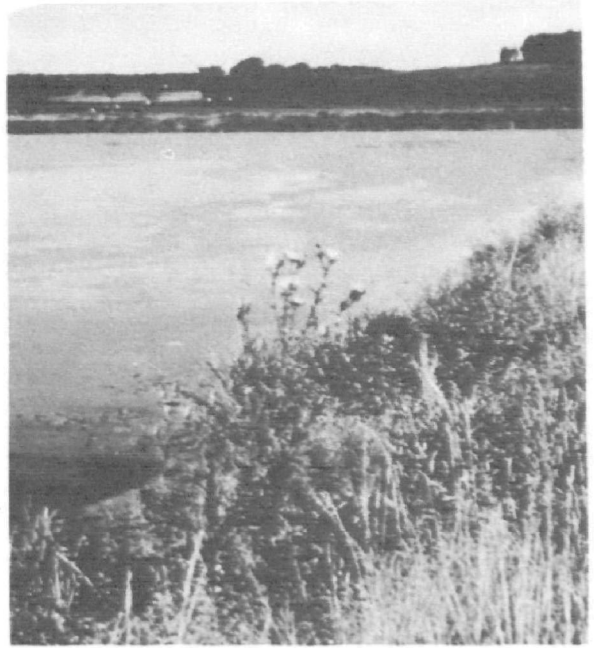
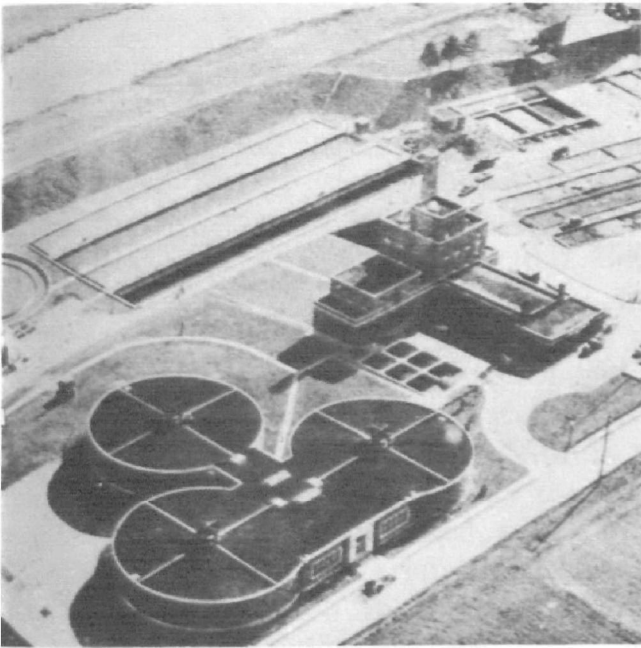
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**Activated sludge sewage
treatment plant.**



Waste stabilization pond.

Water purification plant.

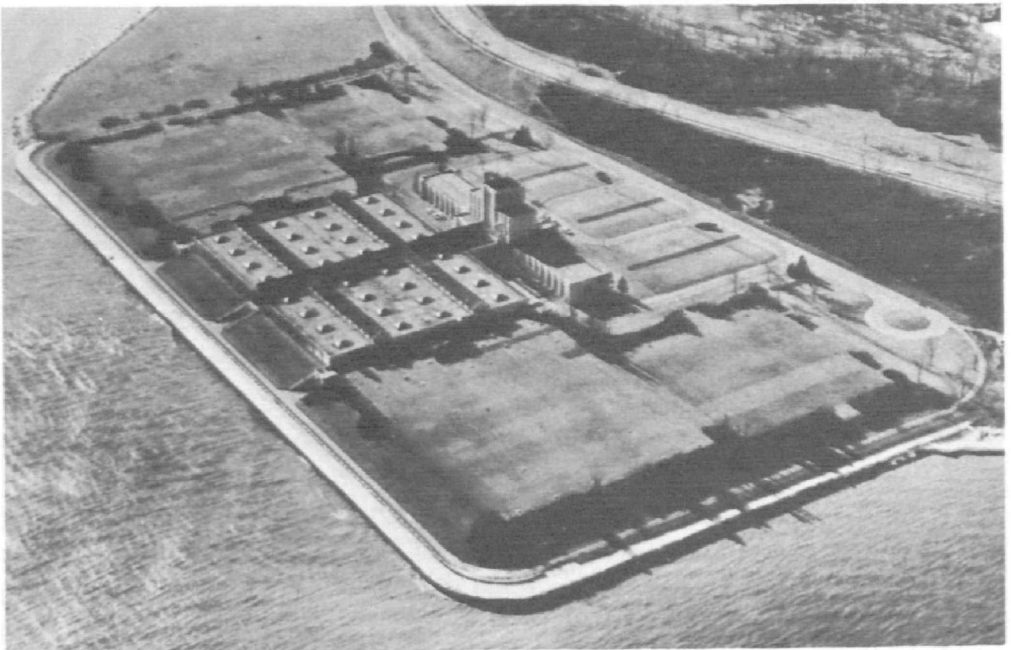


Plate III—Waste Treatment and Water Treatment Aspects

PART III

WASTE TREATMENT AND WATER TREATMENT ASPECTS

SPECIFIC COMMUNITIES of plants and animals are associated with the various phases of decomposition in the biological treatment of wastes. Each of these communities is dependent on the other, and there is gradation of organisms from one community to another at various places in the system. Only those organisms adapted to the conditions for the stage of decomposition under consideration are to be found in abundance at any particular time and place in the decomposition processes.

In designing bio-chemical waste treatment facilities, engineers provide for an optimum physical habitat in which maximum biological decomposition can take place. These vary from imhoff tanks to waste stabilization ponds; each contains a particular assemblage of organisms. Early efforts to study the biological aspects of waste treatment facilities were concerned with the determination of types of organisms present in various treatment processes. Subsequent investigations dealt with the fate of specific organisms in activated sludge and trickling filter systems. Additional studies need to be undertaken to determine organism responses to operational changes within waste treatment facilities.

Unlike the role of organisms in waste treatment, most organisms in water supplies are detrimental, and considerable effort is devoted to providing organism-free water to consumers. Organisms in water supplies and delivery systems can cause discoloration, turbidity, undesirable tastes and odors, disease, plugging, and reduced flowage; their control often involves use of chemicals which in turn may affect the quality of water delivered to the consumer.

In recreational waters, sometimes employed as sources of water for many purposes, certain organisms are deemed beneficial because they are associated in one way or another with the pleasurable use of the water. Man-induced enrichment of such waters, however, often results in excessive growths of organisms which frequently achieve nuisance proportions and restrict or eliminate recreational use. The excessive development of organisms to nuisance proportions stimulates demands for appropriate control measures to retain potential recreational values. Proper control is only achieved by eliminating the cause of such growths, but this may not be feasible for economic or other

reasons, and chemical treatment may be undertaken. Unfortunately chemical treatment rarely provides complete satisfaction in the control of aquatic nuisance organisms, and often the chemical employed has adverse effects on other organisms considered beneficial in the resource.

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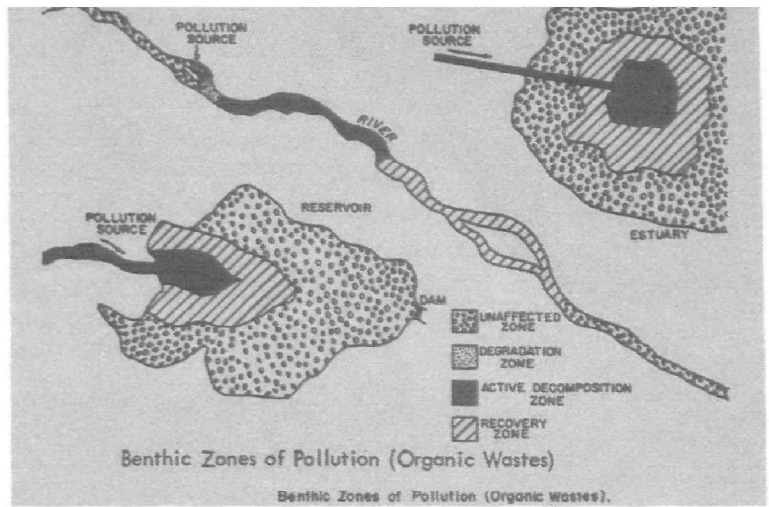
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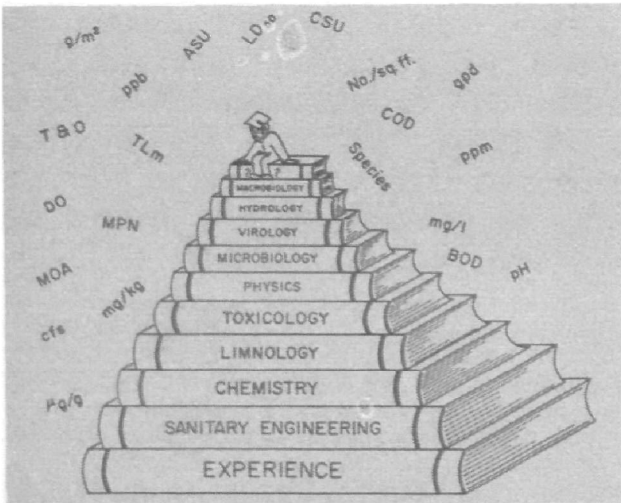
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Graphic display of data.



Data analysis.

Communication of information.

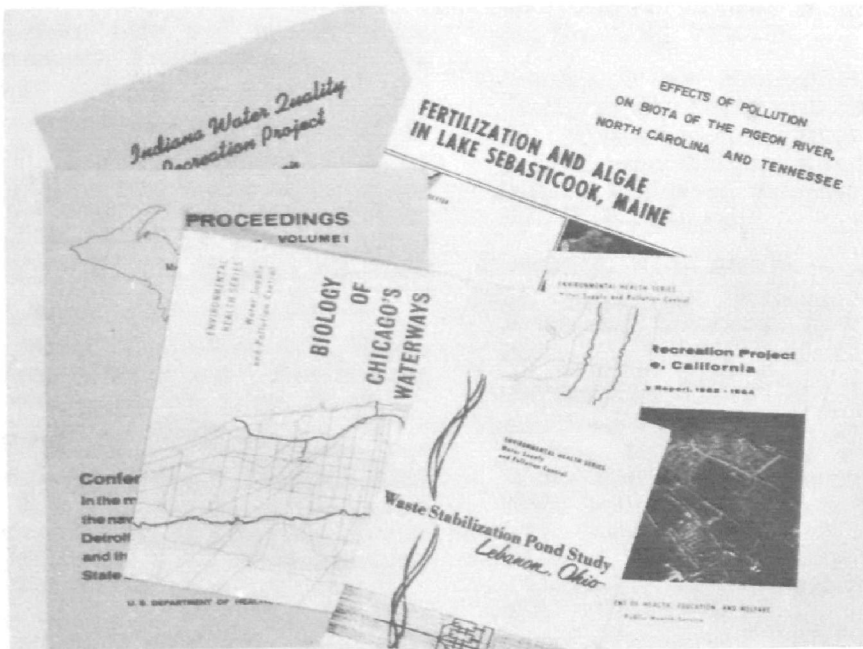


Plate IV—Reporting Biological Data

PART IV

REPORTING ASPECTS FOR BIOLOGICAL DATA

TO DEFINE the biological findings of pollution studies, the biologist must convey his message to those in associated disciplines such as engineers and administrators, and to the general public. Delivery of this message through oral or written reports is not accomplished when the report is cluttered with bad phrases, unnecessary technical terms, meaningless words, and non-pertinent graphical material. It is apparent, then, that one of the biologist's principal responsibilities is to prepare reports containing information that is descriptive, concise, easy to read, and understandable. Such reports accomplish their objectives by communicating the results of the study to all concerned.

Although this unit contains fewer references than any of the preceding, the importance of its contents cannot be understated.

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