

Institutions for Effective Management of the Environment

Report of the
Environmental Study Group
to the
Environmental Studies Board
of the
National Academy of Sciences
National Academy of Engineering

PART I

NATIONAL ACADEMY OF SCIENCES
NATIONAL ACADEMY OF ENGINEERING
Washington, D.C. January 1970

Foreword

The Environmental Studies Board expresses its deep appreciation to those who participated last August in the work of the Summer Study Group at Stanford University. The Summer Study concerned itself with two subjects of study: (1) Institutions for Effective Management of the Environment, which is the subject matter of this document, and (2) Environmental Problems in South Florida, which has to do with the possible environmental effects of construction of a jetport near the Everglades National Park in Florida. This will be the subject matter of a document also being published, and to appear shortly. These two documents are significantly related, of course, this one being concerned with a general problem—how we anticipate and deal with environmental effects in general—and the second with the likely effects of a particular technological project, and what can be done about it.

Thus, this report is Part I of the overall report of the Summer Study Group. The report on the Florida problem will appear as Part II. Both of these documents are intended to serve as

"background papers" and to bring fresh views of people in a variety of academic disciplines, public-policy positions, and related areas of concern bearing upon the non-scientific aspects of environmental affairs. They will, we believe, provide a basis on which the Board will make recommendations for effective approaches and institutional mechanisms for dealing with environmental problems. We believe, moreover, that these study reports to the Board are significant contributions to the developing literature on the environment, and that they will warrant further discussion and broad consideration.

HAROLD GERSHINOWITZ, *Chairman*
Environmental Studies Board
National Academy of Sciences-
National Academy of Engineering

Preface

In the spring of 1969, the Environmental Study Group undertook the organization of a Summer Study on Environmental Problems. We were concerned about whether there existed an adequate institutional base to deal with our mounting environmental problems so that future generations would not inherit an enormous environmental debt.

We concluded that present institutional arrangements for effective environmental management are inadequate, and in this report, we make a number of suggestions aimed at improving them. We believe that a much greater emphasis on environmental monitoring is essential, as is the development of an Environmental Quality Index as a management tool, the establishment of a Board of Environmental Affairs within the Office of the President, and a National Laboratory for Environmental Science. We found a need for continuing systematic analysis in support of our efforts to deal with the environment and our national policies affecting the environment, and have proposed a new Institute for Environmental Studies.

The data supporting the Study Group's deliberations came not only from the existing literature but also from personal discussions with and briefings from a large number of interested people. The major part of the study took place in August at Stanford University and was attended by about sixty participants. The study began in July with the co-chairmen discussing with interested government officials various aspects of the relevant problems. The last three weeks of August were devoted to analyses of problems and discussions with a number of individuals experienced in conceptualizing, organizing, and managing large-scale, technologically oriented enterprises. While the conclusions are our own, the Study Group could not have reached them without the information and insights provided by others.

Stanford University provided facilities for the study during the period August 4-29. We thank President Kenneth Pitzer and Professor Donald Kennedy for their hospitality. Special acknowledgment is due Professor Murray Gell-Mann of the California Institute of Technology for his invaluable contributions to the organization and conduct of the study. Administrative support was organized by Charles K. Reed, Executive Secretary of the Environmental Studies Board, whose contributions were essential to the project. We also acknowledge the valuable work done on the manuscript by Steven Ebbin.

Finally, the Study Group endorses unanimously the substance of the major recommendations and conclusions. However, not all members have had the opportunity to comment on the detailed wording of the final draft of this report.

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*Institutions for
Effective Management
of the Environment*

Summary of Conclusions and Recommendations

The quality of our lives is directly related to the quality of our environment, and the quality of that environment has deteriorated as our national affluence has increased. Unwise and thoughtless use of the environment can create, and in reality is now creating, an onerous national debt that will increasingly burden future generations. As our population increases, demands on the environment grow correspondingly. Rapidly growing population and the industrial economy that underlies our high standard of living have created vast problems that call for extraordinary steps to repair the damage already done and to prevent future destruction of our most valuable resource—our environment.

I. In order to reverse the trend of haphazard destruction we need effective mechanisms for the management of our environment at the highest levels of government; we therefore *recommend* the establishment of a Board of Environmental Af-

fairs within the Office of the President.* This Board should have the strongest possible mandate for action from the President and the Congress. It should recommend and assist the President in formulating policies; evaluate programs and activities of departments and agencies and consider how they will affect the environment, making their judgments fully known to the President, the Congress, and the public; analyze, interpret, and provide assistance in generating needed data concerning environmental matters; serve as coordinator on a working level for interdepartmental activities relating to the environment; and assist state and local governments in dealing with environmental problems. The Board should submit an annual report to the President for submission to the Congress. This report should contain evaluations of the state of the environment and the effectiveness of relevant ongoing policies, programs, and activities supported or carried out by other federal agencies, and should suggest to the Congress effective legislation bearing upon environmental problems.

The new Board would effectively augment the impact of the existing President's Council of Environmental Quality, established by Executive Order last May. Under the new arrangement, the President's Council would continue to provide strong coordinative, review, and oversight functions. Additionally, of course, as a Cabinet-level council it would attract critical public attention, marshaling significant public support for vigorous policies for the management of the environment.

The Board, of course, would differ from the President's Council in several important ways: 1) Deriving its existence from positive legislative action by the Congress, it would enjoy special Congressional interest and, indeed, a Congressional mandate. 2) It would be comprised of an interdisciplinary team of experts, staffed by highly professional, full-time personnel drawn from the relevant disciplines. At present, the Office of Science and Technology, already undermanned, provides only part-time staff backup, among its other duties; moreover, by definition of its legislated numerical limitations, it cannot effectively perform

*Since this recommendation was decided upon by the study group, the Congress has passed and the President has signed S.1075, National Environmental Policy Act of 1969.

additional work, particularly insofar as the Board would exist outside of the OST hierarchy. 3) It would operate on a full-time basis, in contrast to the President's Council, which is comprised of the Secretaries of several agencies, chaired by the President, and which meets irregularly, giving only episodic attention to the problems within its purview. 4) It would be obligated to prepare an annual report on the condition of our environment which the President would submit to the Congress. The present Council has no mandated responsibilities of this kind to the Congress. 5) It would have an annual operating budget of its own. The existing Council has no regularly appropriated operating funds and is reliant on small inputs from other budgets. 6) It would be administratively separate from operating, mission-oriented agencies and therefore more capable of objective analysis of programs and policies, at least internally.

The Board that we recommend requires a highly professional staff, experienced not only in matters relating to the environment, but also in public-policy matters, science policies, Congressional affairs, federal, state, and local relations, information gathering and dispersal, and the broad range of disciplines related to the environment and its effective management.

II. The activities of the Executive Branch in establishing environmental policies, evaluating and overseeing their implementation, and in general managing environmental affairs should, we believe, relate to a more broadly effective Congressional organization than now exists. At present several committees of both Houses of the Congress have jurisdictions that relate to environmental matters. And while we would not presume to suggest a reorganization of Congressional committees, we do *recommend* that a joint committee of the Congress, comprised of the chairmen and ranking minority members of the relevant committees of both Houses, would provide a much needed focal point for the informed discussion of environmental affairs.

Such a joint committee would provide an open forum for annual hearings relating to the President's report, in which the important issues would be discussed and debated in public. This would, of course, in no way infringe upon existing jurisdictions relating to appropriations or other Congressional activities, though

careful consideration should be given to organizational realignments in the future.

III. We cannot effectively manage the environment without knowing what it is, what it was, and what it can be. At present, we do not systematically, comprehensively, or regularly measure environmental quality, nor do we know how and to what extent it is changing and has already changed. We *recommend*, then, that a comprehensive federal program for the monitoring of the environment be initiated and assigned high priority. Though we have not made detailed organizational recommendations, it is clear to us that the present inordinately dispersed structure is inadequate to meet the pressing need for continuous and systematic environmental monitoring programs. The new Board of Environmental Affairs should develop and recommend for legislative action appropriate mechanisms for dealing with environmental problems.

Most of the data now obtained under the aegis of such agencies as the Environmental Science Services Administration, U.S. Geological Survey, Bureau of Commercial Fisheries, National Air Pollution Control Administration, and the Federal Water Pollution Control Administration, are obtained for limited special purposes and not for an overall, ecological evaluation of the quality of the environment. No single agency now assumes direct and specific responsibility for performing this vital function, nor is any common, interchangeable, or comparable sampling method now being used, though the quality of one aspect of the environment (e.g., air) obviously affects the quality of another (e.g., water).

Effective monitoring must be based on a carefully planned, integrated program of widespread and repeated observation. It is clear, moreover, that such a monitoring effort must include at least the following:

1. Physical and chemical properties of land, air, and water
2. Distribution of plants and animals in land, air, and water
3. Land use, including diversity of purpose

4. Construction
5. Noise
6. Epidemiology of man, animals, and plants
7. Evidence of environmental stress, such as tranquilizer consumption and asocial behavior
8. Aesthetic qualities

Once an effective, well-designed monitoring program has been established, it will become possible to set environmental quality goals, create policing mechanisms, and evaluate performance.

IV. Environmental matters involve values that are either difficult or impossible to measure in economic terms. Alternate means of defining these values are imperative. The management of environmental affairs would be greatly aided by the development of appropriate Environmental Quality Indices. We *recommend* that the research required to develop and maintain these indices be encouraged and supported to the fullest extent possible by the Board of Environmental Affairs and other interested government agencies.

Some quantitative measure of what is happening at regional and national levels is essential as an evaluation and management tool. The following are examples of such indices:

1. Transparency of the air
2. Purity of water
3. The ratio of area of open ground to population
4. Noise level
5. Ratio of wild animals to human population
6. Ratio of area of parks to area of parking lots
7. Fraction of utility wires above ground

The various individual indices would be combined and weighted into an overall Environmental Quality Index, which could become a powerful tool in developing priorities among programs affecting the environment. A similar index would need to be developed against which changes in the environment could be compared. The composition and weighting of this index or of its com-

ponents will require careful analysis; we do not attempt even an outline of it. We do emphasize that the program of monitoring must be designed from the beginning to yield appropriate indices.

V. There is no laboratory in the federal government that now carries out systematic research on the environment as a whole. Present efforts are specialized and atomistic, and the overall ecological systems approach has not been adopted by any single federal agency. We *recommend* the establishment of a National Laboratory for the Environmental Sciences, which might well be contractor-operated as other national laboratories are, and funded by the several federal agencies with environmental responsibilities. Its research goal should be the development of knowledge and techniques that will lead to effective management of the environment. Its prime missions would be to carry out research in the environmental sciences and to develop a quick-reaction field function that would call attention to potential threats to the environment. It would perform research in monitoring but should not have operational responsibility for a monitoring program. It would conduct analysis of its research results but not be as policy-oriented as the Institute of Environmental Studies (cf. VI below).

A National Laboratory is one of the essential components of the institutional framework we believe necessary to meet the nation's needs for environmental research. An arrangement outside the government has the advantage of flexibility and a minimum of extra-bureaucratic constraints. It would encourage the relatively free interchange of research staff among universities, private research institutes, the National Laboratory, and other federal laboratories. An independent laboratory has the further advantage of providing diversity of talent and viewpoints necessary to cope with environmental problems. These characteristics have been partially responsible for the success of national laboratories in other fields, notably Brookhaven, Oak Ridge, Los Alamos, and Livermore. Many of the major oceanographic laboratories such as Woods Hole and Scripps behave as and consider themselves national laboratories although they are operated by private institutions. We have the successful experiences of these laboratories in mind in proposing yet another.

Activities of a National Laboratory

The National Laboratory for the Environmental Sciences should be responsible for basic and applied research with the following objectives:

1. Analysis of the interaction of environmental factors, leading to
2. Development of the capacity to predict environmental changes, and thus
3. Development of the capacity to maintain, modify, restore, improve, and generally control the environment.

In order to move effectively toward these objectives the laboratory will need a sizable research staff, laboratory facilities, and special supporting staff and equipment for environmental expeditions and field experiments. Part of the analysis of environmental factors would be based on the vast body of monitoring data to be acquired through the activities of the federal government.

Quick-Reaction Field Function

The capacity of the National Laboratory to conduct environmental expeditions will also permit it to carry out quick-reaction field studies pertinent to potential environmental crises. Quick reactions might involve the rapid deployment of a field force for a period of a few weeks or months. This requires a pool of experienced scientists and technicians familiar with field-operational needs, equipment, and instruments. The pool could function like a fire department, with members on standby, in training, or doing research when not in the field. Alternatively, a team might well be assembled from a sufficiently large group of experienced field environmentalists from outside the Laboratory, as was the case following the earthquake in Alaska in 1964. A similar quick-reaction mechanism may be anticipated in the environmental sciences once the flexible and diverse institutions we propose are operational. Such a team would respond to an early-warning signal from the monitoring and indexing system, or from a research laboratory, or from the Institute of Environmental Studies. The

necessary components for building a National Laboratory, the scientists, supporting staff, and facilities, might well come from existing laboratories whose missions have been accomplished or whose original usefulness has diminished. Biologists, physicists, computer scientists, and other specialists could serve in the new laboratory and after a time serve as well as they did in the various old ones. The growing concern for the environment that we sense among scientists and other professionals, and the need for new kinds of research, might well serve to reinvigorate many professionals who seek new opportunities to assume useful social roles. Such a pool of talent would be useful in building environmental laboratories and should be enthusiastically tapped.

VI. Decision-making in environmental matters at all levels of government has been hampered by lack of adequate analyses of what is now taking place and alternative options. We *recommend* the establishment of an Institute for Environmental Studies. The Institute would carry out the following functions: 1) do long-range planning for the enhancement of the environment; 2) provide early warning on potential threats to the environment; 3) conduct rapid analytical studies in response to emergencies; 4) carry out rapid field analysis; and 5) systematically study and analyze the social, political, economic, administrative, legislative, and other factors that influence environmental decisions and the management of the environment. In order to achieve and maintain objectivity and independence, the Institute should be funded largely by the private sector, though it would, as well, accept grants and contracts from government agencies. The Institute would probably need a staff of approximately 200 professional researchers and analysts, including ecologists, biologists, economists, sociologists, physicians, lawyers, engineers, physicists, chemists, architects, social psychologists, and political scientists, particularly specialists in public administration and international relations, as well as information specialists and others. An institution of this size would require a sizable budget, a substantial portion of which, we believe, should come from the private sector—foundations, industry, and conservation groups—the remainder from contracts with federal, state, and local governments.

An effective Institute would:

1. Need to be financially independent of any department or agency of government and of industry and special-interest groups
2. Need to build confidence in its integrity among clients and supporters as well as among the public
3. Need a talented and highly professional and dedicated staff, broadly representative of a suitable blend of the various relevant disciplines but well disposed toward interdisciplinary efforts
4. Need experienced and insightful public-policy specialists and, at least on an *ad hoc* basis, participation of administrators and other governmental officials
5. Need sufficient financial resources, with reasonable expectations of continuity of support
6. Need to make widely available to the public all studies and research findings
7. Need a conscious and conscientious recruitment policy aimed at attracting young people and placing them in positions of responsibility and influence

VII. In the long term, efforts to conserve national resources and manage the environment depend on educating the public and their representatives and developing needed specialists with broad interdisciplinary backgrounds in problems of the environment. Adequately federally financed (National Science Foundation) curriculum efforts already exist at the elementary school level, but programs in junior and senior high schools are grossly deficient, and many of our children complete school without meaningful exposure to the values of the environment and knowledge about the dangers to it. We *recommend* that the National Science Foundation undertake to develop and sponsor a Junior Environmental Education Program at secondary school level designed to involve teenage youngsters with the whole range of environmental problems. We need to generate "environmental consciousness" through broadly based educational programs in the schools and for the public in general. No matter how rational, well informed,

and sober the advice given to governments by science, and how alarming the consequences of inaction, there is little likelihood of effective action unless pressure for reform is generated by public opinion. This, we believe, can best be achieved by inclusion of environmental education in the secondary schools and by encouraging the media to carry the message to the public as broadly as possible.

VIII. The traditions of the university, with its established discipline-oriented structure and its system of rewarding excellence for research in traditional academic fields, may make development of the broad multidisciplinary efforts required for environmental studies difficult to achieve. Therefore, to promote such efforts, we *recommend* two approaches:

1. Creation of multidisciplinary programs of environmental affairs within existing universities, to be funded in part by federal grants
2. Establishment of an experimental problem-oriented graduate school to be supported in part by a proposed Environmental Coalition

There is a great need for the universities to train the manpower essential to cope with environmental problems in the future, at both the undergraduate and graduate levels. At the undergraduate level, the problem is one of providing broad interdisciplinary, problem-oriented education to students who will, at the same time, acquire proficiency in one of the standard academic disciplines.

At the graduate level, the program would consist of advanced training in the student's speciality, together with group efforts guided by multidisciplinary groups of faculty, to study real environmental problems. For example, a physics student might work with students and faculty on meteorology, marine biology, physiology, and agriculture to study the partition of CO₂ among the atmosphere, the biosphere, and the sea. The results of the investigation might well constitute a group thesis.

The following difficulties must be overcome if suc-

cessful multidisciplinary programs of environmental affairs are to be established:

1. Prestige value must somehow be attached to environmental problems of an applied nature, so that some of the best students and faculty will be attracted to work on such problems.
2. Universities must allocate substantial funds of their own for the development of new programs in environmental affairs precisely at a time when unprecedented demands are being made on their limited financial resources. These difficulties can be alleviated by provision of money from the federal government.
3. Faculty members must learn to work with colleagues from other disciplines in new, unfamiliar, and perhaps awkward ways. Summer workshops, seminars, and symposia can be of considerable help in this regard.

We believe this is best accomplished through multidisciplinary problem-oriented programs of environmental affairs. A typical undergraduate program of studies would include a conventional major program in a discipline but with substantial additional exposure to related environmental curricula. For example, a physics major would also study ecology, meteorology, and geology, as well as the usual mathematics. Regular seminars would be held on environmental problems from the points of view of different disciplines.

IX. Several avenues of approach to informing the public on environmental problems should be developed and implemented. Among these are: 1) displays and demonstrations in museums, schools, and similar public places about the environment, the demands being placed on it, and the effects, dangerous and otherwise; 2) the development of semi-popular literature about the environment, its despoliation, and the need for restoring it as our most important resource and legacy; 3) the use of commercial and educational television and radio as means of creating "environmental consciousness"; 4) the development of curricula for adult education relating to the environment; 5) the encouragement of popular magazine articles about the environment; 6) the en-

couragement of public discussion groups and organizations, such as the League of Women Voters, foreign affairs associations, P.T.A.'s and others, to adopt environmental discussion topics for their organizations. It will be necessary to develop materials and curricula for distribution to and by such groups.

To facilitate the process of public education, we *recommend* the establishment of a National Environmental Coalition, which would be supported by foundations, conservation groups, population organizations, philanthropists, industry, commercial broadcasters, publishers, and the journalistic media. The Coalition would encourage and support the formation of local environmental coalitions all over the country and provide all possible support and encouragement for the formation of similar groups abroad. Such coalitions could well serve as viable mechanisms through which public action programs might be organized, channeled, and implemented.

I Introduction

Effects of decisions relating to the human intrusion into the natural environment are frequently *irreversible*. Historically, we have ignored the despoliation of our environment and have done little to marshal the political, social, intellectual, and institutional tools necessary to deal with mounting environmental problems. In this report we propose some new institutional arrangements, both public and private, which may, if implemented, provide a better foundation on which to build for the development of the knowledge, policies, and programs essential for the improvement of the quality of our environment.

Our discussion of institutional innovations is based in part on our general experience with a variety of environmental problems and in part on a detailed examination of the history of decision-making relating to the environment in South Florida. At issue in that case is the construction of a jetport at a site on the border of Dade and Collier counties, due west of Miami, just north of Tamiami Trail and Everglades National Park. This project brings

into focus in a microcosm many of the important issues common to larger environmental questions: the pressure of population growth, economic factors and political forces, and the need to preserve an irreplaceable, unique ecological system which has complex and fragile connections with the surrounding area.

Study of the Everglades case has furnished us with considerable insight into the types of problems that are faced by decision-makers who must deal with complex and value-laden issues, whose decisions will affect the lives of many people and the future of valuable resources. Major factors appear to be the division of responsibilities between various local, state, and federal governmental and nongovernmental groups, difficulties in communication among these groups, and a severe lack of information on critical aspects of the problems.

In considering what could be done to provide a sound basis for dealing with future situations of this kind, we have been influenced by a number of external considerations. Americans are growing more aware of the deteriorating state of their environment and are increasingly coming to recognize that national wealth is not measured in economic terms alone and that the concept of quality of life is a vitally important consideration. They are beginning to realize that their health, their recreation, and their way of life are being adversely affected by the waste products that their growing and affluent society creates and releases into the environment as unwanted and frequently dangerous byproducts, and they are becoming increasingly concerned.

The large number of interested segments of the society, the number of involved governmental agencies (Health, Education, and Welfare, Interior, Agriculture, Transportation, State, Defense, to name a few), the scope of the technological, sociological, political, and economic aspects of environmental problems, all point to the need for a variety of responsive institutional innovations; no single one can do the job. Indeed, there is a danger that a single step, such as formation of a high-level Board of Environmental Advisors or a new analytical institution, will be interpreted as a sufficient reaction to the entire range of our concerns. We believe much more is needed and we have attempted to develop a comprehensive approach.

From its examination of our environmental problems

the Study Group identified a number of functions that must be accommodated if we are to have effective environmental management in the United States:

1. *Long-Range Planning*: Development of a long-range strategy for effective management, protection, and use of the environment. There is a need to analyze and examine a variety of alternative strategies to deal with environmental matters. Such strategies might well include the use of incentives and user charges to achieve compliance with national standards. Further, there is a need to develop new ways of analyzing and evaluating environmental quality so that the budgetary process at various levels of government can be guided by environmental as well as economic considerations.

2. *Early Warning*: It is necessary to develop a system by which possible environmental disasters as well as positive developments for the improvement of environmental quality can be predicted. This function involves a continuing and systematic examination of national developments that relate to environmental change, projected land uses, and applications of technology to avoid or mitigate possible adverse effects on the environment.

3. *Monitoring*: In order to understand how man is changing his environment we need to develop ways of measuring environmental quality. Measurements of changes can provide a valuable management tool.

4. *Quick-Reaction Field Function*: There is a need to obtain critical data in environmental problem areas on a short-term scale. These data, combined with information obtained over a longer period of time, are of critical importance to the analyst.

5. *Quick-Reaction Analytical Function*: There is a need to bring together available information in a cogent and timely fashion for decision-makers at various levels of government.

6. *Education*: There is a need for greater numbers of personnel professionally trained in environmental problems and public awareness and concern for the environment.

7. *Communication*: Closely coupled to the educational function is the function of making information about the environment available to the public. Moreover, the inadequacy of communication between research workers and decision-makers in

various agencies, at various levels of government, clearly illustrated in the Florida jetport case, makes it necessary that means of communication, including a common language, be developed.

In the following pages we examine these various functions in greater detail and explore possible institutional mechanisms by which these functions can be effectively carried out.

2 *Institute for Analytical Studies*

Among the several institutions we believe are necessary to carry out the functions identified above, perhaps most important is one designed to: 1) do the long-range planning necessary for restoring and protecting the quality of the environment, 2) provide early warning on potential threats to the environment, 3) conduct rapid analytic studies in response to emergencies, and 4) produce rapid field analyses. This proposed organization might be called the Institute for Environmental Studies (IES).

The IES probably would need a staff of approximately 200 professional researchers and analysts, including ecologists, biologists, economists, sociologists, physicians, lawyers, engineers, physicists, chemists, architects, social psychologists, and political scientists. An institute of this size, depending on the experimental facilities included, would require an annual budget of \$10-15 million. We propose that roughly half of this money be sought from the private sector, the remainder to be derived from contracts with federal, state, and municipal governments, from

industry, and from conservation groups. The Institute would be organized as a not-for-profit corporation entirely outside the government.

LONG-RANGE PLANNING

Long-range planning should be genuinely interdisciplinary, with particular emphasis on law, economics, and medicine, as well as on technology. In order to keep attention fixed on possible futures of the real world, it should be closely tied to the quick-reaction function, with some professionals in common and with frequent interchange of others. There should also be a distribution of interest over typical problems and issues at local, state or regional, and national levels so that questions of implementation can be considered from a diversity of points of view.

The principal emphasis should be on the development of strategies for the achievement of future situations in which the environment is much less disturbed than we anticipate it would be if present tendencies were to continue. Ways of gaining public acceptance of these strategies must be sought for as part of the work of the proposed institution. In contrast to the quick-reaction situation, where current political acceptability is critical, the relevant considerations here are future acceptability and how to obtain it.

Development of indicators of environmental quality and their introduction to general use will be helpful both in planning and in education of the public. Indeed, a major function of the proposed Institute for Environmental Studies would be the development of appropriate Environmental Quality Indices.

In devising strategies it is essential to try to identify the *decision-points* in advance—the times and places at which decisions made will profoundly affect the future—and also to determine the *levers*, the instruments by which decision-makers can bring about significant changes. Clearly, one must also consider, and from time to time suggest changes in, the institutions that are available in our pluralistic society for contributing to decisions on the environment: regulatory agencies, monitoring agencies, legislative committees, agencies advisory to government at various levels, citizens' organizations, not-for-profit institutions, universities, and others.

Like the quick-reaction function, long-range planning must involve systems analysis of a special kind, with careful attention to variables difficult to quantify, with projects assessed according to their effects on the total complex of systems and values (possibly conflicting), and with the studies taking into account public sensitivities to environmental quality.

It seems to us that it will be helpful in the development of tools for effective environmental management to depart from the usual emphasis on exploitation and extraction of resources and focus on technical achievements that benefit the environment by:

- a) carrying out needed industrial tasks with less damage to the environment;
- b) repairing damage already done to environment; and
- c) providing attractive alternative employment for those engaged in activities that may have to be phased out to protect the environment.

Strategies for effecting this change in emphasis will undoubtedly include the corresponding shifting of incentives, including, especially, tax incentives at the federal, state, and local levels.

A related question is that of incorporating into the market economy some of the "external diseconomies" of transportation, manufacturing, power production, and so forth, especially those involving the degradation of "public goods" like air, water, wilderness, wildlife, and the visual and auditory surroundings of man. A major question is the extent to which we should supplement the present methods of dealing with these matters at various levels of government by standards and prohibitions, with other methods such as user charges and tax incentives. (An example of tax benefits in connection with land use is a step recently taken by some states to protect the owners of land who wish to keep it wild or semi-wild from the pressure of increased taxation caused by willingness of their neighbors to develop.)

Just as classical economics has been stretched to accommodate the notion that air and water are not free goods in the usual sense, and just as "cost of information" is being integrated into economic doctrine, so it may be desirable to incorporate

effectively into economic theory other important notions, such as that of diversity. For example, even though each of many small districts may maximize its economic benefits in a narrow sense by having the same mixture of cities, farms, and wilderness, there is intuitively a great advantage to having urban concentrations of critical mass, large tracts of wilderness, great rural expanses, and so forth. The quality of the whole country is thereby enhanced.

On the practical side, the maintenance of diversity and the defense of aesthetic and environmental values will require generalization of the concept of zoning, in the direction of stronger and more long-lasting powers involving institutions other than those that are usually associated with the zoning authority. Wilderness areas and parks are already existing examples affecting publicly owned land, but to establish rural belts, for example, will require new means of enforcing restrictions on the use of privately owned land.

Problems on the world scale are likely to be more significant in long-range planning than in quick-reaction effects. Many of them are of transcendental importance, starting, of course, with the urgent problem of world population growth. But there are many others; for example, the world's climate may be subject to cooling by aerosol pollution and heating by CO₂ emission. With one sign or another probably taking the lead, the dangers of the melting of icecaps or of an Ice Age are not trivial. This illustrates a class of problems that must be tackled on a planetary scale.

Use of the oceans, unless conservation and research soon take precedence over exploitation, will be a classic example of the "tragedy of the commons" in which the selfish interest of each single nation runs contrary to the common interest of all. The threat of disappearance of the great whales is only an early example of what may become a general misfortune.

In international issues it is important to emphasize that to obtain diplomatic support of a proposal by a foreign nation, especially a democratic one, it is important to have a strong constituency in that nation supporting the proposal. Any strategy for international conservation measures must include consideration of how to widen and strengthen such constituencies in connection with environmental issues.

RATIONALE FOR THE PROPOSED INSTITUTE

We suggest the following as necessary for a viable and effective institute for analytical studies (not in order of importance).

- Independence from the influence of any government agency or special interest
- Public availability of all studies
- Confidence of clients and the public in the integrity and independence of the institute
- Comprehensive representation of relevant disciplines
- A highly talented and dedicated professional staff
- A group of experienced public-policy specialists and, on an *ad hoc* basis, consultation with administrators and elected officials
- A policy of recruiting young people for positions of responsibility and influence

Non-Governmental Approach

The decisions faced by those responsible for action with regard to environmental matters take many forms. In some cases the decisions involve concrete issues such as the Everglades jetport or the Santa Barbara oil spill, which have received national publicity as a result of citizen concern. Such clearcut, well-defined, and widely publicized issues are, of course, in the minority. Most decisions about the environment, even those that may have a profound effect, are taken with very little publicity or input from other than special-interest groups, and are made entirely within a single government agency or even a single bureau. There is often little communication between agencies.

For effective management of the environment, decision-makers in government agencies require the very best in analysis, so that likely environmental consequences of various possible options are clearly indicated. At present this analytical function is usually carried out within a government agency by busy officials with many other duties and responsibilities. Faced with the myriad

day-to-day pressures of government, analysts often are unable to provide fresh points of view or provide the independent analysis essential to really effective management. Further, the various professional talents needed for balanced decisions—medical, physical, economic, etc.—may simply not be available within any single government agency. Use of consultants is frequently of limited value and inconvenient, and too often leads to delay. Similar problems face members of Congress concerned with legislation affecting the environment.

Of the three functions defined in the previous section—the development of long-range strategies, the early warning, and the quick-reaction analytical functions—it is unlikely that the first two will receive within the existing governmental structure the kind of continuing attention that is necessary. These requirements will best be met if study and evaluation are carried out by an independent group with no commitment to the operating policies of a particular government agency, and whose findings should also be available to the Congress and the public.

The Department of Defense has developed a great deal of experience in the use of outside analytical organizations. In many instances groups such as RAND and the Institute for Defense Analyses have been able to mount in-depth, multi-disciplinary studies on long-range defense problems that have been of tremendous value to the decision-makers. They have frequently carried out studies that essentially could not have been undertaken by agency personnel. In many ways the three environmental-management functions described above are far more complex and less easily handled than those relating to defense. Environmental values are not so easily quantified; simple benefit-cost analyses are certainly inadequate. While, in general, problems of security classification will not arise, the sensitivity and proprietary nature of much of the information, the public-policy and possible financial implications of such studies, make it necessary that an outside analytical institution establish close and confidential working relationships with civilian agencies.

We conclude that the multi-disciplinary talent that must be brought to bear on environmental problems, the freedom from the pressure of day-to-day operations required for long-range planning, the involvement of the various interested government

agencies, and the different levels of government as well as the Congress and the public, all argue convincingly for the establishment of an analytical institute outside the structure of government.

Requirements for Independence

An effective analytical institution must be not only creative but also objective and independent. Without these qualities the institution would not be able to attract and retain the professional talent that is required to deal with difficult environmental issues.

To be independent the institution must have wide latitude in selecting the problems on which it is to work. One way to assure this freedom would be to maintain a balance between governmental and non-governmental support. At least half of the total support for the institution should be available exclusively for self-generated studies. The institution should decline specific contracts if it feels the stipulated guidelines are too restrictive. For example, a contract that categorically states that a facility is to be built at a particular location and asks about the consequences for the environment should generally be refused. A more satisfactory proposal would ask if there is a need for a particular facility and, if so, where should it be located, and what would be the consequences for the environment.

A second essential requirement for independence is that support from government come from a number of different agencies. Multi-agency support would allow the institute to refuse inappropriate requests without fear that its major source of (government) support would be threatened; this would eliminate the danger of becoming captive of a particular agency.

A strong and active board of trustees, providing continual evaluation of the soundness and relevance of activities, is another requirement for the maintenance of the integrity and independence of the institution. A strong Board would also serve the purpose of backing up the administration of the Institute where major disagreements arise between contractors and the Institute. Several diverse interests should be represented on the Board, including representatives from universities, from conservation organizations, and from private industry.

Communication of Study Findings

Study and analysis functions of the institution will be of value only to the extent that these lead to action. There must be close ties between the Institute and those with the power and responsibility to act upon their findings—i.e., the Executive Branch of the government and the Congress—and the public. Dissemination of study results is of prime importance, and results of studies will have to be presented in such a way as to be understandable to audiences of different levels of sophistication.

Professional Staff

In order to undertake the study of environmental problems as wide-ranging and complex as air pollution, better land management, water pollution, technical alternatives to land airports, new strategies for better social use of the environment, comprehensive means of measuring environmental change, a great variety of professional skills and backgrounds will be required in the staff. These would include sociology, economics, political science, management sciences and public administration, law, architecture, civil engineering, systems, and chemical engineering, medicine and public health, ecology, biology, geology, physics, and chemistry. The experience of the Summer Study work on the Florida jetport issue by our Study Group illustrated the need for contributions by specialists in all these disciplines, and that people of such diverse backgrounds can work together effectively.

The type of problem-oriented research and analysis to be carried out in the Institute is quite different from that normally encountered in most universities with their highly structured departments. Organizations such as RAND and the Institute for Defense Analyses were set up to deal with the broad complexities of defense issues precisely because the university structure and purpose were inappropriate for dealing with such problems.

We have arrived at a figure of 200 professional personnel to staff the Institute on the basis of our combined experience with other analytical and research institutions as well as the insights gained during the Summer Study. We have also examined the size of other organizations working on environmental problems.

A smaller group might have to limit its concerns in too few and relatively minor problem areas while a larger organization might become too diffuse and unwieldy.

Organization and Funding

At present the cost of operating research institutes indicates that about \$50,000 per year in direct and indirect costs is required for each senior investigator. Thus, a staff of about 200 professionals would require about \$10 million per year.

Continuity and stability as well as the greatest possible independence and integrity in the Institute require support of five or more million dollars annually, independent of governmental funding. Additional funding could be expected to come from contracts with interested governmental departments.

It is likely that future legislation will place increasing responsibilities on governmental agencies to examine the impact of their programs on the environment. The Institute could well become a major non-governmental source of objective research and analysis which would also make its competence available to state and municipal governments, industry, and conservation groups.

It may well be unrealistic to expect a new institute of this sort to obtain critically important funds of \$5 million annually from private sources. It has been suggested that to ensure initial stability the Institute should be associated with a prestigious existing organization such as the Smithsonian Institution or the National Academy of Sciences–National Academy of Engineering, and that funds should be obtained for an initial period of five years.

MODE OF OPERATION

The Institute for Environmental Studies would initiate much of its own work, particularly that relating to the development of early-warning systems and long-range planning, using its private funds. Some of the basic research that will be needed for the more action-oriented work undertaken by the Institute can be contracted out to universities and other institutions concerned with environmental problems. Summer study groups con-

sidering specific problems, involving university faculty and students, should be organized and encouraged by the Institute. It may be desirable to provide semesters in residence for students who might accompany university professors on leave to the Institute. Similar arrangements for government employees should be encouraged. Seminars for legislators and industrial people could be arranged. Consulting arrangements entailing varying degrees of involvement would be encouraged, as they are by the highly successful Jason Division of the Institute for Defense Analyses (a group of university professors who work with IDA during the academic year as part-time consultants and regularly hold summer studies on topical issues). An analogous group could be formed to serve as the nucleus of a quick-reaction *ad hoc* task force for the Institute for Environmental Studies.

Quite generally we see the Institute as forming a bridge between the government and the academic community, involving people at the various levels of both sectors in environmental affairs.

In connection with early-warning activities, recourse to private funds will be critically important. There will be many cases in which the warning could be highly inimical to one or another industry or to the operation of a government department. The ability to speak freely without conflicts of interest is vital. This will be especially true in cases in which warning must be given before final incontrovertible scientific evidence is available (e.g., as in smoking and lung cancer, heart disease, etc.).

Another important aspect of the Institute of Environmental Studies must be a strong working relationship with conservation groups that inspire action and marshal public opinion in favor of preserving the environment. Working in many cases at the local level and generally with limited funds, these groups often have had great difficulty in carrying out the research necessary to document claims of impending tragedy. These valuable sources of early warnings from the field should be strengthened and encouraged. Some of the Institute's funds should be allocated for the needs of the conservationists, perhaps in part to coordinate their activities with college and university activities.

We also note that an increasing number of the most important environmental problems have international implications,

such as global air and water pollution. An independent organization working broadly with the government but existing outside of it will be in a good position to engage in cooperative activities with institutions in other nations.

There is no doubt that the Institute for Environmental Studies will be largely dependent on governmental agencies and the monitoring agency and national laboratories referred to elsewhere in this report for its basic physical data, since maintenance of extensive monitoring facilities would not be part of the IES. Some field capability may be required to facilitate cooperation with monitoring agencies and to enable quick-reaction field teams in the national laboratories to be effective.

The Institute for Environmental Studies might hope to influence policy by carrying out imaginative, objective, and accurate studies and defining their results in a cogent and reasonable manner to the public, Congress, and the Executive Branch of the government.

PRESENT EFFORTS

The number of university and non-profit research laboratories and institutes directly or tangentially concerned with environmental problems is large and growing rapidly. According to the "Research Centers Directory" and the associated publication "New Research Centers," both reference periodicals, the number of environmental research centers existing outside the federal government in June 1969 was about 250, one third or more of which had begun operations within the last two or three years. Almost all of these are very small (typically, three, five, or ten research professionals and budgets less than one half million dollars per year) and their interests generally rather specialized, e.g., water resources or air pollution. There are at least 42 water-resources laboratories associated with universities in this country.

There are, however, some more substantial institutions. For example, the Ecology Center at the University of Utah at Logan has 22 research professionals and a \$1,029,000 budget in 1968. The Institute for Environmental Medicine at New York University had 23 research professionals and a \$1,400,000 budget

in 1963; Resources for the Future, Inc., of Washington, D.C., has 25 research professionals and a budget of approximately \$1 million per year, and the Center for Environment and Man in Hartford, Connecticut, has 25 professionals and an annual budget of over \$1 million.

In a substantially different class are the big interdisciplinary research institutions whose main client is the Department of Defense, and whose main interests are defense-related economic analysis, military hardware and software, war games, strategy, and related concerns. Most of these institutes are not concerned with environmental problems, but some (RAND, Hudson Institute) have devoted some portion of their efforts to urban problems, transportation problems, and other social problems.

In addition, there are numerous federal government research offices and bureaus within the departments of Agriculture, Commerce, Interior, Housing and Urban Development, Transportation, and Health, Education and Welfare. In almost all cases they employ small numbers of greatly overworked people.

Each of the existing research organizations is severely limited in one or more of the fundamental respects outlined at the beginning of this section. Furthermore, modification or expansion of existing organizations would probably not be satisfactory. Some of the smaller ones (like Resources for the Future) are lacking only in size, diversity of disciplines, and money. Environmental problems are so critical, and public and political concern so high, that a new and innovative approach to developing an analytical institution seems both necessary and desirable. We feel that the proposed Institute for Environmental Studies would meet these needs.

It is clear that there already exists considerable, though seriously uncoordinated, capability for research on environmental problems and their solution. One of the essential primary tasks of the new institution would necessarily be to assess the strengths and weaknesses of existing organizations, large and small, throughout the nation. Strenuous efforts would have to be made to coordinate their activities, so that a rational overall research strategy could be developed.

3 *Education and the Environment*

Successful efforts to conserve our natural resources and manage the environment more effectively will depend in large measure on our ability to train people to understand and to cope with the related complex technical and social problems, as well as to develop and implement programs for the distribution of information on a broad scale. We will need to generate an "environment consciousness" through broad educational programs in the schools and more generally for the public. Unless this consciousness is developed it will be difficult to change living habits and industrial practices, the effects of which are often damaging to the environment. No matter how rational, well informed, and sober is the advice given to government by science, and no matter how alarming the consequences of inaction, there is little likelihood of effective action unless pressure for reform is supported by public opinion. And the public will be unmoved unless people generally come to know the price of continued deterioration of the environment and the results of inaction. Major environmental catastrophes are

usually the result of gradual and incremental despoliation and not of single dramatic events, to which the public would be more inclined to react spontaneously.

ENVIRONMENTAL EDUCATION IN ELEMENTARY AND SECONDARY SCHOOLS

There are approximately 50 million children in the nation's elementary schools and junior and senior high schools. Many complete their secondary education without having been exposed to the values of the environment and potential dangers to it. It is helpful to begin by considering some of the federally assisted school programs that have already been developed.

At the high school level (grades 10-12) a number of well-known science-education programs, dating back to the late 1950's and the 1960's, are already in existence. These include the Physical Science Study Committee program (PSSC) in physics, and analogous programs in chemistry, earth sciences, and other fields. Such courses are aimed at improving the level of scientific education of the population, but each is directed toward a single traditional discipline. It might prove difficult to introduce a broad interdisciplinary program in the environmental sciences into the high schools at this time since many already have committed themselves to new science programs of the PSSC type. Thus they may be unwilling and unable to make a substantial investment of funds available in the immediate future for environmental education and teacher-training programs.

At the elementary level (K-6) the situation is somewhat brighter. There are at least three federally assisted programs of national importance, the major ones being Elementary Science Study (ESS), Science—A Project Approach (SAPA), and Science Curriculum Improvement Study (SCIS). Of these, SCIS is the most promising for environmental education, because it centers attention on ecological and biological questions. Also, it is unique in that it provides a variety of living organisms for classroom demonstrations and experiments as part of a complete elementary science course. The educational materials consist of textbooks, teachers' manuals, films, demonstrations, and experimental kits.

At present the course is being taught to 200,000 children, and that figure is expected to rise to between 2 and 5 million within a few years. The project staff consists of approximately 30 persons, led by two scientists of national reputation and a young school administrator with a strong background in science. It is funded by the National Science Foundation in the amount of approximately \$600,000 per year; the total spent so far is approximately \$4 million. The project is housed at the Lawrence Hall of Science, a Science Museum Teacher Training Center at the University of California in Berkeley.

The project has been received favorably in U.S. schools and has been adopted by the Swedish government for use in Swedish public schools. It impresses us as an excellent beginning program in environmental science for young children. The essential features that permitted success and that we believe must be present in new programs designed for the higher grades are:

1. Inspired leadership provided by one or more distinguished scientists
2. Sustained adequate support
3. The appropriate academic environment for the project itself—working space, moral support, efficient management, and a vital intellectual community, plus teacher-training facilities

A great demand has recently arisen for new science programs to follow SCIS, SAPA, and ESS in the junior high schools (grades 7-9). We *recommend* that the highest priority be given to a new Junior Environmental Education Program (JEEP), to be implemented as follows:

1. The project leader to be a distinguished scientist, preferably to be chosen by a national advisory committee of well-known persons
2. Sustained funding at \$750,000 to \$1 million per year, preferably from the National Science Foundation
3. The project to be located at a leading university, preferably in a community with good public schools. The Lawrence Hall of Science is in many respects an advantageous site,

since many of the SCIS personnel might make a significant impact, and since teacher-training facilities and a good museum exist there.

In summary, the SCIS program is a good beginning in environmental education, though the situation in high schools at present is not good, and a vacuum is waiting to be filled by a well-oriented junior high school program (JEEP).

ENVIRONMENTAL SCIENCE AND UNIVERSITIES

Most universities are organized along departmental lines, and interdisciplinary or multidisciplinary approaches, such as would be required for dealing with environmental matters, tend to be concentrated in institutes, which generally stand apart from the main focus of the parent institution. This is in part a consequence of history, but partly results from a kind of distaste for problem-oriented activities among more tradition-oriented scholars. The universities, however, must provide the needed manpower to cope with the environmental problems of our society, and this can be done only by providing relevant education at both the undergraduate and graduate levels.

At the undergraduate level, the problem is to provide broadly interdisciplinary, problem-oriented education to students who will, at the same time, acquire deep proficiency in the separate relevant standard academic disciplines. We believe this would best be done by encouraging the creation of new interdisciplinary programs for environmental studies under institutional arrangements appropriate to individual universities. As in engineering, the student would get most of his education outside his major department, and his professional orientation within it.

A typical undergraduate enrolled in such a program would follow a more or less conventional major program in a selected discipline, but with substantial additional exposure to related environmental disciplines. For example, a physics major would also study ecology, meteorology, and geology, as well as the usual mathematics. There would be regular seminars, beginning in the freshman year, devoted to some broad environmental problem examined from the point of view of many separate dis-

ciplines, e.g., global energy resources and requirements as seen through the eyes of the physicist, the engineer, the demographer, the economist, the ecologist, and others as appropriate. Summer field work could provide practical experience as well as an appreciation of values other than the traditional ones.

At the graduate level, the program would consist of advanced training in the student's specialty, together with group efforts guided by interdisciplinary groups of faculty working at solving real environmental problems. For example, a physics student might work with students and faculty from meteorology, marine biology, physiology, and agriculture to study the partition of CO₂ in the atmosphere, the biosphere, and the sea. The results of the investigation could constitute a group thesis for all the students concerned. In fact, there are precedents for this approach, particularly in high-energy physics.

The following difficulties must be overcome if successful environmental programs are to be established:

1. Prestige value must somehow be attached to environmental problems of an applied nature, so that some of the best students and faculty will be attracted to work on such problems.
2. Universities must allocate substantial funds of their own for the development of new programs in environmental affairs precisely at a time when unprecedented demands are being made on their limited financial resources. These difficulties can be alleviated by provision of money from the federal government.
3. Faculty members must learn to work with colleagues from other disciplines in new, unfamiliar, and perhaps awkward ways. Summer workshops, seminars, and symposia can be of considerable help in this regard.

On the positive side, imaginative new programs in environmental science would almost certainly enjoy an enthusiastic response from students. As is well known, students now are deeply troubled about the state of the world, and for the most part sincerely anxious to do something about it. The kind of program described above could provide a constructive channel for their energy and idealism. Also, as interdisciplinary faculty groups develop experience in dealing with environmental affairs, they should

evolve into research groups of high competence, capable of solving environmental problems on the local and state levels. We *recommend* a federal assistance program (through the National Science Foundation) to aid the universities in making these needed changes.

NEW PROBLEM-ORIENTED UNIVERSITY

We are not sanguine about university faculty and administration rising fully to the challenge of environmental problems. The deeply conservative nature of universities, the established reward system for excellence in research in narrow traditional disciplines, and the professional society structure all make the changes discussed above difficult to effect.

The creation of problem-oriented graduate programs would be accelerated by the establishment of an entirely new post-graduate Environmental Studies University which we hereby *recommend* for consideration and further exploration. Our tentative proposal would be that students, after one or two years of conventional graduate work in one of the traditional disciplines, would be admitted to the experimental institution to do problem-oriented, multi-disciplinary work. It therefore seems natural to suggest that the staff of the proposed Institute for Environmental Studies itself should supply at least part of the faculty, and that the new graduate school, if not actually a part of the Institute, should at least be located at the same place. Students would benefit from their exposure on a regular basis to the best environmentalists in the country, being "where the action is" and participating in the actual work of the IES. For the staff of the Institute for Environmental Studies it would likewise be an advantage to be exposed to able young students. The new school might also serve as a vehicle for training government officials in mid-career, or for retraining other professionals, for example, aerospace engineers, who might suffer major dislocation resulting from reductions in defense spending or major budgetary shifts to more environment-oriented programs.

GENERAL EDUCATION OF THE PUBLIC

Several avenues of approach must be developed and implemented for effective education of the public on environmental questions. *First*, exhibits, demonstration projects, and packaged display materials relating to the environment to show in science museums, schools, and other public places around the country should be encouraged. The Museum of Natural History in New York has already set an admirable precedent with its centennial exhibit "Can Man Survive?" which opened in May of 1969, and is scheduled for a two-year run.

Second, a steady output of semipopular literature should be developed on environmental subjects. A number of publishers with large distribution capabilities have expressed interest in publishing such materials.

Third, commercial and educational television and radio should be used extensively for developing public consciousness about environmental problems. National Education Television (NET) might well be an excellent medium for effective programming related to environmental matters. Commercial television should also be used, of course, as this becomes possible. CBS presented a one-hour special: "The Natural History of our World: The Time of Man" on September 18, 1969, which was highly entertaining and informative.

Fourth, the development of curricula for adult education relating to the environment.

Fifth, the encouragement of popular magazine articles about the environment as well as simple comic strips, etc.

Sixth, the encouragement of popular discussion groups and organizations such as the League of Women Voters, Foreign Affairs Associations, Parent-Teacher Associations, and others to adopt environmental topics for organizational discussions.

Efforts to fund public-education projects might well be handled by the new Environmental Coalition supported by Conservation Groups, Foundations, individuals, industry, and commercial broadcasters and publishers.

ENVIRONMENTAL COALITION

We would also suggest creation of an Environmental Coalition, somewhat like the Urban Coalition, which would provide the impetus and organizational base upon which the mechanisms we suggest could be developed and fostered. Such a coalition might also serve as a vehicle for public action programs relating to environmental matters.

At present there is a large number of citizen groups whose interests, and indeed reason for being, relate to concern for the quality of the environment. Their efforts are disparate and uncoordinated and thus less effective than they otherwise could be. The establishment of an Environmental Coalition, whose mission would be to coordinate and achieve support for all relevant publicly instigated programs and activities, would bring all these efforts to a new level of effectiveness for the benefit of all society.

4 *Monitoring the Environment*

We cannot effectively manage the environment without knowing what it is and how it behaves. We cannot detect changes, natural or man-made, desirable or undesirable, without repeated observations and established baselines. We neither know in a systematic way what the environment is like nor how and at what rate it is changing. We do make some baseline and serial observations at present through such environment-related agencies as the Environmental Science Services Administration, the U.S. Geological Survey, the Bureau of Commercial Fisheries, the Bureau of Sport Fisheries and Wildlife, the Forest Service, the National Air Pollution Control Administration, and the Federal Water Pollution Control Administration. In addition, many local and state agencies secure data on environmental parameters. Most of these data are obtained for special purposes, there is little cross-referencing of data, few comparative studies, and no overall evaluation of the quality of the environment. The existing environmental monitoring program has many critical gaps.

At the present time, no agency has responsibility for monitoring and reporting the quality of the whole environment. Since the present monitoring effort is so fragmented, various institutions use different sampling methods. Thus, for example, data secured by the Air Pollution Control Administration is not directly comparable to the data obtained by the Water Pollution Control Administration. Yet the quality of the air affects the quality of water. The fragmentation of responsibility results in a lack of coherence in research programs relating to environmental parameters.

Effective monitoring must be based on carefully planned, totally integrated programs of widespread and repeated observations. At present we do not have more than the base structure for such programs. The development of research programs in this area should have high priority. It is clear that monitoring activities should be concerned at least with the following:

1. Physical and chemical properties of land, air, and water
2. Distribution of plants and animals in land, air, and water
3. Land use, including diversity of purpose
4. Construction
5. Noise
6. Epidemiology of man, animals, and plants
7. Evidence of environmental stress such as tranquilizer consumption or asocial behavior
8. Aesthetic qualities

Although this list is incomplete, it includes more than the elements now being monitored as parts of the environment. The necessity for very broad monitoring is suggested by consideration of a relatively simple environmental relationship. Many people have settled in Southern California to enjoy the sun at the broad, clean beaches. Houses have been built right at the edge of the beach, which in some places have then become littered with kelp and buzzing with flies. The houses have displaced tiny animals such as isopods, which previously ate the kelp. More houses have been built inland and in some areas have been subject to floods. Dams have been built and have stopped not only flood

water but also the sand that replaced the beach sand being constantly lost to deep water. Thus the beaches are becoming less wide and less widespread. Finally, to get to the beaches, more and more people drive more and more automobiles, and the resulting smog obscures the sun.

This is a very simple outline of a most complex relationship. We cannot say what happened. We shall have no more success than we have had so far in dealing with these problems in the future without a comprehensive plan for monitoring the whole environment and its changes and knowing the possible consequences.

Once an effective monitoring program is in force it will become possible to set environmental-quality goals based on realistic evaluations of conditions and thereby permit enactment of legislation, policing, and the establishment of permanent national policies. Prompt action could lead to the establishment of a monitoring system by the beginning of 1972, and this could be taken as the base year.

ENVIRONMENTAL QUALITY INDEX

The management of the economic affairs of the nation has been aided by a variety of indices that provide some measure of the nation's economic health. Rates of employment are one such index, as are the measure and rates of growth of the gross national product. In developing the total federal program and determining how much the administration is willing to spend and the Congress is willing to appropriate, these indices could have a crucial effect on the judgments upon which federal policies and programs are based.

The environment and our relationship to it involve values that are either difficult or impossible to measure in economic terms. Alternate means of defining these values are required. One approach is to define certain environmental indices that can serve as quantitative measures of what is happening at regional and national levels. We strongly *recommend* the development of such indices. The following are examples.

1. Transparency of the air
2. Purity of water
3. The ratio of area of open ground to population
4. Noise level
5. Ratio of wild animals to human population
6. Ratio of area of parks to area of parking lots
7. Fraction of utility wires above ground

Measurement of these aspects of the environment would be useful for the purposes of government. A federal or state government might set a goal—for example, that the transparency of the air in a region could not fall below a certain level or over a period of time should be restored to a higher level. A program could then be planned to achieve this goal by appropriate organization, funding, incentives, policing, and publicizing.

The various individual indices could be combined and weighted into an overall Environmental Quality Index, which could become a powerful tool in developing priorities among programs affecting the environment. A familiar index would exist against which changes in the environment could be compared. The composition and weighting of this index or of the component measures will require careful analysis which we do not even attempt to outline. We do emphasize that the program of monitoring must be designed from the beginning to yield appropriate indices.

ENVIRONMENTAL MONITORING AGENCY

We recommend that development of federal programs for comprehensive and systematic monitoring of environmental quality be given highest priority. It could be carried out by a new independent agency or an existing agency. The Board of Environmental Affairs recommended in this report should turn its attention to developing comprehensive monitoring programs as soon as possible after it becomes operational.

The monitoring function would be based initially on the work currently under way in the various specialized environmental agencies and bureaus. Many of these, such as the Atomic

Energy Commission, will have a need to continue their specialized monitoring activities. However, most of the environment-monitoring activities of the federal government should be centralized.

The stated objectives give some indication of why an agency with central responsibility of all monitoring is an essential mechanism. Measurements must be designed to yield Environmental Quality Indices and to indicate when changes in the environment require counteraction. It is doubtful that the environment will ever be understood if we measure, for example, weather only at airports and airborne pollution only in the centers of cities, or if observation stations are moved every time a new airport is built.

ENVIRONMENTAL RESEARCH IN GOVERNMENT LABORATORIES

Numerous government laboratories concerned with problems of the environment now exist in the departments of the Interior, Commerce, Agriculture, and Defense. An increased unification of federal environmental agencies should be accompanied by increased integration and redirection of many of these existing laboratories. There is a special need for a much broader view of the environment and man's effect upon it than we now have. Ecologists and other specialists who employ ecological methodologies should be more numerous in such laboratories, and narrow scientific disciplines should be de-emphasized. With some changes these laboratories could provide the direct support needed for the development of environmental monitoring systems. They also would have the basis for interaction with universities and contract research groups, and potentially with the proposed National Laboratory. They may conduct field experiments or carry out environmental expeditions in the manner discussed in connection with a national laboratory (following section). The principal difference between these laboratories and the national laboratories and university research institutes should be in the degree of operational intimacy with operating agencies. Government laboratories are, at present, more responsive to immediate needs of the operating

agencies and should continue to be so. Non-government laboratories generally address themselves to longer-range problems, but in the environmental sciences long-term and short-term problems and applied and basic research overlap even more than in the more narrowly defined, traditional disciplines. Very close ties and joint investigations between laboratories of all sorts should be expected and encouraged.

5 *National Laboratory for Environmental Science*

The disparate efforts of the many government agencies concerned with environmental matters have led to a greater variety of research programs, but with very special aims and with almost no cohesion. There is no laboratory within the federal government structure, and probably none outside, that carries out research on the environment as a whole. The Federal Water Pollution Control Administration and the U.S. Geological Survey sponsor research programs on surface and subsurface waters. Neither agency is primarily concerned with erosion or the interaction of the water with the air. Various units of the departments of Agriculture, and Health, Education, and Welfare undertake research on pesticides; the influence of airborne pesticides on water quality falls between the cracks. In our judgment, all environmental research efforts now going on at the federal level are inadequate from an ecological point of view. There are too few ecologists in the National Park Service, the Soil Conservation Service, and the Forest Service, for example. As a result, the viewpoint of the

ecologist, dealing with and viewing the environment as a system, has not had sufficient influence on federal research programs.

We recommend the establishment of a National Laboratory for Environmental Science. In our view the laboratory should be contractor-operated, perhaps by a consortium of universities, and funded by government agencies having responsibility for environmental affairs. Its prime mission would be to carry out research in environmental science, and it would be responsible for the quick-reaction field function described elsewhere in this report. It would perform research in monitoring but should not have operational responsibility for a monitoring program. It would conduct analysis of its research results but would not be as policy-oriented as the Institute for Environmental Studies.

A National Laboratory is one of the major components we believe necessary to meet the nation's needs for environmental research. An institution of the kind we envision, outside the government, has advantages of flexibility and minimum bureaucratic constraints, and thus we could have relatively free interchange of research staff and information between universities, the National Laboratory, and federal laboratories.

We point to the successful operation of national laboratories in other fields, notably Brookhaven, Oak Ridge, Los Alamos, and Livermore. Many of the major oceanographic laboratories such as Woods Hole and Scripps behave as and consider themselves national laboratories although they are operated by single, nongovernmental institutions. We have the successful experiences of these laboratories in mind in proposing yet another.

ACTIVITIES OF A NATIONAL LABORATORY

The National Laboratory for Environmental Science should be responsible for basic and applied research with the following objectives:

1. Analysis of the interaction of environmental factors, leading to
2. Development of the capacity to predict environmental changes, and thus

3. Development of the capacity to maintain, modify, restore, improve, and generally manage the environment.

In order to work effectively toward these objectives the laboratory will need a sizable research staff, laboratory facilities, and special supporting staff and equipment for environmental expeditions and field experiments. Part of the analysis of environmental factors would be based on the vast body of data to be acquired through the monitoring activities of the federal government.

We know so little about the environment that it is safe to predict that the data derived from federal monitoring efforts will be but one input in a total monitoring system. Similar circumstances arise in all scientific research, and progress will require further examination in the laboratory or in the field. In some situations, the needed information may simply be collected by one or two men using a few collecting bottles and a rented car. However, complex environmental relationships will demand substantially larger environmental "expeditions." A modern, general-purpose oceanographic expedition suggests the nature, scale, and costs of similar expeditions. A representative oceanographic ship may have a crew of 25 in addition to about 15 scientists and costs \$3,000 per day to operate, not including the salaries of the scientists. On any single day, biological, chemical, physical, and geological observations are made by the scientists and technicians at sea and ashore. An expedition may continue for a year and cost more than a million dollars. The most modern ships have computers and facilities for data analysis aboard. Though productive, they are expensive units to build and operate. The deployment of an ecological expedition consisting of scientists, technicians, lawyers, economists, hydrologists, and physicians and backed with an array of equipment will likewise be expensive if it is to be effective. Moreover, environmental studies are apt to last for several years before a representative sampling of climatic factors, for example, is completed.

Environmental expeditions may be effective in various institutional arrangements. The need for field teams may be minimized by the establishment from the beginning of several regional or branch laboratories. An effort of long duration might indicate the establishment of a temporary field station or operations based

on a local government or university facility. Finally, the observations function might be contracted out to a university or an industrial laboratory in the area. Contractual arrangements could be effective, particularly in situations in which the supervisors were former National Laboratory associates and were available to do the job.

The environmental-expedition approach helps to solve problems with data gathered by observation and experimentation with natural phenomena. The data evolved should be useful in analyzing interactions and predicting environmental changes. However, man-made experiments and demonstrations might provide more useful information needed to solve problems and will be essential to the development of the capability to restore, modify, and control the environment. Controlled experiments on thermal pollution of a small lake or nutrient pollution of a river could provide data of great significance to environmental management. To a certain extent all major human activities are environmental experiments that are more or less out of control. A city generates heat and changes the environment. A dam backs up a lake and does the same. Planned and controlled experiments related to major problems may commonly be of a comparably large scale although of short duration. Such experiments may require major logistic support, including special airplanes, ships, satellites, radar arrays and other remote sensors, and special land transport. It does not appear efficient to maintain such logistic support within the National Laboratory or even within government laboratories. Consequently, the Department of Defense, the National Aeronautics and Space Administration, and the Coast Guard would be called upon for cooperation in the experiments. An excellent record of cooperation already exists and may be expected to continue if appropriate funding is provided.

QUICK-REACTION FIELD FUNCTION

The capacity of the National Laboratory to conduct environmental expeditions will also permit it to carry out quick-reaction field studies pertinent to an environmental crisis. Quick

reactions might involve the rapid deployment of a field force for a period of a few weeks or months. This would require a manpower pool of experienced scientists and technicians familiar with field operational equipment, instruments, and procedures, on standby alert or in training when not engaged in quick-reaction operations. However, the alternative exists of having a sufficiently large group of experienced field environmentalists to staff quick-reaction studies. Such large groups exist in some of the environmental sciences at present but not in ecology. A scientific party to study the effects of the Alaskan earthquake was quickly assembled from within and outside of government. Specialists of the highest competence dropped what they were doing and engaged in the study because it was a unique opportunity to examine the very significant effects of a natural environmental phenomenon. A similar quick-reaction operation is envisioned in the environmental sciences once the various mechanisms we propose are operational. It may entail deployment of a small environmental expedition from a single laboratory or a cooperative effort. It may be generated because of an early warning from the monitoring and indexing system, or from research in a laboratory, or from social and political problems, or from the long-term analyses of the Institute of Environmental Studies.

When a new laboratory is established, some consideration of its ultimate fate is appropriate. The history of most special laboratories is that the bad ones do very little and the good ones solve the problems that caused them to be established, thus working themselves out of a job. Is one more laboratory, let alone a system of laboratories, justified? We believe it is, as the problems of environmental pollution most certainly will be with us for a long time. It has been a hundred years since salmon swam in the streams of the eastern seaboard, and it may be another hundred years before they do it again. Nevertheless, it is pertinent to suggest that the proposed National Environmental Laboratories could be built on the remains of existing but now obsolete national laboratories. The scientists, supporting staff, and facilities of some existing laboratories could make useful components in structuring the National Laboratory we are proposing. Retrained, redirected, and importantly, rededicated, biologists, physicists, computer scien-

tists, and other specialists could serve in the new laboratories after a time as well as they did in the old. This will not occur if a dispirited and ineffectual laboratory merely has its name changed. It will occur, however, if the concern for the environment that we sense among scientists and other professionals is nurtured. These people would be useful additions to the staff of environmental laboratories and should be encouraged to make the transition.

6 *Federal Organization for Managing the Environment*

Our government has encouraged the development of a productive technology and the exploitation of natural resources for economic benefit. Extraordinary success in these undertakings has led to the world's highest standard of living. In the course of reaching this high level of economic prosperity, we have precipitated undesirable changes in the environment. The federal government has responded to these changes by creating special agencies to deal with specific problems. The erosion and exhaustion of the soil led to the establishment of the Soil Conservation Service, now within the Department of Agriculture. The destruction of forests resulted in the Forest Service, also within the Department of Agriculture. The careless slaughter of wildlife led to the Fish and Wildlife Service, within the Department of the Interior. The recognition of the great problems in maintaining water quality resulted in the establishment of the Federal Water Pollution Control Administration, recently transferred from Health, Education, and Welfare to Interior.

In the future the number of environmental problems will multiply at an increasing rate. If they continue to be dealt with in piecemeal fashion, an increasing number of specialized agencies will be needed. The result will be organizational chaos. More importantly, the unity of the environment and the interdependence of its parts will not be the responsibility of any of the competing units, each with partially overlapping and possibly conflicting responsibilities. Such fragmentation will prevent the development and implementation of a national policy for the environment.

In this section we review recent administrative and legislative actions and proposals that affect the management of environmental affairs. In addition we analyze the difficulties involved in creating a Department of the Environment. Finally, we propose a new Board of Environmental Affairs, which would be charged with the responsibility of evaluating the effect of federal programs on the environment, and a Select Joint Committee of the Congress to provide a public forum for the discussion of environmental affairs.

EXECUTIVE ACTIONS

Both the executive and legislative branches of government have foreseen the perils of a continuation of past practices. The President has established within his Office a Council on Environmental Quality consisting of the President, the Vice President, and the Secretaries of Agriculture, Commerce, Housing and Urban Development, Interior, Transportation, and Health, Education, and Welfare. The Executive Secretary of this group is the Director of the Office of Science and Technology, and his small office is expected to provide the staff of the Council.

The Executive Order establishing the Council also provided for a Citizens' Advisory Committee on Environmental Quality. This Committee is to act as the citizens' arm of the Council, providing information and raising policy issues as viewed by those outside the federal establishment.

While the creation of the Council clearly indicates high-level concern within the Administration for the environment,

its long-term effectiveness can be questioned. The Council is composed of high-level officials with a multitude of other responsibilities. They are asked to devote their efforts to interagency affairs in addition to their departmental responsibilities. The President's Council, chaired by the President and including all the Departmental Secretaries, was designed to deal expeditiously with the most major environmental problems. The difficulty is that the President, with his multitude of responsibilities, is unlikely to have sufficient time for the kind of continuing effort that is clearly required. Further, the designated Cabinet officers have differing degrees of responsibility as well as different sets of interests, sometimes conflicting, relating to the environment.

In brief, the Environmental Quality Council, even with limited staff and budget, can perform a valuable function in keeping the major decision-makers of government aware of environmental issues. But, we believe that a Council of highest-level government officials supported by a part-time staff is an inadequate response to the problem of developing mechanisms for effective environmental management.

PRESENT FEDERAL AGENCIES

At present, responsibility for managing parts of the environment is spread over a great variety of government agencies, including the departments of Agriculture, Commerce, Defense, Health, Education, and Welfare, Housing and Urban Development, Interior, Transportation, and even the Department of State. In addition, the Atomic Energy Commission, the Federal Power Commission, the General Services Administration, and the Tennessee Valley Authority are all involved in environmental affairs. Quite clearly a matter of highest priority is a regrouping of agency functions in some more rational way relative to the environment. Such a regrouping, however, should come about only after sophisticated management analysis, coupled with a realistic assessment of Executive-Congressional relationships. In the following discussion we explore in a preliminary way some of the problems that may be encountered in any reorganization scheme.

CONGRESSIONAL ORGANIZATION AND PROCEDURE

Not all the major environmental entities within the federal Executive Branch report to the same committees of the Congress. For example, most of the Department of the Interior agencies dealing with parks, wildlife, and water—Bureau of Sport Fisheries and Wildlife, National Park Service, Bureau of Commercial Fisheries, Bureau of Outdoor Recreation, Bureau of Reclamation—report to the Committee on Interior and Insular Affairs. The Federal Water Pollution Control Administration, however, reports to Public Works, which also considers solid-waste-disposal and air-pollution activities of the Department of Health, Education, and Welfare. The same pattern is not repeated in the House, however. FWPCA does report to Public Works, but this Committee does not also consider solid-waste or air-pollution problems. Most fisheries questions are considered by the Merchant Marine and Fisheries Committee. The Army Corps of Engineers of the Department of Defense, a major water-project constructor, also reports to Public Works in both Houses of Congress. Appropriation Committee subcommittee organization in each House of the Congress generally follows the subject-matter committee structure. These Congressional organization patterns present certain obstacles to organization in the environmental field.

The creation of a federal department on the environment cannot be considered or decided upon as exclusively a question concerning the organization of the Executive Branch, but involves the committee structure in Congress as well.

THE EXECUTIVE BRANCH

Even more than the creation of a new department of the Executive Branch, a reorganization of several existing departments creates a variety of bureaucratic problems. Existing agencies have an interest in maintaining responsibilities. There is usually no existing power base for a new agency.

Even a casual examination of a table of organization of the Department of the Interior reveals that a majority of those units

charged with protection of the environment are physically or organizationally located there, and therefore Interior should become the nucleus of a department on the environment. A closer examination reveals some juxtapositions that pose real problems. The Bonneville Power Administration has exhausted the potential of hydro-electric power generation in the Northwest and must now turn to other sources, with nuclear power appearing most feasible. Its objective, an increase in power production at lower cost, is not necessarily compatible with that of the FWPCA in terms of water temperatures, or with that of the Bureau of Commercial Fisheries in terms of increased populations of salmon. The Bureau of Mines is charged with increasing the uses of coal to enhance the economies of mining; control of acid-mine drainage is an added cost that impairs activity directed toward what the Bureau regards as its primary objective. The production of oil from shale, promoted by the Bureau, will be inhibited if the cost is increased by required installation of expensive water-pollution-control equipment. The Bureau of Reclamation is not necessarily disposed to having the impact of irrigation-return flows on water quality for downstream uses introduced as a factor in consideration of its irrigation projects; nor is it happy when use of simultaneous hydro-electric power production in its projects, which reduces the cost of water supply, is attacked as reducing downstream oxygen levels in violation of water-quality standards established by the Federal Water Pollution Control Administration.

If a new Department on the Environment were to be established, it might well prove to be desirable to transfer many of the functions now existing in other executive departments to the new department. Some obvious functions are those relating to air and water pollution, solid waste, and waste treatment. Others, which are not so clear, but should be considered, are: recreational and land-management activities, construction of water supply, dredging, flood-control projects, and nuclear plant siting.

The list is a long one, and again, while we do not suggest that all these should be in an environmental agency, they should be consciously included or excluded with reason. The jurisdictional difficulties of disengaging them where they are and re-establishing them where they are to be placed should be

weighed, and this evaluation should be a factor in the final decision. Recognition of Congressional organization and liaison should also be a part of the deliberation.

We do not in this paper advocate a major reorganization of government to deal with environmental matters but only point out its importance and recommend that management studies be carried out so as to provide for a realignment of agency responsibilities. With the great variety of agencies and functions it is necessary in the interim and perhaps even on the longer term to have a strong and inventive agency at the President's level.

BOARD OF ENVIRONMENTAL AFFAIRS

We *recommend* the establishment of a Board of Environmental Affairs within the Office of the President. Such a Board should have the strongest possible mandate for action from the President and the Congress. The Board should recommend and assist the President in formulating policies; evaluate programs and activities of departments and agencies and consider how they will affect the environment, making their judgment fully known to the President, the Congress, and the public; analyze, interpret, and provide assistance in generating needed data concerning environmental matters, serve as coordinator on a working level for interdepartmental activities relating to the environment, and assist state and local governments in dealing with environmental problems. The Board should submit an annual report to the President for submission to the Congress relating to the state of the environment and the effectiveness of ongoing policies, programs, and activities for dealing with environmental matters supported or carried out by other federal agencies, and in this report suggest to the Congress legislation bearing upon environmental problems.

The new Board would effectively augment the impact of the existing President's Council for Environmental Quality, established by Executive Order last May. Under the new arrangement, the President's Council would continue to provide strong coordinative, review, and oversight functions. Additionally, of course, as a Cabinet-level council, it would attract critical public attention, marshaling significant public support for vigorous policies for the management of the environment.

The Board, of course, would differ from the President's Council in several important ways: 1) Deriving its existence from positive legislative action by the Congress, it would enjoy special Congressional interest and, indeed, a Congressional mandate. 2) It would be comprised of an interdisciplinary team of experts, staffed by highly professional, full-time personnel drawn from the relevant disciplines. At present, the Office of Science and Technology, already undermanned, provides only part-time staff support, among its other duties; moreover, by definition of its legislated numerical limitations, it cannot effectively perform additional work, particularly insofar as the Board would exist outside of the OST hierarchy. 3) It would operate on a full-time basis, in contrast to the President's Council, which is comprised of the secretaries of several agencies, chaired by the President, and which meets irregularly, giving only episodic attention to the problems within its purview. 4) It would be obligated to prepare an annual report on the condition of our environment, which the President would submit to the Congress. The present Council has no mandated responsibilities of this kind to the Congress. 5) It would have an annual operating budget of its own. The existing Council has no regularly appropriated operating funds and is reliant on small inputs from other budgets. 6) It would be administratively separate from operating, mission-oriented agencies and therefore more capable of objective analysis of programs and policies, at least internally.

The Board that we recommend requires a highly professional staff, experienced not only in matters relating to the environment, but also in public-policy matters, science policies, Congressional affairs, federal, state, and local relations, information gathering and dispersal, and the broad range of disciplines related to the environment and its effective management.

In these procedures we see the Environmental Quality Index serving an important management function. This Index, however imperfect it may be during the early years of its application, could provide a quantitative measure of the effect of federal programs on the environment.

As research increases the sophistication of this measure, the sensitivity of the Index to federal programs would be increased. The use of an Environmental Quality Index in this way circumvents some of the obvious problems arising from the appli-

cation of arbitrary standards. In many areas there is still insufficient knowledge to develop adequate standards. The policing of these standards often turns out to be local responsibility, and the federal government, therefore, has little control. The use of such an Environmental Quality Index in the budgeting process could provide the federal government with an important tool in increasing awareness of the importance of environmental quality at local and regional levels of government. It would be hoped, of course, that the methods developed in the use of such indices could be adopted at state and local governmental levels.

ANNUAL CONGRESSIONAL HEARINGS

The activities of the Executive Branch in establishing environmental policies, evaluating and overseeing their implementation, and in general managing environmental affairs should, we believe, relate to a Congressional organization appropriate to the task. At present several committees of both Houses of the Congress have jurisdictions that relate to environmental matters. And, while we would not presume, of course, to suggest a reorganization of Congressional committees, we do *recommend* formation of a joint committee of the Congress, comprised of the chairmen and ranking minority members of the relevant committees of both Houses, which would provide a much-needed focal point for the informed discussion of environmental affairs.

Such a joint committee would provide an open forum for annual hearings relating to the President's report, in which the important issues would be discussed and debated in public. This would, of course, in no way impinge on existing jurisdictions relating to appropriations or other Congressional activities.

An annual report on the environment requires in turn that there be annual committee hearings in which the views and recommendation in the report become the subject of analysis and debate. These annual hearings would serve as a national forum on environmental policy and would be a significant element of a strategy aimed at meaningful environmental improvement over the long term.

Hearings will not adequately serve this purpose if they continue to be held piecemeal, as they are at present, by the several committees having jurisdiction over special-purpose programs relating to the environment. There will, however, be an ongoing need within the standing legislative committees to continue to deal with specific legislative proposals within their jurisdictions. It seems to us highly desirable that there be, in addition, regular annual public forums in Congress directed to broad consideration of the President's report.

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