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JOINT HOUSE-SENATE COLLOQUIUM TO DISCUSS A
NATIONAL POLICY FOR THE ENVIRONMENT

GOVERNMENT
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HEARING
BEFORE THE
COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS
UNITED STATES SENATE
AND THE
COMMITTEE ON
SCIENCE AND ASTRONAUTICS
U.S. HOUSE OF REPRESENTATIVES
NINETIETH CONGRESS
SECOND SESSION

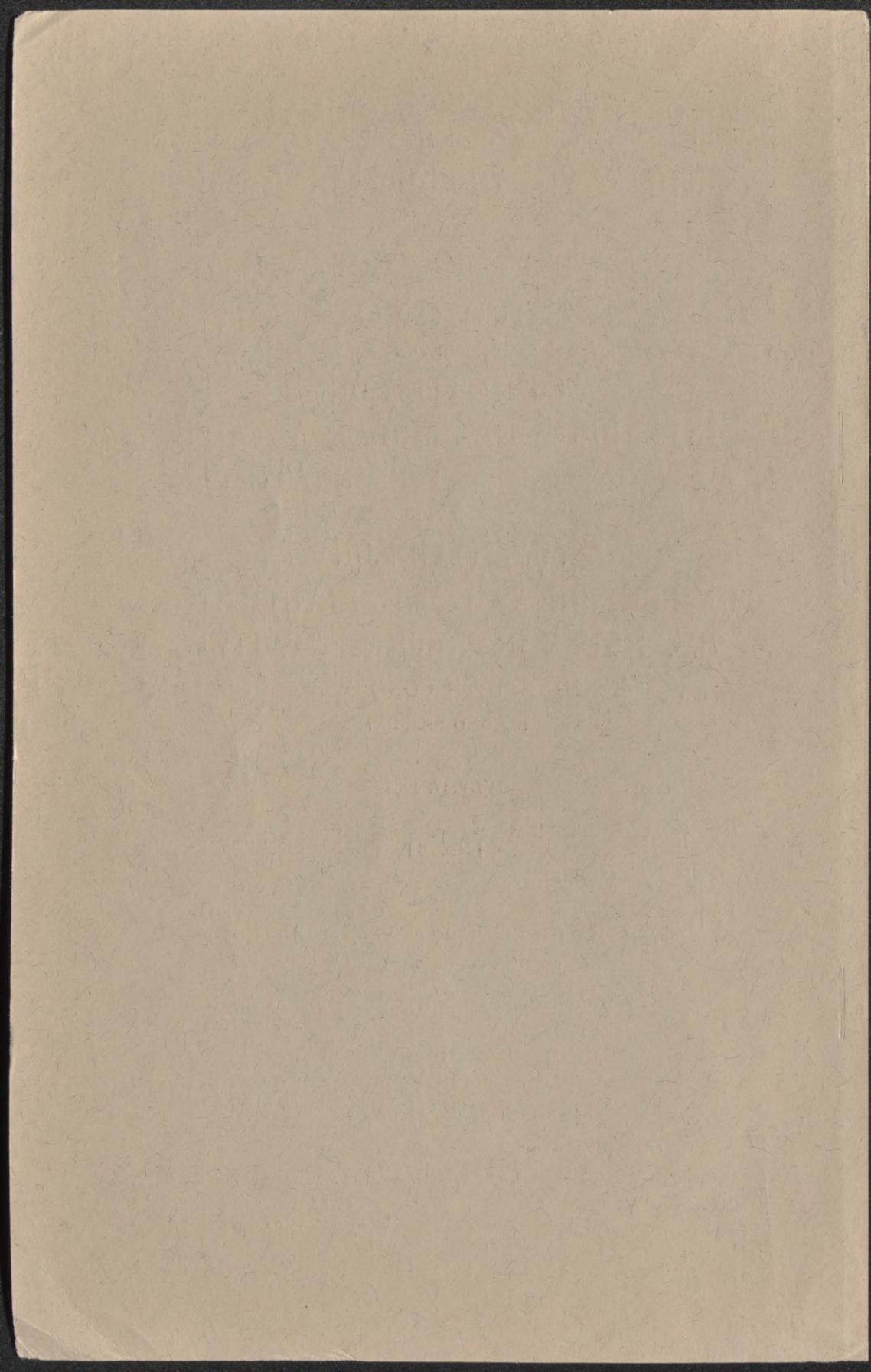
JULY 17, 1968

[No. 8]

Printed for the use of the Senate Committee on Interior and Insular
Affairs and the House Committee on Science and Astronautics



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JOINT HOUSE-SENATE COLLOQUIUM TO DISCUSS A NATIONAL POLICY FOR THE ENVIRONMENT

WEDNESDAY, JULY 17, 1968

U.S. SENATE,
COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, AND
HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C.

The House of Representatives Committee on Science and Astronautics and the Senate Committee on Interior and Insular Affairs met in joint session, pursuant to call, in room S-407, Capitol Building, Hon. Henry M. Jackson and Hon. George P. Miller presiding as cochairmen.

Cochairman MILLER. The meeting will come to order. We welcome you here.

This morning we begin a unique experiment in congressional procedure. Several committee and subcommittee chairmen of the House and Senate, together with other members, are joining me here in an informal study session on a subject of great importance to each of us.

A major reason for this method is to obviate certain jurisdictional limitations of the committees we represent. We want to collaborate in a survey of policies for environmental management in order that all of the committees concerned might gain fuller knowledge and understanding of the requirements for effective legislation and overview in this field.

It is our hope that subsequent to this meeting we will keep each other better informed of developments, programs, and activities of our respective committees. By doing so, unnecessary duplication of effort may be avoided in what we recognize as a frequently overworked committee system. Moreover, the Congress as a whole should do a better job of legislating on the vital topic under consideration.

If we are successful, or even partially so, I think it is reasonable to assume that Congress will subsequently want to carry this procedural innovation forward in other legislative subject areas of equal complexity.

Today we are fortunate to have with us distinguished Cabinet Secretaries and the President's science adviser. Each is involved with important environmental activities affecting the management of resources, urban and rural developments, science and technology programs, and human health.

We also are very pleased to welcome Mr. Laurance Rockefeller, a leader in the quest for environmental quality.

I doubt that there have been many times when such an able and experienced group has been gathered together with Senators and Representatives in the cause of policy planning for the environment.

In convening this colloquium, it was our expectation that the basic outcome would be an identification of the elements of a national policy for the environment. We seek the advice and counsel of our panelists as well as invited guests.

We want to discuss the directions environmental policy should take in the years ahead to make our physical surroundings more stable, more productive, more healthful, and more esthetically pleasing for all our citizens.

This colloquium, we believe to be a necessary step in the expanding congressional concern with the problems of environmental decay and social distress.

We are most grateful to all of you who have come here to participate, and we shall listen with great attention and interest to your presentation.

I am quite honored to be able to turn this meeting over now to Senator Jackson, who came to Congress just a couple years before I did, but became my mentor when I arrived here.

Cochairman JACKSON. Thank you, George. I'm delighted to cochair this colloquium this morning and this afternoon with you.

In recent years growing concern has been expressed over the need to incorporate the concept of "environmental quality" into the decision-making process of government. This is a popular idea. As a generalization it has great appeal. It doesn't take much courage, for example, to come out four square in favor of a quality life in a quality environment for all Americans—as long as we don't get too specific about what we mean. When we do get specific, when we attempt to define what we mean and apply it, however, we run into considerable conflict. For example:

In 1966 in the Transportation Act Congress adopted, a policy of protecting our parks, recreation areas, wildlife refuges, and historic sites from invasion by our growing transportation systems. Now, however, this strong policy has run up against the hard realities and is in the process of being whittled away by weakening amendments.

This year we succeeded in committing a minimum of \$200 million a year to the land and water conservation fund to support the acquisition of outdoor areas. But, we had a close call in the Senate when the provision for the dedication of offshore oil revenues to these public purposes was defeated. It was subsequently restored in the House-Senate conference. Again, conflicting interests and desires came into play.

Other examples involving both legislation and administration in the fields of air and water pollution, public health, urban and rural development, technology control, and many others could be given. The point to be made, however, is that in our efforts to formulate a national policy for the environment, we face large and increasingly complex problems which affect a wide range of public and private interests. We also face problems that are themselves constantly changing and evolving.

Perhaps, as a result of today's discussions and future deliberations, we may find that the concept of environmental quality as a national goal is not transferable into rigid policy guidelines. In any event, I

believe we have to do a great deal more toward defining what we want and how we are going to get it.

Some obvious questions are: What does the concept of "environment" mean? Does it refer to the natural world alone or does it include everything that affects the physical and mental health of man?

What are the criteria for a good quality environment? Who should decide this and who should bear the costs involved?

What is an appropriate division of responsibilities between the private and public sectors for environmental quality management?

The basic point which these and many other relevant questions raise is whether we can act as a government to guarantee a quality environment for future generations. Fortunately, we are raising these questions at a point in time when we still have options, choices, and alternatives.

Today we have the opportunity to hear from the Nation's foremost practitioners in the field of environmental management and in the "art of the possible." I am especially grateful to you all for taking time from your busy schedules to participate in this occasion.

Since this is a departure from the usual hearing practice, I think we should agree on ground rules.

This morning we shall hear brief statements from each of our panelists, then turn to questions and debate among the panel and members.

In the afternoon, Dean Don K. Price, of Harvard University's John Fitzgerald Kennedy School of Government will comment on the morning session and open a discussion.

We invite the audience to participate by submitting questions on cards available from the staff. These will be handed to the chairman and, time permitting, we shall obtain replies from the panelists and also the members present. The record will be kept open for four weeks. Any of you who wish to submit statements or observations are most welcome to do so.

By now I think all of you have received several background documents, two of which are committee prints. The first, "Managing Our Environment," was issued by the House Science and Astronautics Committee. The second entitled "A National Policy for the Environment"¹ was recently issued by the Senate Interior Committee. Additional copies are available on request.

Now, I would like first of all to introduce our colleagues here. On my left, Congressman Daddario from Connecticut, and next to him, Congressman Fulton from Pennsylvania.

And, on my right, the able and distinguished Senator from Maine, Senator Muskie, who has taken a lead in determining the full scope of problems dealing with the quality of our environment and has done so much as chairman of the Subcommittee on Air and Water Pollution of the Public Works Committee of the U.S. Senate.

I notice just coming into the room, Congressman Blatnik, who has done yeoman work in the same area as a member of the House Public Works Committee of the House of Representatives. We are delighted, John, that you could come.

Then, Senator Thomas Kuchel, the ranking and distinguished minority member of the Senate Interior Committee, who is a cosponsor

¹ See app. 1, p. 87.

with me of the bill, S. 2085, and who has done a terrific job on that committee.

Next is Congressman Brown, who has taken a very keen interest in the work preceding today's colloquium and has also been most interested in the whole area that is under discussion. We are delighted, Congressman, that you could be here.

Likewise, Congressman Mosher, to his right. We are very pleased to welcome you here and have you participate, and we know of your very keen appreciation of the topic.

I don't need to introduce Laurance Rockefeller. That would be entirely out of order. I merely call on him now to open the panel discussion.

I thought, gentlemen, that we would defer questions of the panelists until they have all made their presentation.

Mr. Rockefeller, we are delighted to welcome you once again to Capitol Hill.

STATEMENT OF LAURANCE S. ROCKEFELLER

Mr. ROCKEFELLER. Thank you, Mr. Chairman, ladies and gentlemen. It is a privilege for me as a citizen to participate in this meeting of distinguished Members of the Congress and to have the opportunity to discuss with you some of our environmental problems.

This is an extraordinarily timely and useful undertaking. The American people are vitally concerned, as never before, about what is happening to their land, their water, and their air. They want action to preserve and enhance their environment. They are looking to political leadership from the city halls to the Congress to the White House for continued and accelerated progress. There has also been extraordinary progress, of which we may be proud.

Congress has enacted landmark legislation for land and water conservation, the Field Wilderness Act, air and water pollution control, and has created a score of new national parks and recreation areas. There has been a dramatic surge of action in the States.

Since Governor Rockefeller's pioneering open space bond issue in 1960, 20 of the States have enacted special programs for a better environment. President Johnson has sent messages to the Congress on natural beauty. There has been a White House Conference on Natural Beauty, and a special task force. Most important of all, there is a strong and deep-running spirit of citizen action and concern for a better environment. I believe that an outline of these developments would be helpful to the deliberations of this group. However, rather than take your time in reviewing this history now, I am submitting a brief résumé of it which is available to you.

I'm also submitting separately for the files of this study a series of documents which describe this recent history in more detail.

Now I would like to draw a series of conclusions from this brief outline and from the events which underlie them, based on my experience as an interested citizen who has had the opportunity to participate in some of these efforts over the past 10 years.

First, there is a strong and deep-seated concern among the American people for a better environment. The quality of our surroundings is emerging as a major national social goal. Obviously, the political

leadership at every level and in every branch of government must be responsive to it.

Secondly, the focal point of this concern is increasingly urban. We are familiar with the figures that indicate how much of our population lives in the cities and suburbs, and here environmental problems are the most difficult. Here is where the difficult planning decisions must be made to allocate limited resources among worthwhile competing uses.

Third, we do not have a clearly stated national attitude toward the environment. In the areas of civil rights, education, full employment, and a number of others, the Congress of the United States has set forth a clearly understood national policy. We know what our hopes and goals are, and we are moving toward them.

In the field of environmental concern, we had leadership from the White House and from individual Members of Congress, but we have not set down in clear terms what our goals are for the long-term future. Certainly, no aspect of national life is more important to the health and welfare of our children and grandchildren.

This lack of overall national policy has been reflected in recent actions of the courts in reversing decisions of administrative agencies on the grounds that they did not give sufficient consideration to environmental factors. Clearly, these agencies need better guidelines.

At the local level, resource decisions often turn into public relations battles with the decision sometimes turning on the relative noise level rather than on rational planning.

Fourth, our Federal Government structure is still designed for the problems of an earlier day. The basic allocation of responsibilities among departments reflects a nation which was predominantly rural, which had to dispose of its vast public lands and tame its rivers and forests. It is not designed for the complex, highly urban society in which we are now living, or the changed circumstances in our rural areas.

The efforts which we have made to adapt the structure through coordinating councils and ad hoc committees have been admittedly patchwork remedies. This complexity presents real problems. The State or local official has difficulty knowing where to turn for help. It takes a serious student of the Federal organization to find the one in over 200 grant-in-aid programs which might help him.

The average citizen can be bewildered and then discouraged by the maze. Our citizens' committee recently published an action guide to help the average citizen use the many Federal environmental programs more effectively.

Congress has established a Commission to review the maze of laws and policies governing the public lands. That Commission is at work under the distinguished chairmanship of your colleague, Wayne Aspinall. The findings and recommendations of the Public Land Law Review Commission will doubtlessly make a great contribution toward simplifying and giving direction to our public land policy. However, this is only one aspect of the entire governmental structure affecting the environment.

The public is demanding action in many other fields as well. We have seen a change in basic approach from the day when Government was a referee among competing resource users to a day when Government

must be a trustee of the environment for all the people. We need to review the Federal organizational structure to see that it is adequate for this emerging new role.

Fifth, it appears to me that we are not fully harnessing our great technological talent and resources for the effort to attain a better environment. Certainly, we are not applying brainpower as effectively as the space and defense efforts are.

The area where greater knowledge would help is in the resource decisionmaking process. Many Federal resource decisions are still made on a benefit-cost ratio which does not adequately reflect environmental factors. We know—or are told we know—precisely what the dollar benefits are for flood control, irrigation, or highway traffic—but no one can tell us the cost of various alternatives in long-term environmental values. We need to know if we are to make wise decisions.

Sixth, the layman is confused by the organization of Congress in the environmental field. For example, I know that in 1961, we were quite surprised to see an excellent open space program come out of the Senate Banking and Currency Committee. The expert, of course, knows that that committee handles housing legislation, but the average citizen does not. Similarly, citizens are somewhat confused to see highway beauty and the impact of the highway on the environment handled by the Public Works Committee.

The organization of Congress is entirely the prerogative of its members. However, I do suggest that if the citizen is not well informed about its organization, he cannot exercise his right to petition the Congress in a knowledgeable way.

Having concluded that there are important unresolved issues, it would be extremely satisfying now to offer some pat solutions, which unfortunately I cannot do.

The tempting road is to recommend sweeping reorganizations of the executive branch and the congressional committee system. But, as you know better than anyone, major reorganizations are not easily wrought, and sometimes they create as many problems as they solve.

My own hope is that this meeting today will be the initial action toward the creation of national policy and the reorganization of the Federal Government so as to make both responsive to environmental needs.

I suggest to you that an effective means of proceeding might be a Commission on Environmental Policy and Organization.

This Commission should be made up of Members of Congress, key officials of the executive agencies, and private citizens, perhaps an 18-man Commission with each element represented equally.

I believe quite strongly that each of these three elements should be represented.

From our work with the ORRRC Commission, we learned that the Congress leadership is an essential in achieving workable, realistic recommendations.

The Federal agencies should be a part of the effort as it is their future in large part which is under review.

I also believe that informed private citizens can make a great contribution. We particularly need the involvement of the business community for their day-to-day decisions have a very great voice in determining the future environment of this country.

Recently our Citizens Advisory Committee completed a joint task force study on the impact of the electric utility industry on the environment. Some 15 top utility executives joined with us in this study and their participation was not only invaluable to a thorough study, but I believe it will pay long-term dividends in getting our findings implemented.

I suggest that the Commission's study need not be long term or elaborate. The membership should be individuals who are already informed and interested people. They will not have to educate themselves.

The subject has already been carefully studied. From the Hoover Commission to today, leaders have recognized that we have problems in this field. The point is that the issues have become more urgent and the need for solutions more critical.

It may be that this task can be done by some entity less formal than a commission. The same components—congressional, executive, and citizen leadership might be called together by the White House and the leadership of the Congress and put to work without a legislative mandate.

Whatever device is used, there must be a sense of immediacy and urgency about it. We need more of a task force approach than a long-term study effort. I would hope that proposals would be ready to present to the new President early in his administration.

Given the decision and the will to do the job, I believe that there is sufficient talent available on the congressional staffs and in the executive departments to provide the necessary groundwork. I know that a substantial amount of staff work is already being done for this informal discussion.

Our Citizens Advisory Committee plans to make this subject one of our major interests during the coming year. We already have work underway. I am asking that our small staff and the consultants available to us concentrate on this matter as a first priority.

We are, of course, directed to make recommendations to the President and the President's Council. But, I would hope and expect that our principals will encourage us to be a part of any study action you might initiate here. Certainly as an individual I stand ready to cooperate and work with you in any way I can.

In closing, let me reiterate my gratitude in being asked to be part of this discussion. I look forward to learning from it and earnestly hope it will be the beginning of a concentrated effort to make our policies and programs more responsive to the deep-seated longing of the American people for a better environment.

Thank you very much.

Cochairman JACKSON. Thank you, Mr. Rockefeller, for your very fine statement.

(The complete prepared statement of Mr. Rockefeller follows:)

STATEMENT BY LAURANCE S. ROCKEFELLER BEFORE THE JOINT
HOUSE-SENATE COLLOQUIUM ON ENVIRONMENTAL POLICY

It is a privilege for me as a citizen to participate in this meeting of distinguished members of the Congress and to have the opportunity to discuss with you some of our environmental problems.

This is an extraordinarily timely and useful undertaking. The American people are vitally concerned, as never before, about what is happening to their land, their water and their air. They want action to preserve and enhance their environment. They are looking to political leadership from the city halls to the Congress to the White House for continued and accelerated progress.

I understand that the purpose of this discussion is to review current government organization and national policy in the light of the national concern for a better environment.

I believe that my most productive contribution to this purpose might be a review of some of the changes and the efforts to meet the changes over the past ten years in the fields of conservation, outdoor recreation and natural beauty.

The past decade is a convenient and useful frame of reference. It was ten years ago last month that Congress enacted the law which created the Outdoor Recreation Resources Review Commission. In those ten years we have seen a considerable evolution in policy and some changes in organization.

I had the privilege of serving as chairman of ORRRC and the pleasure of working with eight members of the two Interior Committees—four from each body of the Congress. Your distinguished co-chairman today, Senator Jackson, was one of our valued leaders.

The ORRRC Commission was a bold new approach to national social goals. For the first time in the history of any nation, a group of legislators and citizens were given a charter to plan forty years ahead for the recreation needs of the people. And they were given staff and money to do it.

To be sure, there were skeptics. Some derided the effort as a "play commission," and there was some difficulty in obtaining our first appropriation.

There was one interesting aspect of the ORRRC law which is particularly relevant to our discussion today. The Commission was specifically directed *not* to concern itself with urban recreation. We were, in effect, told to stay out of the cities.

However, as our information developed, we found that recreation problems basically were where the people were and that most people, of course, were in metropolitan areas. We decided that our study must be people-oriented to be effective. With the concurrence of our Congressional leadership, we did consider the recreation needs of urban people—at least as they involved resources out of the city.

The three year study produced a report of recommendations and 27 study reports. I shan't attempt to review the ORRRC findings here. Basically we found that people liked the outdoors, that they wanted to use it more. We found that opportunities were in short supply where they were needed most and that the situation was growing increasingly difficult.

We presented our report to President Kennedy and to the Congress in January of 1962 and offered almost a hundred specific recommendations. We grouped them into five major needs:

1. A National Outdoor Recreation Policy;
2. A Classification System for Planning;
3. Expansion and Changes in Existing Programs;
4. A new Bureau of Outdoor Recreation; and
5. A Grant in Aid Program to the States.

The President and the Congress were responsive, and action came quickly. President Kennedy established the Bureau of Outdoor Recreation by Executive Order in April of 1962, and the Congress strengthened it with a basic act in May, 1963, (P.L. 88-29).

The Land and Water Conservation Fund created a grant in aid program and the stable source of funds for Federal action when it became law in January, 1965, (P.L. 88-578).

The Commission's deliberation on the Bureau of Outdoor Recreation is particularly pertinent to the subject at hand today. We found that there were over twenty Federal agencies with some responsibility for outdoor recreation. Nowhere was there any real coordination. Some programs were overlapping.

Some even conflicting. No one was charged with worrying about the gaps among programs.

The Bureau of Outdoor Recreation was a compromise. Many of the ORRRC citizen members wanted a new Department—a Department of Natural Resources with recreation as a major function. However, on further consideration and upon the advice of our Congressional leaders, we determined that it was wiser to recommend a new bureau with the Department of the Interior.

We knew that a bureau in one Department could not really coordinate the work of bureaus in other Departments. Therefore, we called for the establishment of a cabinet level Recreation Advisory Council for the coordination task. The new Bureau would be staff to the Council.

Frankly, we knew that the Council was not the strongest structure, but at the time we believed it to be the most realistic alternative available. In all candor, it hasn't worked particularly well, and I shall have more to say of that later.

But the years following the ORRRC report—1962, 1963—were good ones for conservation and outdoor recreation. The new bureau was at work and things were happening. The states were developing their plans and the importance of outdoor recreation was raised in all the councils of government.

There was a particularly strong dynamic at work in the states. In New York in 1960, Governor Rockefeller proposed a \$75 million bond issue to buy park land and open spaces before it was lost forever. The voters showed their concern dramatically by approving this bond issue by a three to one margin. Other states followed New York's example and more than twenty of them enacted bond issues or special programs to buy land.

Voters were ready to support still broader measures. Later Governor Rockefeller proposed a one *billion* dollar bond issue to clean up the state's rivers and streams within six years. And this came in a year of a new sales tax and an extremely tight budget. But again the voters approved. The four to one margin gave convincing proof that they not only care about their environment but are willing to back up their concern with their pocketbooks.

All across the country there seemed to be a new awareness, a new spirit of involvement with the environment. It was related to the traditional conservation and park movements but it was somewhat different. People who never thought of themselves as park people or conservationists were beginning to care. They wanted their water less polluted, their air less filthy, and their countryside less ugly. They began to ask why we could not do better than the dreary roadsides that made every major road a neon and billboard canyon. They began to ask why new subdivisions had to be dreary replicas of the ones which the bulldozers had hurriedly scraped out before.

This new concern cut across a number of fields—conservation, urban planning, highway design, architecture, waste control and ecology. President Johnson summed them all up with the term "natural beauty" and he made natural beauty a major theme of his famous Great Society speech at the University of Michigan.

The President followed up on these words. In the fall of 1964, he appointed a number of task forces to prepare ideas on problems facing the country to be met by a new administration. Many of the task forces had been the subject of study groups often in earlier years—foreign aid, execution, civil rights, transportation, but there was a new one added to the list—natural beauty.

The task force recommended that the mandate of the Bureau of Outdoor Recreation be expanded to include natural beauty. It urged a new program of landscape and townscape grants. It placed heavy emphasis on helping cities restore their park systems and urged Federal aid for demonstration projects and increasing operating efficiency.

The President again followed up. In February of 1965 he sent a message to the Congress on Natural Beauty. This was an extraordinary event in itself. Only a half century earlier a powerful speaker of the House had decreed that the "Congress was not going to spend one damn cent for scenery." Now a president was sending an entire message to the Congress calling for action not only on scenery but on pollution control, parks, highway design, trails and urban improvements as well. That message also announced that the President was calling a White House Conference on Natural Beauty in May.

One of the emergent themes of the Conference was that natural beauty was a far ranging and pervasive issue. We found that natural beauty was far more than what one might take the term to mean literally. It involved the entire quality of the environment. And the concern focused heavily on the urban environ-

ment where people are. The Conference presented recommendations on the town-
scape, the waterfront, the new suburbia, as well as parks and the countryside,
directly to President and Mrs. Johnson at the White House.

One of the Conference highlights was an open meeting of the Recreation
Advisory Council—one of the Council's better attended meetings, I might add.
After hearing the Council in action, the Conference recommended that its man-
date be expanded to include natural beauty as well as recreation. It also recom-
mended that a Citizens Advisory Committee to the Council be appointed.

In May of the following year the charter of the Council was expanded to
include natural beauty, and its membership expanded to reflect its broader man-
date. A Committee of 12 citizens was appointed to advise the President and the
Council.

One of the specific directives to the Committee was to make recommendations
on how well the Council was functioning. In its first annual report submitted in
June of 1967, the Committee found that it was really not doing very well.

It recommended that the rotating Chairmanship among cabinet members be
replaced with a permanent chairman—the Vice President. It further recom-
mended that the members be more vigorous in bringing true inter-Departmental
issues before the Council. The Citizens Committee found that there had been a
tendency to bring only non-controversial matters to the Council agenda and
avoiding the important policy issues.

In April of this year the President named the Vice President Chairman of
the Council and charged him to give it new leadership. The Vice President ac-
cepted with enthusiasm and the first meeting of the Council was held under
his leadership last month. At that time the Citizens Advisory Committee pre-
sented its second annual report and it was clear that the Vice President intends
to make the Council a strong force. It was also clear from the assignments which
the Vice President gave at that meeting that the Council will become very much
concerned with urban issues.

I am submitting separately for the files of this study a series of documents
which describe in detail this recent history. The documents are:

1. "Outdoor Recreation for America," the Report of the Outdoor Recreation
Resources Review Commission.
2. The Report of the Task Force on Natural Beauty of 1964 to President
Johnson.
3. The Proceedings of the White House Conference on Natural Beauty.
4. The First Annual Report of the Citizens Advisory Committee on Recreation
and Natural Beauty.
5. "Community Action for Natural Beauty"—a guide published by the Citizens
Committee.
6. The Second Annual Report of the Citizens Advisory Committee on Recrea-
tion and Natural Beauty.

I would like to draw a series of conclusions from this brief outline and from
the events which underlie them.

First, there is a strong and deep seated concern among the American people
for a better environment. The quality of our surroundings is emerging as a
major national social goal. Obviously the political leadership at every level and
in every branch of government must be responsive to it.

Secondly, the focal point of this concern is increasingly urban. We are familiar
with the figures that indicate how much of our population lives in the cities
and suburbs, and here is where environmental problems are the most difficult.
Here is where the difficult planning decisions must be made to allocate limited
resources among worthwhile competing uses.

Third, we do not have a clearly stated national policy toward the environ-
ment. In the areas of civil rights, education, full employment and a number of
others, the Congress of the United States has set forth a clearly understood
national policy. We know what our hopes and goals are, and we are moving
toward them.

In the field of environmental concern we had leadership from the White
House and from individual members of Congress. But we have not set down
in clear terms what our goals are for the long-term future. Certainly no aspect
of national life is more important to the health and welfare of our children and
grandchildren.

This lack of overall national policy has been reflected in the recent actions
of the courts in reversing decisions of administrative agencies on the grounds
that they did not give sufficient consideration to environmental factors. Clearly
these agencies need better guidelines.

At the local level, resource decisions often turn into public relations battles with the decision sometimes turning on the relative noise level rather than rational planning.

Fourth, our Federal government structure is still designed for the problems of an earlier day. The basic allocation of responsibilities among Departments reflects a nation which was predominantly rural, which had to dispose of its vast public lands and tame its rivers and forests. It is not designed for the complex, highly urban society in which we now live, or the changed circumstances in our rural areas.

The efforts which we have made adapting the structure through coordinating councils and ad hoc committees have been admittedly patchwork remedies. This complexity presents real problems. The state or local official has difficulty knowing where to turn for help. It takes a serious student of the Federal organization to find one of the over two hundred grant in aid programs which might help him.

The average citizen can be bewildered and then discouraged by the maze. Our Citizens Committee recently published an action guide to help the average citizen use the many Federal environmental programs more effectively.

Congress has established a Commission to review the maze of laws and policies governing the public lands. That Commission is at work under the distinguished chairmanship of your colleague Wayne Aspinall. The findings and recommendations of the Public Land Law Review Commission will doubtlessly make a great contribution toward simplifying and giving direction to our public land policy. However, this is only one aspect of the entire government structure affecting environment.

The public is demanding action in many other fields as well. We have seen a change in basic approach from the day when government was a referee among competing resource users to a day when government must be a trustee of the environment for all the people. We need to review the Federal organizational structure to see that it is adequate for this emerging new role.

Fifth, it appears to me that we are not fully harnessing our great technological talent and resources in the effort for a better environment. Certainly we are not applying brainpower as effectively as the space and defense efforts are.

Greater knowledge, applied effectively, could substantially improve the process by which we make resource allocations. Many Federal resource decisions are still made on a benefit-cost ratio which does not adequately include environmental factors. We know—or are told we know—precisely what the dollar benefits are for flood control, irrigation or highway traffic—but no one can tell us the cost of various alternatives in long-term environmental values. We need to know if we are to make wise decisions.

Sixth, the layman is confused by the organization of Congress in the environmental field. For example, I know that in 1961, we were quite surprised to see an excellent open space program come out of the Senate Banking and Currency Committee. The expert, of course, knows that committee handles housing legislation, but the average citizen does not. Similarly, citizens are somewhat confused to see highway beauty and the impact of the highway on the environment handled by the Public Works Committee.

Of course, the organization of Congress is entirely the prerogative of its members. However, I do suggest that if the citizen is not well informed about its organization, he cannot exercise his right to petition the Congress in a knowledgeable way.

Having outlined recent history and having concluded that there are important unresolved issues, it would be extremely satisfying now to offer some pat solutions. Unfortunately I cannot.

The tempting road is to recommend sweeping reorganizations of the executive branch and the Congressional committee system. But as you know better than anyone, major reorganizations are not easily wrought, and sometimes they create as many problems as they solve.

My own hope is that this meeting today will be the initial action toward the creation of national policy and the reorganization of the Federal government so as to make both responsible to environmental needs.

I suggest to you that an effective means of proceeding might be a Commission on Environmental Policy and Organization.

This commission should be made up of members of Congress, key officials of the executive agencies and private citizens, perhaps an eighteen man commission with each element represented equally.

I believe quite strongly that each of these three elements should be represented.

From our work with the ORRRC Commission, we learned that the Congress leadership is an essential in achieving workable, realistic recommendations.

The Federal agencies should be a part of the effort as it is their future in large part which is under review.

I also believe that informed private citizens can make a great contribution. We particularly need the involvement of the business community for their day to day decisions have a very great voice in determining the future environment of this country.

Recently our Citizens Advisory Committee completed a joint task force study on the impact of the electric utility industry on the environment. Some fifteen top utility executives joined with us in this study and their participation was not only invaluable to a thorough study, but I believe it will pay long-term dividends in getting our findings implemented.

I suggest that the Commission's study need not be long-term or elaborate. The membership should be individuals who are already informed and interested people. They will not have to educate themselves.

The subject has already been carefully studied. From the Hoover Commission to today, leaders have recognized that we have problems in this field. The point is that the issues have become more urgent and the need for solutions more critical.

It may be that this task can be done by some entity less formal than a Commission. The same components—Congressional, Executive and Citizen leaders might be called together by the White House and the leadership of the Congress and put to work without a legislative mandate.

Whatever device is used, there must be a sense of immediacy and urgency about it. We need more of a task force approach than the long term study effort. I would hope that proposals would be ready to present to the new President early in his Administration.

Given the decision and the will to do the job, I believe that there is sufficient talent available on the Congressional staffs and the Executive Departments to provide the necessary groundwork. I know that a substantial amount of staff work is already being done for this informal discussion.

Our Citizens Advisory Committee plans to make this subject one of our major interests during the coming year. We already have work under way. I am asking that our small staff and the consultants available to us concentrate on this matter as a first priority.

We are, of course, directed to make recommendations to the President and the President's Council. But I would hope and expect that our principals would encourage us to be a part of any study action you might initiate here. Certainly as an individual I stand ready to cooperate and work with you in any way I can.

In closing, let me reiterate by gratitude in being asked to be a part of this discussion. I look forward to learning from it and earnestly hope it will be the beginning of concentrated effort to make our policies and programs more responsive to the deep-seated longing of the American people for a better environment.

Cochairman JACKSON. The Chair will call next on Secretary Udall.

STATEMENT OF STEWART L. UDALL, SECRETARY, DEPARTMENT OF THE INTERIOR

Secretary UDALL. Mr. Chairman, let me say first before I read my brief prepared statement, if I may make a few ad lib comments: I think all of us are enormously heartened by these hearings. I look around the table and I see Congressmen and Senators who have become specialists and who, in my judgment, have made a tremendous contribution to this country in particular areas that concern the environment. The truth of the matter is that most of you also have in the process developed insights and a point of view that have given you an awareness and an ability to speak up and to lead the country in areas where we were getting little leadership a few years ago, and yet we are confronted with the basic threshold problem that it is difficult to formulate national policy when the elements of it are frag-

mented. Departments are fragmented downtown, the committees of the Congress are fragmented, and what you have done today is to bring everyone together to see how we can orchestrate this overall effort. As Laurance Rockefeller has indicated, it isn't simply a matter of organization. It's a matter of the need for an overview and for developing discussions that reflect an overview.

I look back over the seven and a half years that I have served under two Presidents and I see tremendous progress that has been made. I think we do at least have a national policy concerning the environment in sight. But, I want to say in the next breath that there are almost as many discouraging things any given day of the week as there are things that encourage one. The picture is still confused. We have one inning when we win and the next inning we lose. I would like to cite some examples of that. All of us were enormously heartened a couple of months ago when the State of Vermont took a bold action and joined Hawaii as the only States in the Union to eliminate highway billboards. It did this for very sound reasons. The bill passed a Republican legislature with a Democratic Governor after very vigorous debate. Vermont is, of course, an especially beautiful little cameo State. It decided that by having sign plazas that the State would maintain, by putting everyone on an equal footing, that this would be a better solution in terms of preserving the beauty of a very beautiful State. Yet, we look at the Congress, and the highway beauty legislation at present which is mangled and battered and hardly has any life, so let's be honest about it. And, those of us that are lameducks can be quite candid too these days about the situation.

The House of Representatives 2 days ago passed several excellent conservation bills and some that need to be improved in conference. It failed to get a two-thirds vote that was needed for a scenic rivers bill that I consider in terms of establishing a national policy one of the most exciting and vital bills that has ever been presented while I was Secretary. I think this is as important as the wilderness bill but it hasn't, for some reason, gotten the type of support and interest that the wilderness bill got.

So, there is still confusion. There is still a lack of overview. I think sometimes that if we continue to develop the type of leadership that we have developed in the 1960's as compared with what we had when I came to Congress in the middle of the 1950's, I am enormously encouraged; but, I would like to identify one other basic issue that it seems to me runs through the whole problem of the quality of the environment, and that is the question of funding. It's not just a matter of policy. In the long run it's going to be a matter of funding. Are we willing to pay for a quality environment? I would single out one issue that is pending before the Congress this very day because in the last 3 or 4 years this Congress—and two of the principal leaders are here, Senator Muskie and Congressman Blatnik—wrote the basic foundation legislation that this country needs to clean up the water of the country. Yet, we are all aware of the fact that you can write laws, you can set standards of water quality. You can set up programs of action, but if you don't fund the programs, you are going to go nowhere. This is an issue that we have all been wrestling with because under the budgetary stringencies of recent months and the last 2 or 3 years we haven't been able to get big new grant funds for a program

of this kind that ultimately rests on money and the participation of governments.

And, the question of whether the Congress can come up with legislation to get the Federal money on the line is hanging in doubt today. The Senate has acted. We hope the House will. We hope legislation can be produced that will be acceptable, but here is an example—and I simply single it out, Mr. Chairman, because I think that funds are probably going to be more important than policy in the long run. We can pass laws. We can establish excellent policies. If we don't back them up with funds, if we don't give these programs a priority so that they can compete with other programs, we are simply not going to have a quality environment in this country.

I can go ahead and give other examples, but I don't want to take more than my share of the time. I think it is very plain that we will not succeed either unless the major industrial groups in this country, the mining industry, the electric power industry, the highway construction industry, unless these people are also brought into this fight for a better environment, and unless they respect the basic laws of conservation in their operations. I could go on and on on this. I see many encouraging things. I see many discouraging things. The battle is anything but won in this field.

So, the 1960's have been years of extraordinary achievement in developing public policies to preserve and restore the quality of our environment. But, despite this progress, can any objective observer assert that we are close to having a livable environment for this or future generations? To find the answer, one has only to drive through any major American city, scan the horizon, or try swimming in the nearest river. We have a long way to go.

Any future catalog of the conservation landmarks of this decade will, I am sure, include this colloquium to discuss national policy for the environment. In this area, both Congress and the executive branch—to say nothing of the private sector—have a lot of soul searching to do.

The concept of a national policy for the environment is intriguing. To some, it suggests that we can solve a broad range of tough policy and organizational issues by putting the stamp of approval on some booming rhetoric. To expect much of any policy statement is unrealistic. But, we certainly have reached the point where we can set forth some basic principles to guide the attitude and the conduct of the Federal Government toward our environment.

Let me suggest some of these basic principles, as I see them.

No. 1, we must begin to work with, not against, the laws of the planet on which we live (This is a little space ship, and that's about as accurately as I can describe it), rejecting once and for all the false notion that man can impose his will on nature. This requires that we begin to obey the dictates of ecology, giving this master science a new and central position in the Federal scientific establishment.

Second, we must espouse the creation of an order which not only promotes the well-being of the living but enhances the total environment—the basic wealth we bequeath to our children and their children. The real wealth of the country is the environment in the long run. We must reject any approach which inflates the value of today's satisfactions and heavily discounts tomorrow's resources. The fact that some-

thing may be cheaper, more efficient, or more convenient must no longer be decisive. The well-being of generations yet to come must first be weighed in the balance.

I'll never forget one of the first things when I first became Secretary that illustrated too dramatically the old attitudes. I had an encounter with one of the top officials of the Tennessee Valley Authority, which, of course was created and established, and has a charter as a great conservation organization. Yet the raids on the hills of eastern Kentucky, which were occurring then and in some areas still are occurring, a devastation of an enormous area being carried out to mine coal, which was then carried out over into the magic circle of the TVA. When the issue was brought up with the TVA officials as to why they didn't do something about it, their answer, their very blunt and direct answer was that their mission was to produce electric power as cheaply as possible, and that since that was their charge, they were duty bound to let contracts for coal to get it as cheaply as possible; and that if this destroyed resources, rivers and hillsides, and ruined parts of the country outside the TVA area for all time, this was none of their business.

Well, I hope we have gone beyond that, but I use this simply as a dramatic way to show the difference in attitude.

We must sharply define our concern for specific resources, making crystal clear that plans to protect air and water, wilderness or wildlife are in fact plans to protect man. Our efforts to enhance these resources must be based on the premise that such action is essential to the self-renewing systems of nature that sustain the earth.

Fourth, we must establish as a principle of national policy that the relationship between our population and our finite resources is a major concern of the Federal Government. No comprehensive policy for our environment can fail to include recognition of the hazards of irresponsible population growth. The Federal Government has for too long resisted involvement in this central issue.

We are accustomed to accept the idea that population in this country is going to double and redouble. I think the time has come that we have to address ourselves to that question, and I would like to suggest to the colloquium itself to direct a discussion in this direction because the truth of the matter is that most of the things that we prize most in this country in terms of the natural environment will be inevitably sacrificed if we go down the road to a doubling and redoubling of the population. The truth of the matter is that population in this country is moving sharply in the direction of leveling off, and yet all of our official predictions are geared to the population statistics of the past decade.

But statements of principle are not enough. By themselves they will not forestall the continuing assault on our environment. They will not stop the inexorable highway construction, the obnoxious boom of supersonic aircraft, the wrongheaded dam building, or the pernicious concept of calculated obsolescence that fouls our countryside. Such statements can only have meaning if Congress and the executive branch have the will to give them life through new laws and new policies that reject the old ways.

For example, we must be willing to require that the nature and potential of new goods and services be examined for their impact

on man and nature before, not after, their first use. And, where necessary, we should be able to ban the use of products which have a damaging effect on our environment.

We must also be prepared to insist that industries whose products foul the landscape—from brewers to carmakers—change their approach and concentrate on reuse and retarding obsolescence.

There passed across my desk last week an item indicating that in Sweden or one of the Western European countries, someone had developed a beer-soft drink container that very readily dissolved. I sent it down to my science adviser with a suggestion that he find out whether this was as promising as it sounded. But I'm convinced myself that scientists can produce such a container if we just held their feet to the fire.

Congress must take the lead in enacting laws which establish performance standards for American industry and make sound conservation practices a normal part of the cost of doing business. American consumers will pay for a cleaner technology, but get a cleaner country in the bargain.

With the growth of concern for environmental quality has come a rash of ideas for organizing the Federal Government to deal with environmental problems. Let no one suppose there is any organizational panacea for dealing with environmental problems at the Federal level.

Indeed, as part of the solution in the long run, I see no way to do the job in the most effective way possible unless there is the kind of communication that we have begun to develop in the Federal Establishment where people like Bob Weaver and Orville Freeman and Don Hornig and the rest of us are in the same ring and are communicating effectively backward and forward not only on areas where we happen to bump together, but on issues that we happen to have a common insight. Because almost all Federal agencies are involved in environmental problems, no one organizational device offers a complete solution. There could be, of course, some changes within the executive branch. There have been some in recent years; but to combine all programs affecting the environment in one department would obviously be physically impossible. Ultimately, every Federal agency must become concerned with the environmental impact of its programs. If it does not, we are sure to fail. Each agency should designate responsible officials to establish environmental checkpoints to be sure they have properly assessed this impact.

In the case of established programs with known effect on the environment, special procedures must be adopted to insure that environmental factors are carefully weighed in program decisions.

One hopeful sign has been the recent trend toward greater cooperation among Federal agencies on environmental matters. I would cite in this connection the cooperative arrangements between Interior and the Corps of Engineers for evaluating the effects of dredging practices. There will be need for similar cooperation in many other areas, some of which can be handled informally, some of which may require statutory authorization.

What I have said about the executive agencies applies with equal force to the Executive Office of the President. Whether or not new institutional arrangements are accepted, the Bureau of the Budget and

the Office of Science and Technology must play a central role in collecting facts, anticipating impacts, and providing an early warning system for environmental protection. They should encourage effective interagency cooperation and be prepared to referee the inevitable conflicts between departments concerned primarily with the environment such as Interior, and those whose primary interests lie elsewhere.

More important than any organizational reform is the development of a state of mind—in the Congress, in the executive branch, in the private sector—which gives first priority to the quality of our environment. If we can develop a new sense of responsibility toward the environment, the policy and organizational problems will assume manageable proportions.

Thank you very much, Mr. Chairman.

Cochairman JACKSON. Thank you, Secretary Udall, for a very fine statement.

(The excerpts from remarks by Secretary Udall follow:)

EXCERPTS FROM REMARKS BY SECRETARY OF THE INTERIOR
STEWART L. UDALL BEFORE THE JOINT HOUSE-SENATE COLLO-
QUIUM TO DISCUSS NATIONAL POLICY FOR THE ENVIRONMENT

The 1960's have been years of extraordinary achievement in developing public policies to preserve and restore the quality of our environment. But despite this progress, can any objective observer assert that we are close to having a liveable environment for this or future generations? To find the answer, one has only to drive through any major American city, scan the horizon or try swimming in the nearest river. We have a long way to go.

Any future catalog of the conservation landmarks of this decade will, I am sure, include this colloquium to discuss national policy for the environment. In this area, both Congress and the Executive Branch—to say nothing of the private sector—have a lot of soul-searching to do.

The concept of a national policy for the environment is intriguing. To some, it suggests that we can solve a broad range of tough policy and organizational issues by putting the stamp of approval on some booming rhetoric. To expect much of any policy statement is unrealistic. But we certainly have reached the point where we can set forth some basic principles to guide the attitude and the conduct of the Federal government towards our environment.

Let me suggest some of these basic principles, as I see them:

1. We must begin to work with, not against, the laws of the planet on which we live, rejecting once and for all the false notion that man can impose his will on nature. This requires that we begin to obey the dictates of ecology, giving this master science a new and central position in the Federal scientific establishment.

2. We must espouse the creation of an order which not only promotes the well-being of the living but enhances the total environment—the basic wealth we bequeath to our children and their children. We must reject any approach which inflates the value of today's satisfactions and heavily discounts tomorrow's resources. The fact that something may be cheaper, more efficient or more convenient must no longer be decisive: the well-being of generations yet to come must first be weighed in the balance.

3. We must sharply define our concern for specific resources, making crystal clear that plans to protect air and water, wilderness or wildlife are in fact plans to protect man. Our efforts to enhance these resources must be based on the premise that such action is essential to the self-renewing systems of nature that sustain the earth.

4. We must establish as a principle of national policy that the relationship between our population and our finite resources is a major concern of the Federal government. No comprehensive policy for our environment can fail to include recognition of the hazards of irresponsible population growth. The Federal government has for too long resisted involvement in this central issue.

But statements of principle are not enough. By themselves, they will not forestall the continuing assault on our environment. They will not stop the inexorable highway construction, the obnoxious boom of supersonic aircraft, the dam building, or the pernicious concept of calculated obsolescence that fouls our countryside. Such statements can only have meaning if Congress and the Executive Branch have the will to give them life through new laws and new policies that reject the old ways.

For example, we must be willing to require that the nature and potential of new goods and services be examined for their impact on man and nature before, not after, their first use. And where necessary, we should be able to ban the use of products which have a damaging effect on our environment.

We must also be prepared to insist that industries whose products foul the landscape—from brewers to car makers—change their approach and concentrate on reuse and retarding obsolescence.

Congress must take the lead in enacting laws which establish performance standards for American industry and make sound conservation practices a normal part of the cost of doing business. American consumers will pay for a cleaner technology, but get a cleaner country in the bargain.

With the growth of concern for environmental quality has come a rash of ideas for organizing the Federal government to deal with environmental problems. Let no one suppose there is any organizational panacea for dealing with environmental problems at the Federal level. The threat to our environment comes from many sources and is to be found in almost every Federal program. It is worth noting that Interior recently intervened in a proceeding before the Interstate Commerce Commission which involved freight rates on scrap metal. The relationship between these rates and the scrap disposal problem was sufficiently close to justify our intervention.

Because almost all Federal agencies are involved in environmental problems, no one organizational device offers a complete solution. Some consolidation of functions within the Executive Branch would certainly help. But to combine all programs affecting the environment in one Department would be physically impossible. Just because atomic power plants may have certain undesirable characteristics from an environmental viewpoint does not justify moving the AEC to some new superagency. Similarly, the notorious environmental impact of highway construction does not justify the transfer of highway programs from the Department of Transportation.

Ultimately every Federal agency must become concerned with the environmental impact of its programs. Each agency should designate responsible officials and establish environmental checkpoints to be sure it has properly assessed this impact. In the case of established programs with known effect on the environment, special procedures must be adopted to assure that environmental factors are carefully weighed in program decisions.

One hopeful sign has been the recent trend towards greater cooperation among Federal agencies on environmental matters. I would cite in this connection the cooperative arrangements between Interior and the Corps of Engineers for evaluating the effects of dredging practices. There will be need for similar cooperation in other areas, some of which can be handled informally, some of which may require statutory authorization.

What I have said about the Executive agencies applies with equal force to the Executive Office of the President. Whether or not new institutional arrangements are accepted, the Bureau of the Budget and the Office of Science and Technology must play a central role in collecting facts, anticipating impacts and providing an early warning system for environmental protection. They should encourage effective interagency cooperation and be prepared to referee the inevitable conflicts between departments concerned primarily with the environment, such as Interior, and those whose primary interests lie elsewhere.

More important than any organizational reform is the development of a state of mind—in Congress, in the Executive Branch, in the private sector—which gives first priority to the quality of our environment. If we can develop a new sense of responsibility towards the environment, the policy and organizational problems will assume manageable proportions.

Co-chairman JACKSON. The Chair wishes to state that Secretary Wilbur J. Cohen is detained. We expect him a little later. We are not following any particular order of seniority. We will go right down

the line. We are delighted to have Secretary Weaver with us this morning.

Mr. Secretary, you have a prepared statement, I believe.
You may proceed in your own way.

STATEMENT OF ROBERT C. WEAVER, SECRETARY, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Secretary WEAVER. Senator Jackson, Congressman Miller, and Members of the Senate and House of Representatives and other distinguished participants, obviously, I think this is a most significant occasion and one which should bring some real progress in a very difficult and complicated area.

Obviously the first step is to recognize the problem and start doing something about it.

There is no simplistic formula under which we can insure the development of a viable and valid national environmental policy for urban America, not today and not for a good many days to come. There are too many things we do not know, basic matters such as how we define quality in the urban environment, how we measure it, and how we strike a balance among competing values.

There are large problems of taming our technology so that we are the masters rather than the victims of progress. Too often in our cities we are drowning in our own profligate outpouring of goods. We are beset by the din of traffic noise and the fumes of poisoned air and the stench of polluted streams.

As Winston Churchill said in a speech at the Massachusetts Institute of Technology in 1949, we entered this century with "a sense of moving hopefully forward to brighter, broader, easier days." But, by mid-century we had a new realization; again to quote Churchill:

Our need was to discipline an array of gigantic and turbulent facts. To this task we have certainly so far proved unequal. Science bestowed immense new powers on man, and, at the same time, created conditions which were largely beyond his comprehension and still more beyond his control.

But, Churchill also realized that man does not bow to mindless forces. He realized that we cannot go back to the past, and shouldn't if we could.

Americans by and large realize they cannot. Yet, Americans cling to memories of the past. We do invoke Walden Pond in moments of nostalgia. And, surveys continue to show that a majority of Americans claim a preference for a life on the farm and in small towns. As in all memories, the hardships are submerged—the wood-burning stoves, horseback travel, and death by plague. This romantic nostalgia for the "good old days" is constantly reinforced by the ever-present difficulties and deficiencies of our present urban environment.

Herein lies the problem: How can we preserve the amenities we remember and want—clean air, sparkling brooks, nearby fields and woods, and a sense of identity with a community—against the forces of urbanization. Consider the facts of urban expansion:

That today there are more than 200 million Americans but by 1980 there will be almost 240 million and by the year 2000 about 312 million in the 48 contiguous States and the District of Columbia alone, if

present projections are borne out. Even if they are not borne out, there will be a sizable increase in population regardless of what happens.

That the three major primarily urban regions alone—the Metropolitan Belt reaching from Maine to Virginia and westward to Illinois and Wisconsin, and the Floridian and California regions—will leap in population from the 82 million of 1960 to more than 180 million by the year 2000.

That the urban population of 1960—about 125 million—occupied less than one and a half percent of the land area, and that the urban population of 2000—over 260 million—may cover more than 3 percent of our land area.

These are the approaching realities of urban growth. There are other factors with which we are all familiar: problems of decay and of the poor and alienated in the central city; of the ugliness and waste that accompanies too much of our urban growth.

There is a serious problem of stubborn resistance to change in our political institutions.

This is true at the local and State level, where the term “metropolitan government” is a spark to the tinder, and where needed cooperation among neighboring local governments is sometimes resisted for fear it will lead to metropolitan government.

It is also true here in Washington. Within the executive departments and congressional committees there are some who resist change with magnificent vigor, as all of us in this room are only too aware. Our friend, John Gardner, aptly characterized these people as those “who love their institutions and tend to smother them in an embrace of death, loving their rigidities more than their promise, shielding them from life-giving criticism.”

In the very fact of sheer physical bulk and massive rigidity, cities also resist change. Anyone connected with rebuilding a city knows this.

Given these factors, then where are we in evolving that viable and valid national policy for the urban environment that I mentioned in the beginning?

If our objectives are to control and improve our environment, then we must make major adjustments in our institutions, dig deeper into our resources, and bring about a far higher order of responsibility for social justice. If these things do not happen, then we will frustrate these objectives.

There are four major efforts that must be made.

First, we must develop a national urban land policy, a policy that can serve to guide both public and private action. Land should be used to encourage democratic choice and diversity—for places to live, work, and play, and when market forces are inadequate, public expenditures should be used to encourage such diversity. We should enunciate a policy of future growth, to assure that the land is there and properly planned for decent urban growth. Among other things, this means that green spaces should be planned into future growth. We should establish priorities which balance long-run public costs with short-run private gains, and if this means some additional limitations on the traditional sanctity of private ownership, then perhaps it must be done.

Because of constitutional and traditional limitations, the States are potentially the best instruments available for carrying out a land

policy. The Federal Government's role is to enunciate goals and provide leadership, to induce the States through incentives to take up their responsibilities, and to coordinate interstate planning. I believe Americans are ready for action in this area, and will welcome leadership. They are harassed by rush-hour traffic, by empty wells and overflowing septic tanks, and by the clutter and din and dirt of too much of their urban environment. If the States do not enact their role, then I believe there will be a demand for Federal action.

As part of a land-use policy that would provide support for new choices and diversity in urban living, we are badly in need of a strengthened new communities' program of the type pending in the Administration's omnibus housing and urban development bill.

This program was designed to permit the Federal Government to share some of the risks of private developers in building new communities. We know how to design a better city. The new communities program would offer some of the building tools needed by private enterprise and by local governments to develop such new communities.

Next, we must evolve—invent if necessary—metropolitan organizations to meet problems that cannot be handled between historic boundaries of local government. Our Federal legislative efforts have been oriented toward providing incentives for the planning of those facilities that affect metropolitan growth—such things as highways, and transportation systems, and open space and sewer systems. This means that at the Federal level, we should and we have helped create institutions for metropolitan subsystems that can handle problems that affect the environment of whole metropolitan areas.

But, again, this is an area where the action of States, counties, and local governments will be crucial.

Once again, if there is a failure at these levels, there will be, in my estimation and evaluation, eventually a strong demand for Federal action.

Third, we must take the responsibility—on both a national and at the local level—of rebuilding our inner cities so that the environment is once again amenable to human life. On the Federal side, we have brought in such well-known programs as urban renewal, a broad range of housing aids and such comprehensive and coordinated efforts as the model cities program. We have important new programs this year—a massive combined Federal and private effort to build and rebuild enough housing in the next decade to give decent housing to all Americans. If this effort is to be successful, then we must dig deeper than ever before into our resources.

Finally, we must realize that we cannot attain a decent environment without social justice. I do not state this as a theory, but as a fact.

Turmoil and division will be an unhappy ingredient in America until we redress the balance between the haves and have-nots and put racial and religious bigotry into the low estate they deserve in our society.

The slum, urban or rural, is the worst of America. So is the ghetto, racial or religious. And, when we combine these two, then we have a contagion, physical and social, from which there is no possibility of security and escape. To try to achieve a decent environment without social justice is comparable to efforts to build the city beautiful by

concentrating on the boulevards and ignoring the indecencies of life that exist in the densely packed slums behind the facade.

In closing, may I make this observation. Today the matter of managing the urban environment is, simply, the matter of dealing with people and their institutions. This takes us into politics and into the complicated area of formulating an urban land use policy that will be acceptable to the public, among other things. Without getting pedantic about it, there are always periods in the historic development of democracies when the leadership is ahead of the electorate, and other periods when the leadership is behind. Certainly in the matter of planning the urban environment—and this is the overwhelming problem of our era—there must be strong and imaginative leadership. That, as I understand it, is the main purpose in our meeting here today.

Cochairman JACKSON. Thank you, Dr. Weaver for your excellent statement.

(The complete prepared statement of Secretary Weaver follows:)

REMARKS BY ROBERT C. WEAVER, SECRETARY, DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, NATIONAL POLICY FOR THE ENVIRONMENT

SUMMARY

There is no simplistic formula which can ensure a viable national environmental policy for urban America. There are still too many things we do not know. But we can get on our way by making four major efforts: (1) Developing a national urban land policy; (2) Evolving or inventing metropolitan organizations to meet problems that cannot be handled between historic boundaries of local government; (3) rebuilding our inner cities so that the environment is once again amenable to human life; and (4) bringing about a far higher order of responsibility for social justice. If these things do not happen, then we will frustrate the objectives of controlling and improving our environment.

There is no simplistic formula under which we can ensure the development of a viable and valid national environmental policy for urban America, not today and not for a good many days to come. There are too many things we do not know, basic matters such as how we define quality in the urban environment, how we measure it, and how we strike a balance among competing values.

There are large problems of taming our technology so that we are the masters rather than the victims of progress. Too often in our cities we are drowning in our profligate outpouring of goods. We are beset by the din of traffic noise and the fumes of poisoned air and the stench of polluted streams.

As Winston Churchill said in a speech at the Massachusetts Institute of Technology in 1949, we entered this century with "a sense of moving hopefully forward to brighter, broader, easier days." But by mid-century we had a new realization, again to quote Churchill:

"Our need was to discipline an array of gigantic and turbulent facts. To this task we have certainly so far proved unequal. Science bestowed immense new powers on man, and, at the same time, created conditions which were largely beyond his comprehension and still more beyond his control." But Churchill also realized that man does not bow to mindless forces. He realized that we cannot go back to the past, and shouldn't if we could. Americans by and large realize they cannot.

Yet, Americans cling to memories of the past. We do invoke Walden Pond in moments of nostalgia. And surveys continue to show that a majority of Americans claim a preference for life on the farm and in small towns. As in all memories, the hardships are submerged—the wood-burning stoves, horseback travel, and death by plague. This romantic nostalgia for the "good old days" is constantly reinforced by the ever-present difficulties and deficiencies of our present urban environment.

Herein lies the problem: How can we preserve the amenities we remember and want—clean air, sparkling brooks, near-by fields and woods, and a sense

of identity with a community—against the forces of urbanization. Consider the facts of urban expansion:

That today there are more than 200 million Americans but by 1980 there will be almost 240 million and by the year 2000 about 312 million in the 48 contiguous states and the District of Columbia alone, if present projections are borne out.

That the three major primarily urban regions alone—the Metropolitan Belt reaching from Maine to Virginia and Westward to Illinois and Wisconsin, and the Floridian and California regions—will leap in population from the 82 million of 1960 to more than 180 million by the year 2000.

That the urban population of 1960—about 125 million—occupied less than 1½ percent of the land area, and that the urban population of 2000—over 260 million—may cover more than 3 percent of our land area.

These are the approaching realities of urban growth. There are other factors with which we are all familiar: problems of decay and of the poor and alienated in the central city; of the ugliness and waste that accompanies too much of our urban growth.

There is a serious problem of stubborn resistance to change in our political institutions.

This is true at the local and state level, where the term metropolitan government is spark to the tinder, and where needed cooperation among neighboring local governments is sometimes resisted for fear it will lead to metropolitan government.

It is also true here in Washington. Within the executive departments and Congressional committees there are some who resist change with magnificent vigor, as all of us in this room are only too aware. Our friend John Gardner aptly characterized these people as those “who love their institutions and tend to smother them in an embrace of death, loving their rigidities more than their promise, shielding them from life-giving criticism.”

In the very fact of sheer physical bulk and massive rigidity—cities also resist change. Anyone connected with rebuilding a city knows this.

Given these factors, then where are we in evolving that viable and valid national policy for the urban environment that I mentioned in the beginning?

If our objectives are to control and improve our environment, then we must make major adjustments in our institutions, dig deeper into our resources, and bring about a far higher order of responsibility for social justice. If these things do not happen, then we will frustrate these objectives.

There are four major efforts that must be made:

First, we must develop a national urban land policy, a policy that can serve to guide both public and private action. Land should be used to encourage democratic choice and diversity—for places to live, work and play, and when market forces are inadequate, public expenditures should be used to encourage such diversity. We should enunciate a policy of future growth, to assure that the land is there and properly planned for decent urban growth. Among other things, this means that green spaces should be planned into future growth. We should establish priorities which balance long-run public cost with short-run private gains, and if this means some additional limitations on the traditional sanctity of private ownership, then perhaps it must be done.

Because of constitutional and traditional limitations, the states are potentially the best instruments available for carrying out a land policy. The Federal Government's role is to enunciate goals and provide leadership, to induce the states through incentives to take up their responsibilities, and to coordinate interstate planning. I believe Americans are ready for action in this area, and will welcome leadership. They are harassed by rush hour traffic, by empty wells and overflowing septic tanks, and by the clutter and din and dirt of too much of their urban environment. If the states do not enact their role, then I believe there will be a demand for Federal action.

As part of a land use policy that would provide support for new choices and diversity in urban living, we are badly in need of a strengthened new communities' program of the type pending in the Administration's omnibus housing and urban development bill. This program was designed to permit the Federal Government to share some of the risks of private developers in building new communities. We know how to design a better city. The New Communities program would offer some of the building tools needed by private enterprise and by local governments to develop new communities.

Next, we must evolve—invent if necessary—metropolitan organizations to meet problems that cannot be handled between historic boundaries of local government. Our Federal legislative efforts have been oriented toward providing incentives for the planning of those facilities that affect metropolitan growth—such things as highways, and transportation systems, and open space and sewer systems. This means that at the Federal level, we should and have helped create institutions for metropolitan sub-systems that can handle problems that affect the environment of whole metropolitan areas.

But again this is an area where the action of states, counties and local governments will be crucial. And again, if there is a failure at these levels, there will in my estimation eventually be a strong demand for Federal action.

Third, we must take the responsibility—on both a national and at the local level—of rebuilding our inner cities so that the environment is once again amenable to human life. On the Federal side, we have brought in such well-known programs as urban renewal, a broad range of housing aids and such comprehensive and coordinated efforts as the model cities program. We have important new programs this year—a massive combined Federal and private effort to build and rehabilitate enough housing in the next decade to give decent housing to all Americans. If this effort is to be successful, then we must dig deeper than ever before into our resources.

Finally, we must realize that we cannot attain a decent environment without social justice. I do not state this as a theory, but as a fact.

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In closing, may I make this observation. Today the matter of managing the urban environment is, simply, the matter of dealing with people and their institutions. This takes us into politics and into the complicated area of formulating an urban land use policy that will be acceptable to the public, among other things. Without getting pedantic about it, there are always periods in the historic development of democracies when the leadership is ahead of the electorate, and other periods when the leadership is behind. Certainly in the matter of planning the urban environment—and this is the overwhelming problem of our era—there must be strong and imaginative leadership. That, as I understand it, is the main purpose in our meeting here today.

Cochairman JACKSON. The Chair will next call on Assistant Secretary, Mr. John Baker, representing the Secretary of Agriculture, Secretary Freeman.

STATEMENT OF JOHN A. BAKER, ASSISTANT SECRETARY, DEPARTMENT OF AGRICULTURE

Secretary BAKER. Thank you, Mr. Chairman.

The success of our effort as a nation to adopt and implement a national policy for the environment may well determine the survival of man as a species, at the least whether we can insure it while maintaining a democratic way of life. The pressures of modern, free society compel and challenge us all to enlarge the environmental and ecological concepts we have been using to encompass a broader spectrum of concerns.

To do our part in this effort is a major top priority effort and mission of the Department of Agriculture. Of the six supraorganizational action task forces of the Department, two are exclusively concerned with managing the environment for higher quality—resources in action and communities of tomorrow. More than half the work of the

other four is, also, so directed—income and abundance, science in the service of man, consumer protection, international agriculture. These activities involve major concerted effort in policy formulation and program planning and evaluation by all the top officials of the Department. To insure unity of purpose and complete coordination of these activities, the task forces operate within the Department under unified leadership, with combined staffs.

Our purpose in the Department of Agriculture is to perfect and to operate, within our sphere of responsibility, a total systems approach to a higher quality environment for man in better communities of tomorrow with continued security of supply. Managing the environment for the best long-term interest of man is our aim and has been for over a century.

We are, also, integrating our work with that of other executive departments, of State and local governments, and of nongovernmental organizations. We have made our basic information and advice fully available to the many congressional committees who are deeply concerned with the many elements of basic old and emerging new environmental problems.

Today we welcome the opportunity to participate under your leadership in this refreshingly broad-based approach—one we hope and expect will lead to an internally coordinated, ecologywide national policy and a fully programed plan for national action.

As we view the task of environmental management, we are convinced it must encompass all aspects of our social, economic, cultural, and political systems as well as the physical, biological, natural, and chemical. Use, development, restoration, and preservation of natural resources are potentially compatible with each other and with a safe and good life for man in the long run. But, we must continually rearrange our activities, our institutions and our ways of doing things to enhance and insure this essential compatibility.

Recognizing that environmental policy in a democracy, like any other policy, is dependent upon public awareness, upon public understanding of the dimensions of the effort and upon public support and cooperation, we feel deeply the need to define, in understandable terms, the relevant national purposes and goals and the action required to fulfill them.

Your committee's interest and this colloquium will make a major contribution to this end.

The physical and biological environment of man consists of soil, air, water, and minerals, and the many life forms, the constructions of man and the circumstances and space in which he is allowed to live.

If we are to maintain human life with a rising level of civilization, we must manage the environment to provide adequate food, water, and fiber, materials for shelter, energy, transportation, space to live, sanitation and control of diseases and pests; adequate opportunities for economic development; increasing personal income and levels of living; full cultural experience and development, esthetic, spiritual, and educational; and, wholesome recreation.

Harmonizing productive use with the need to develop, preserve, restore and develop resources in ways that will avoid pollution and degradation is of vital concern to all of us and to national security.

Population impaction, poverty itself, is a form of pollution as well as a source of ugliness; as important as water, air, noise and other kinds of pollution. The overwhelming majority of our population is already concentrated in huge metropolitan complexes—occupying less than 2 percent of our land. The other 98 percent of the land contains only a small portion of our people, but almost all of the Nation's natural resources—air, water, soil, minerals, and plant and animal life.

Rural resources can help relieve the problems of population impaction that Secretary Weaver outlined by providing an abundance of food, feed, fiber, forest products, and water for the Nation as well as space for living and for outdoor recreation and esthetic enjoyment for all our citizens.

The countryside, also, offers an opportunity for building entirely new communities of tomorrow where large sections of our population can live, work, and play in a healthy, attractive, and vigorous environment that will enable 300 million American in the year 2000 to live less impacted lives than most of our 200 million now live, and lives that are less subject to water, air and noise pollution.

Historically, increased production efficiency in agriculture has released vast areas of land and a great deal of manpower for other uses. Much of the land once needed for agricultural production is now available and highly suitable and is being used for forests, scenic, and recreational uses. All such areas should be treated and managed for a symphony of multiple uses that will contribute to an improved environment and well-being for local residents, newcomers, and visitors alike in the national interest.

Operating under various laws, Executive Order 11307, and our appropriation acts as well as under our own initiative under our organic statute, the Department of Agriculture has over the years assumed responsibility for leadership in several parts of the overall national job of environmental management. Our current activities are outlined in Secretary's memorandum No. 1631, "Enhancing the Quality of the Environment." These activities are:

1. Reduction of the damages and losses from pollution;
2. Revitalizing rural communities;
3. Maintaining and improving the quality of rural living;
4. Expanding outdoor recreation;
5. Enhancing natural beauty; and
6. Protecting public health.

To organize and conduct these activities within the context of the overall national program, we are developing a Departmentwide systems analysis capability for evaluating and interpreting the ongoing programs. Results of these studies are used in the day-to-day operations of our programs. We seek to organize our efforts in ways that will make them compatible with efforts that may be undertaken by other agencies. We fully expect other agencies to do likewise.

Mr. Chairman, we have prepared several publications on these different subjects, and they are here, and we can make them available to members of the committee and to other participants.

Our research and our experience convince us that the Nation must:

1. Develop and proclaim a national policy on environmental management.

2. Use that national policy to coordinate in concert the programs of individual departments and agencies, utilizing their full competencies in complementary efforts.

3. Arrange for interdepartmental coordination and planning under the direction and leadership of the Executive Office of the President. This activity should give special attention to the development and use of a broad-spectrum analysis approach utilizing within it Department capabilities in a symphony of effort.

4. Provide for legislative oversight of the implementation of the national policy.

5. Build upon our historic working relationships, to continue to encourage and support State and local governments, conservation and other districts, educational institutions, private organizations, business and industry, and farmers, ranchers, business enterprises, industrial firms, and rural landowners in the multiple use of natural and human resources for the benefit of everyone. We in the Department of Agriculture have well-established, organized means, and are using them through highly competent personnel to reach out to those with whom we work in rural areas.

6. Direct special attention and action toward enlightenment of the citizenry on the true relationship of continuing environmental needs to newly emerging ones to the end that a national will is developed to support a comprehensive and positive program of environmental management. The glamour of newly discovered purposes must not be allowed to blind us to the age-old concerns of man.

Please be assured of the full cooperation of the Department of Agriculture. We want to, and will, do our part in a total national system of environmental management.

Thank you, Mr. Chairman.

Cochairman JACKSON. Thank you, Secretary Baker, for presenting a very fine statement.

(The complete prepared statement of Secretary Baker follows:)

STATEMENT OF JOHN A. BAKER, ASSISTANT SECRETARY, U.S. DEPARTMENT OF AGRICULTURE, JOINT HOUSE-SENATE COLLOQUIUM TO DISCUSS NATIONAL POLICY FOR THE ENVIRONMENT

Mr. Chairman, the success of our effort as a Nation to adopt and implement a national policy for the environment may well determine the survival of man as a species, at the least whether we can insure it while maintaining a democratic way of life. The pressures of modern, free society compel and challenge us all to enlarge the environmental and ecological concepts we have to encompass a broader spectrum of concerns.

To do our part in this effort is a major top priority effort and mission of the Department of Agriculture. Of the six supra-organizational Action Task Forces of the Department, two are exclusively concerned with managing the environment for higher quality—Resources in Action and Communities of Tomorrow. More than half the work of the other four is, also, so directed—Income and Abundance, Science in the Service of Man, Consumer Protection, International Agriculture. These activities involve major concerted effort in policy formulation and program planning and evaluation by all the top officials of the Department. To insure unity of purpose and complete coordination of these activities, the Task Forces operate within the Department under unified leadership, with combined staffs. Our purpose is to perfect and to operate, within our sphere of responsibility, a total systems approach to a higher quality environment for man in better communities of tomorrow with continued security of supply. Managing the environ-

ment for the best long term interest of man is our aim and has been for over a century.

We are, also, integrating our work with that of other Executive Departments, of State and local governments, and of non-governmental organizations. We have made our basic information and advice fully available to the many congressional committees who are deeply concerned with the many elements of basic old and emerging new environmental problems.

Today we welcome the opportunity to participate under your leadership in this refreshingly broad-based approach—one we hope and expect will lead to an internally coordinated, ecology-wide national policy and a fully programmed plan for national action.

As we view the task of environmental management, we are convinced it must encompass all aspects of our social, economic, cultural and political systems as well as the physical, biological, natural and chemical. Use, development, restoration and preservation of natural resources are potentially compatible with each other and with a safe and good life for man in the long run. But we must continually rearrange our activities, our institutions and our ways of doing things to enhance and insure this essential compatibility.

Recognizing that environmental policy in a democracy, like any other policy, is dependent upon public awareness, upon public understanding of the dimensions of the effort and upon public support and cooperation, we feel deeply the need to define, in understandable terms, the relevant national purposes and goals and the action required to fulfill them. Your Committee's interest and this colloquium will make a major contribution to this end.

The physical and biological environment of man consists of soil, air, water, and minerals, the many life forms, the constructions of man and the circumstances and space in which he is allowed to live.

If we are to maintain human life with a rising level of civilization, we must manage the environment to provide

- adequate food, water, and fiber;
- materials for shelter;
- energy;
- transportation;
- space to live;
- sanitation, and control of diseases and pests;
- adequate opportunities for economic development;
- increasing personal income and levels of living;
- full cultural experience and development (aesthetic, spiritual and educational);
- wholesome recreation.

Harmonizing productive use of resources with their development, preservation, and restoration in ways that will avoid pollution and degradation is of vital concern to all of us and to national security.

We are convinced the Nation can do all of these things without destroying the basic forces of nature upon which we depend for survival. And we can do them, if we act with dispatch, in ways that will not require totalitarian regimentation.

Population impaction, poverty itself, is a form of pollution as well as a source of ugliness; as important as water, air, noise and other kinds of pollution. The overwhelming majority of our population is already concentrated in huge metropolitan complexes—occupying less than two percent of our land. The other 98 percent of the land contains only a small portion of our people but almost all of the Nation's natural resources—its air, water, soil, minerals, and plant and animal life.

Rural resources yield food, feed, fiber, forest products, and water for the Nation as well as space for living and for outdoor recreation and aesthetic enjoyment for all our citizens.

The countryside, also, offers an opportunity for building entirely new communities of tomorrow where large sections of our population can live, work, and play in a healthy, attractive, and vigorous environment that will enable 300 million Americans in the year 2000 to live less impacted lives than most of our 200 million do now—and lives that are less subject to water, air and noise pollution.

Historically, increased production efficiency in agriculture has released vast areas of land and a great deal of manpower for other uses. Much of the land once needed for agricultural production is now available and highly suitable and is being used for forests, scenic and recreational uses. All such areas should

be treated and managed for a symphony of multiple uses that will contribute to an improved environment and well-being for local residents, newcomers, and visitors alike—all in the National interest.

Operating under various laws, Executive Order 11307, and our Appropriation Acts as well as under our own initiative under our organic statute, the Department of Agriculture has over the years assumed responsibility for leadership in several parts of the overall national job of environmental management. Our current activities are outlined in Secretary's Memorandum No. 1631, "Enhancing the Quality of the Environment." These activities are:

1. *Reduction of the Damages and Losses from Pollution* to soil, water, and air by agricultural chemicals, crop, livestock, and forestry wastes, sediment, sewage, and mining operations. The Department will continue to work with other Federal, State, and local agencies to minimize air and water pollution from urban and industrial sources.

2. *Revitalizing Rural Communities* through effective, balanced use of human talents and natural and economic resources to achieve more jobs, with more income for more people. The goal is to build Communities of Tomorrow that can reverse the present trend toward metropolitan congestion and help attain a rural-urban balance in which man can live in harmony with his environment.

3. *Maintaining and Improving the Quality of Rural Living* as an attractive, healthful place to live, through increased assistance providing equally to all people the services and amenities of contemporary life—such as housing, water supply, waste disposal, power, communication, transportation and education.

4. *Expanding Outdoor Recreation* to help meet the public demand, and to create jobs and strengthen the economy of the countryside. The Department will expand recreational facilities in the National Forests and provide financial, technical, and educational assistance to rural communities, farmers, and others to establish or enlarge such facilities for public use.

5. *Enhancing Natural Beauty* through landscaping, screening of residential and industrial developments, rehabilitation of surface-mined lands, protection of soil and plants, and conservation activities generally.

6. *Protecting Public Health* in both rural and urban areas by controlling pests that ravage food crops and livestock, and transmit human diseases, guarding the wholesomeness and quality of food products against contamination, reducing pollution of soil, water, and air, and providing and improving sanitation and waste disposal systems in rural areas.

To organize and conduct these activities within the context of the overall national program, we are developing a Department-wide systems analysis capability for evaluating and interpreting the on-going programs. Results of these studies are used in the day-to-day operations of our programs, to make indicated corrections in them and to formulate needed new programs. We seek to organize our efforts in ways that will make them compatible with efforts that may be undertaken by other agencies. We fully expect other agencies to do likewise.

Our research and our experience convince us that the Nation must:

1. Develop and proclaim a national policy on environmental management;

2. Use that national policy to coordinate in concert the programs of individual Departments and Agencies, utilizing their full competencies in complementary efforts;

3. Arrange for interdepartmental coordination and planning under the direction and leadership of the Executive Office of the President. (This activity should give special attention to the development and use of a broad-spectrum analysis approach utilizing within it Departmental capabilities in a symphony of effort);

4. Provide for legislative oversight of the implementation of the national policy;

5. Build upon our historic working relationships, to continue to encourage and support State and local governments, conservation and other districts, educational institutions, private organizations, business and industry, and farmers, ranchers, business enterprises, industrial firms, and rural land owners in the multiple use of natural and human resources for the benefit of everyone. (We in the Department of Agriculture have well established, organized means with highly competent personnel to reach out to those with whom we work in rural areas.);

6. Direct special attention and action toward enlightenment of the citizenry on the true relationship of continuing environmental needs to newly

emerging ones to the end that a national *will* is developed to support a *comprehensive* program of environmental management. (The glamour of newly discovered purposes must not be allowed to blind us to the age-old concerns of man.)

Please be assured of the full cooperation of the Department of Agriculture. We want to, and will, do our part in a total national system of environmental management.

Cochairman JACKSON. Our next participant in the colloquium is Dr. Donald F. Hornig, Director of the Office of Science and Technology.

STATEMENT OF DR. DONALD F. HORNIG, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY

Dr. HORNIG. Mr. Chairman, it is indeed a pleasure to join with you in discussing this subject which is of enormous consequence to us all and which I think will become more important as the years go on. The papers which the Senate and House committees prepared as a background are thought-provoking documents which call for a national policy on environmental management. I highly subscribe to the desirability of attempting to articulate a policy which will make explicit the beliefs, needs, and desires that underlie our many existing programs touching on the environment. We have always lived off our environment. We have been drawing on our capital and depleting our bank account. The problem now is whether we are willing not only to write policies, but to take the actions and to spend the money to keep our environment solvent and to understand and do the things it takes to understand what is meant by keeping our environment solvent.

There have been a number of proposals for what amounts to a national policy for the environment. For example, President Johnson enunciated a "creed to preserve our national heritage" in his message to Congress of February 23, 1966. The legislative branch, too, has been active in policy formulation, but its pronouncements are scattered throughout many separate congressional enactments. Agencies in the executive branch are guided by these enactments and the missions of the agencies are defined by them. These mission definitions both specify mandates for action and prescribe limitations or authority to the agents, and they are often, as has been testified before, fragmentary and even contradictory.

This body of policy, like the organization of Government, is the cumulative result of nearly two centuries of ad hoc decisions, each of which dealt with a pressing problem such as disposal of public land, or immigration, or irrigation, or agricultural practices. It is not surprising that we now find them to be fragmented and even contradictory when viewed in terms of environmental quality. We notice more and more that the factors affecting the environment and their effects are complex and intertwined with other serious problems. The difficulty is that we will never be able to simply deal with problems of environment as problems of environment alone. They are necessarily entwined with other problems.

It would certainly be helpful if this body of differing, widely scattered, fragmented authorities could be reviewed and reduced to a more coherent series of statements which, together with any necessary additions for completeness, would set out a national policy for the environment. Of course, a national policy will only be useful if its

philosophy and its provisions can be inculcated into the myriad laws the Congress enacts and the executive carries out, particularly those which concern matters that are not thought of primarily as influencing the environment. We must get the philosophy of environmental improvement, of environmental management, into all of our activities.

I have not thought through the means of accomplishing this nor have I considered in detail the conflicts that might arise in other fields from declaration of such a policy, but this meeting, which includes so many of the relevant committees of the Congress, is an important beginning. If these two points—a suitable means of insuring effectiveness and carrying it out, and an evaluation and rationalization of effects on other national goals—can be accommodated, I can see real benefit from a statement of national policy for the environment.

I visualize the policy as a formulation of goals that would serve as a frame against which proposed and existing programs would be considered and judged in terms of priority and content, and which would provide guidance in making the hard decisions involving competing goals. I see a need for a series of principles that would constitute the ground rules for action.

In my view, national policy must recognize the very wide array of appropriate and necessary uses of air and water and land. It would recognize, too, the existence of a number of beneficial but noncompatible uses, and make provision for resolving these conflicts. It should result in an environment that is safe, healthful, and attractive, and that is economically and biologically productive, yet that provides for sufficient variety to meet the differing requirements and tastes of man.

Principles to be included might give guidance for the consideration of competing desires in decisions affecting environmental use. For example, it seems to me that the costs to the environment ought to be entered into any cost-benefit calculations. We might recognize more explicitly the liability of people for damages done to the environment, the need for particular care in decisions that affect the environment irreversibly. Some things we do can be repaired. We can replete the soil and add fertilizer up to a point, but other things we do and we are becoming increasingly aware of that may lead to changes which can never be recovered. Any policy should recognize the critical Federal role in environmental management. The problem is now that we must not only recognize the urgencies and the principles, but we must be prepared to pay a price in many ways. We want to improve the environment, but at the same time we need to maintain our wealth and our productivity if we are going to have the wherewithal to do it. It is frequently said that technology is the source of many of our problems. Now, technology in itself is only a collection of skills. It is what we do with technology that may produce problems.

It is the pressure of increasing population and our desire for an increasing amount of goods that leads us to use technology in ways that causes us problems. But, if we are to deal with these problems, we need to know the facts. We need to know relationships. We are going to have to develop the science which will uncover those more subtle relationships which lead to a long-term degradation of the environment; and we are going to have to develop new technology to help us meet the environment problems.

We are going to have to develop technologies which will allow us to remain productive and still not damage the environment in ways we don't want. In short, technology not only provides us the skills which enable us to increase the scale of our industrialization and creates some of our problems, but we are going to need technology, new processes, new skills as an essential part of solving those problems.

Much recent discussion of environmental quality problems has centered on the organization of the Federal Government. Most suggestions have focused upon: shifting functions among agencies, assigning primary responsibility for resolving environmental quality problems to one agency, or establishing some permanent central body to review, coordinate, and perhaps even maintain control over Federal efforts in this area.

I was pleased in the discussion so far that this particular aspect has been somewhat deemphasized.

Petronius Arbiter, a Roman official in the time of Emperor Nero, about 1,700 years ago, was recently quoted by Dr. Handler with regard to these policies, and Petronius Arbiter said: "We tend to meet any new situation by reorganizing. And, a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency, and demoralization."

This wisdom seems to me to be applicable to the problem before us today, which obviously needs to be improved wherever it can, but organization alone is not the answer.

In principle, the authority for oversight and coordination—and, in fact, executive responsibility for management—is vested in the President; it is exercised through the Executive Office of the President, particularly by the Office of Science and Technology and the Bureau of the Budget, in this respect. We have been working very hard on this problem of coordination, and we have made much progress. But, if our efforts turn out to be insufficient, further steps will surely be necessary and new organizational forms may be needed in the Executive Office.

The creation of special councils to meet special problems—and the environment is only one of this class of problems which cuts squarely across many of the agencies and structures of the Government—does not seem the right direction to go. A proliferation of councils—and we already have a number—would simply move agency interactions to a new echelon, and then who would coordinate the councils? Certainly a general strengthening of staff capability at the Executive Office level to deal with the whole array of national goals is at least as attractive a possibility as a new organizational entity.

Furthermore, I do not think that this is the time to reassign functions among agencies. Logic might dictate the concentration of all environmental programs in a single agency, but we all know that this would fractionate the other important functions of the agencies. I think the whole matter needs more study at this point.

In summary, I believe that an explicit National Policy for the Environment would provide a valuable guide for the congressional actions and a frame in which existing executive agencies could conduct their programs. Such a policy, properly conceived, would permit us to get on with the task by dividing up the problems rather than cutting up the agencies.

I think the problem now is to get to work on the substance rather than the generalities.

Thank you.

Cochairman JACKSON. Thank you, Dr. Hornig, for another fine and excellent statement.

(The prepared statement of Dr. Hornig follows:)

STATEMENT OF DR. DONALD F. HORNIG, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY, EXECUTIVE OFFICE OF THE PRESIDENT, BEFORE THE JOINT HOUSE-SENATE COLLOQUIUM ON A NATIONAL POLICY FOR THE ENVIRONMENT

Senator Jackson, Congressman Miller, members of the Senate and House of Representatives, Secretaries, distinguished guests, it is indeed a pleasure to join with you in discussing this subject which is of such enormous consequence to us all.

The Senate and House Committee background papers both are thought-provoking documents which call for a national policy on environmental management. I wholeheartedly subscribe to the desirability of articulating a policy to make explicit the beliefs, needs, and desires that underlie our many existing programs touching on the environment.

POLICY

There have been a number of proposals for what amounts to a national policy for the environment. For example, President Johnson enunciated a "Creed to Preserve Our National Heritage" in his message to Congress of February 23, 1966. The Legislative Branch, too, has been active in policy formulation, but its pronouncements are scattered throughout many separate Congressional enactments. Agencies in the Executive Branch are guided by these enactments and the missions of the agencies are defined by them. These mission definitions both specify mandates for action and prescribe limitations of authority.

This body of policy, like the organization of Government, is the cumulative result of nearly two centuries of ad hoc decisions, each of which dealt with a pressing problem such as a disposal of public land, or immigration, or irrigation, or agricultural practices. It is not surprising that we now find them to be fragmented and even contradictory when viewed in terms of environmental quality. We notice more and more that the factors affecting the environment and their effects are complex and intertwined with other serious problems.

It would certainly be helpful if this body of differing, widely scattered fragmented authorities could be reviewed and reduced to a more coherent series of statements which, together with any necessary additions for completeness, would set out a National Policy for the Environment. Of course a National Policy will only be useful if its philosophy and provisions can be inculcated into the myriad laws the Congress enacts and the executive carries out, particularly those which concern matters that are not thought of primarily as influencing the environment. I have not thought through the means of accomplishing this nor have I considered in detail the conflicts that might arise in other fields from declaration of such a policy, but this meeting, which includes so many of the relevant committees of the Congress, is an important beginning. If these two points—a suitable means of ensuring effectiveness, and an evaluation and rationalization of effects on other national goals—can be accommodated, I can see real benefit from a statement of National Policy for the Environment.

I visualize the Policy as a formulation of goals that would serve as a frame against which proposed (and existing) programs would be considered and judged in terms of priority and content, and which would provide guidance in making the "hard" decisions involving competing goals. I see a need for a series of principles that would constitute the "ground rules" for action.

In my view national policy must recognize the wide array of appropriate and necessary uses of air and water and land. It would recognize, too, the existence of several beneficial but non-compatible uses, and make provision for resolving these conflicts. It should result in an environment that is safe, healthful, and attractive and that is economically and biologically productive, yet that provides for sufficient variety to meet the differing requirements and tastes of man.

Principles to be included might give guidance for the consideration of competing desires in decisions affecting environmental use; the need for particular care in decisions that affect the environment irreversibly; and should recognize the critical Federal role in environmental management.

ORGANIZATION

Much recent discussion of environmental quality problems has centered on the organization of the Federal Government. Most suggestions have focused upon:

- (a) Shifting functions among agencies;
- (b) Assigning primary responsibility for resolving environmental quality problems to one agency; or
- (c) Establishing some permanent central body to review, coordinate and perhaps even maintain control over Federal efforts in this area.

Petronius Arbitrator, a Roman official in the time of Emperor Nero, about 1,700 years ago, was recently quoted by Dr. Philip Handler in a speech before the American Physical Society:

We tend to meet any new situation by reorganizing. And a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralization.

This wisdom seems to me to be applicable to the problem before us today. Organization alone is not the answer.

In principle, the authority for oversight and coordination (and in fact, executive responsibility for management) is vested in the President; it is exercised through the Executive Office of the President, particularly by OST and BOB. We have been working very hard on this problem of coordination, and we have made much progress. If our efforts turn out to be insufficient, further steps will be necessary and new organizational forms may be needed in the Executive Office.

The creation of special councils to meet special problems does not seem the right direction to go. A proliferation of councils would simply move agency interactions to a new echelon, and then who would coordinate the councils? Certainly a general strengthening of staff capability at the Executive Office level to deal with the whole array of national goals is at least as attractive a possibility as a new organizational entity.

Furthermore, I do not think that this is the time to reassign functions among agencies. Logic might dictate the concentration of all environmental programs in a single agency but we all know that this would fractionate the other important functions of the agencies.

In summary, I believe that an explicit National Policy for the Environment would provide a valuable guide for the Congressional actions and a frame in which existing Executive agencies could conduct their programs. Such a Policy would permit us to get on with the task by dividing up the problems rather than cutting up the agencies.

Cochairman JACKSON. Here to represent Secretary Cohen—he had hoped to be here but he is detained at the White House—is Dr. Philip Lee, the Assistant Secretary for Health and Scientific Affairs, HEW.

Dr. Lee, we are delighted to have you here.

(The statement of Secretary Wilbur J. Cohen, HEW, follows:)

PREPARED STATEMENT OF WILBUR J. COHEN, SECRETARY, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Mr. Chairman, Senators and Representatives, I welcome this opportunity to join with you in what I believe is a vitally important and most timely discussion of the complex issues surrounding the broad question of environmental quality.

The environment consists of air, water, land, and living organisms, and their interrelationships. The quality of living is affected by far more than our physical surroundings. It is also related to population pressure, to the order or disorder in urban growth, to the safety of the products and services which enter our lives. Environmental quality is determined by esthetic as well as physical factors, by the ability of

people to move from place to place, to find change when they want it, and to experience beauty.

Our goal must be to assure an attractive, comfortable, convenient, and healthy environment for every American.

Three years ago, the Environmental Pollution Panel of the President's Science Advisory Committee enunciated the following statement of national principle:

The public should come to recognize individual rights to quality of living, as expressed by the absence of pollution, as it has come to recognize rights to education, to economic advance, and to public recreation.

It is time not only to recognize that right but to implement it as rapidly and effectively as possible.

The Department of Health, Education, and Welfare is committed to that goal. We place a high priority on the activities we conduct to preserve and protect environmental quality.

Our responsibilities in this field are broad and varied. They extend from air pollution control to assuring the quality of food and drugs, from reducing the stresses of noise and crowding to safeguarding drinking water, from the control of insect carriers of disease to minimizing the effects of radiation. These activities are intrinsic to our basic mission: the highest possible quality of life for every individual in our society. Our concern for health in its broadest context—in the words of the World Health Organization definition, "A state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity"—makes us the appropriate Federal agency to deal with problems of environmental quality.

Today those problems are infinitely complex and seriously threatening to our future.

I believe that man has precipitated a revolution in the environment, a revolution that is here and now, and must be acknowledged. He has set in motion forces of such magnitude and rapidity as to overtake and overwhelm the natural forces of environmental change. We are meeting today because of that very fact.

Many eminent scientists have emphasized that our efforts to achieve and maintain a clean environment may indeed decide our ability to survive on this planet. The Congress has responded to this national crisis with many important legislative measures designed to safeguard and improve our environment. The existence of many new programs, launched to meet separate problems of environmental contamination and located in numerous Federal agencies, is one of the reasons for this meeting today.

Even if we do not accept the possibility that human life may cease if we fail to act further, we must agree with the premise that concern for the health and welfare of our citizens is sufficient cause for our best thought and action to solve these problems.

Environmental changes of the kind occasioned by air and water pollution, unwise use of pesticides, declining water supplies, and urban sprawl may develop unobtrusively but can be devastating in their end result. These changes are insidious. They occur gradually and thus fail to arouse public awareness. They have irreversible harmful effects on man and the environment before they are detected and understood. Environmental quality continues to decline, while Government, lacking or perhaps failing to recognize a popular consensus for comprehensive control, is unable to stem the tide.

Despite the intense interest of the Congress, as well as that of the executive branch and many parts of the private sector, many of the problems of environmental quality have not been solved.

Our economy grows, our urbanization increases, and our population continues to expand. Yet our actions are not adequate to enable people to live in this changing Nation in full enjoyment of physical and mental health, well-being, and comfort. Let me cite a few specific examples of the problem:

Despite widespread efforts to control the use of pesticides, the amount of these poisonous chemicals accumulating in the environment is steadily increasing. We still do not know all we should about the possible human and other effects of exposure to small amounts of pesticides over a long period of time.

Nor have we solved the problem of bacterial food contamination—while witnessing thousands of foodborne disease outbreaks every year, or of exposure to unnecessary amounts of radiation.

The Food and Drug Administration has estimated that the American people are exposed to thousands of different products, many over long periods of time. Yet few of these products have been studied and cataloged in a manner that might provide the basis for determining their effects on man.

There is serious concern about the health hazards of air pollution, and yet this problem is steadily growing worse. Unless we accelerate our efforts to bring it under control, pollution will inevitably reach critical proportions in many large urban areas within the next several years.

Unfortunately, these separate insults to the system do not impinge on one individual one at a time; they occur all at once. While the individual may be able to adapt to slightly polluted water, or air, or food, he probably cannot adapt to the collective onset of all of them. And, if he is subjected at the same time to slum housing, crowding, noise, and other urban environmental stresses, he will find life altogether unbearable.

In addition to the collective effects, we have to understand the cumulative effects of environmental hazards. Threats to health can follow from prolonged, repeated exposure to concentrations of environmental pollutants so small that they do not make an individual sick enough to send him to the doctor.

In sum, we are concerned with problems that stem from all the activities of our society, but concentrate in one spot: the well-being of the individual.

Perhaps the most important contribution of our Department is our unswerving adherence to the concept that the most important reason for exercising wisdom, constraint, and caution in our uses and abuses of the environment is people's health and welfare, and probably their survival. But there are other important considerations as well.

There is no doubt, for example, that the well-being of our citizens is lessened by the spoliation of vistas which once brought beauty. The quality of people's lives is crippled when they no longer have access to clean air, sparkling water, grass and flowers, and those experiences which renew our bonds and ties with nature and truly nourish the spirit and hence the whole man.

In dealing with the breadth of problems I have mentioned, it is clear that correspondingly broad programs of action are needed. If we are to protect, restore, and enhance the quality of our environment, these programs must give attention to pollution of air, land, water, and food, and the management of our national resources; provide more rationally for our housing needs; improve arrangements of the varied services and facilities in our urban communities; give appropriate attention to maintenance of natural beauty; and develop improved institutional arrangements for implementing these actions at various levels of government, in industry, and in our society in general.

These actions involve our entire society and call for the use of all our scientific, technological, and educational skills. Our goals must be expressed in terms of human values, not disciplines of knowledge—human values such as health, the right to privacy, equality of opportunity, the right to live in a world that sustains, rather than degrades, the human spirit.

We have come far in recent years in developing an understanding of this principle. It is now amply clear that we have a general national policy to preserve and improve environmental quality in the interest of human and economic welfare. We have made considerable progress in implementing programs to improve environmental quality in such fields as pollution control, consumer protection, housing and food quality. All levels of government as well as the private sector are involved in these efforts. And I believe these efforts have wide public support.

For the most part, our policy has been built brick by brick through the implementation of specific programs. In following this course, it is important that we bear in mind our basic objective: the promotion of human health and welfare. If we keep our eye on this target, we cannot fail to conserve our natural resources and foster continued economic growth.

The Federal Government can not, and should not, assume total responsibility for improving the quality of the environment. State and local government, industry, the scientific community, conservation and health organizations, and the public must all be involved. And increasingly, in programs administered by the Department of Health, Education, and Welfare, they are involved, indeed, I believe we have an obligation to help provide opportunities for all interested segments of society to play an active role in the creation of a better environment.

But the Federal Government has a key role to play in at least three areas. The first of these is research and development to advance our knowledge of environmental problems and their effects on health and welfare, and to improve our ability to prevent and control these problems. Industrial groups, including organizations experienced in aerospace and defense work, also contribute to this search for new knowledge.

A second area involves Federal activity to support State and local environmental control efforts. States and communities must shoulder a major share of the responsibility for dealing with problems of environmental quality. Clearly, the Federal Government must be prepared to furnish both financial and technical support, and to encourage State and localities to carry out vigorous regulatory programs.

A third major area of Federal responsibility involves regulatory activity. Many environmental problems can be solved only in part, if at all, through State and local action. The regulatory activities of the Food and Drug Administration are designed to cope with problems of this kind; so are the National Air Pollution Control Administration's standard-setting activities pertaining to motor vehicle pollution. Our experience with environmental problems has demonstrated that some regulatory activity is invariably necessary to insure adequate control of environmental hazards. This does not mean that the Federal Government must become the policeman of the environment, but it does mean that we must be prepared to exercise regulatory authority where State and local action is either ineffective, inadequate, or inappropriate.

These principles are embodied in many pieces of Federal legislation. They are general principles, rather than detailed instruction, and designedly so. The environmental problems with which we are concerned are not static, not solvable on a formula basis. For this reason, the Congress has wisely developed legislation that permits a flexible, responsive approach to environmental control. This is as it should be.

Turning now to the question of how the Federal effort in environmental control can best be organized, I am sure we can all agree that no single department or agency can or should assume exclusive responsibility for dealing with such a complex set of problems. Many departments and agencies are contributing to the Nation's efforts to improve the environment, and should continue to do so. We need to draw on all the resources, experience, and skills that are found throughout the Federal Government.

The executive branch has long struggled with the problem of how best to organize to meet its environmental responsibilities. I submit that reorganization is not in itself a guarantee for more or better action. Rather it is a method whereby, hopefully, new arrangements and alinements can bring about more effective action. Organizations must continually undergo examination and change if they are to remain viable and responsive in the face of change.

In general, two organizational patterns of Federal effort have emerged in the environmental field.

In certain discrete, well defined areas, activities have been organized under the "lead agency" concept. In these instances—for example, air and water pollution control, food and drug regulation—primary program responsibility is assigned to a single agency which has an obligation to use not only its own resources, but also those available elsewhere in government and in the private sector.

The second pattern involves multiple rather than single agency leadership, primarily because it must accommodate a variety of interests, no one of which takes precedence. For example, pesticide control relates to basic problems of disease vectors and their control, agricultural productivity, forestry, wildlife conservation, fisheries, and so on. For such elements of the environmental quality problem, different mechanisms of organization must be employed. Obviously, coordination is a major organizational problem.

The Executive Office of the President has played a significant and constructive role in achieving coordination through such agencies as

the Bureau of the Budget, the Office of Science and Technology, the Federal Council on Science and Technology, and the Council of Economic Advisers.

There is certainly a need for improved coordination, which, in my view, can and should be met through strengthening the existing agencies and coordinating bodies.

There are two other problems relating to national environmental policy that I would like to bring to your attention.

The first of these is the conflict between environmental quality goals and economic interests. We need to find a way of minimizing this conflict. Environmental controls may be costly in the short run, but in the long run they are a bargain both for industry and the public it serves. What we are really seeking is an enlightened self-interest, an interest that industry and commerce have often exhibited. Indeed it is gratifying to see a remarkable change in the attitude of a growing number of business leaders who recognize that sound public policy is also in the best interests of sound corporate policy.

Related to this problem is the operation of Federal regulatory agencies whose program responsibilities may result in lack of adequate attention to environmental quality. I am glad to note that many of these Federal agencies are now showing an increasing awareness of environmental quality control as a part of their broader responsibilities.

The second problem I would like to mention relates to the way in which the Congress deals with the development of Federal policy and to program organization and conduct in the environmental quality field. The current organization tends to a fragmentation of interests, with many legislative and appropriations committees concerned, but with no effective mechanism for a broad and coordinated approach to problems of environmental quality. I think this is a matter to which the Congress must give attention if we are to achieve a coordinated national policy and program in this field.

In summary, I would like to offer three general suggestions for future action:

First, the various Federal agencies should examine and strengthen their activities in the environmental quality field. The Department of Health, Education, and Welfare has undertaken a series of measures to implement and upgrade its programs in the environmental quality field. This month, through the creation of the Consumer Protection and Environmental Health Service, we have focussed in a single agency the responsibility for identifying hazards in the environment, developing and promulgating criteria and standards for the control of such hazards, and mounting appropriate compliance programs. Specifically, the new agency will:

1. Establish a better understanding of the ecological system through consolidation of existing knowledge and acquisition of new knowledge.
2. Develop environmental control strategy consistent with health, esthetic, economic, and social factors.
3. Acquire, compile, and evaluate information on the total burden of environmental contaminants in various population groups.
4. Establish criteria and standards on the permissible burden of environmental contaminants.

5. Conduct action programs to implement strategy at the several levels of Government.

6. Assess total environmental contaminant levels obtained from surveillance networks on a continuing basis.

Second, I would like to suggest that the executive branch as a whole continue its intensive efforts to achieve greater coordination of environmental quality programs. I believe we are making significant progress in this direction, but I am convinced that we need greater utilization of existing resources to be even more productive.

Third, we recommend that the Congress examine its own organization in order to improve its ability to deal in a comprehensive and coordinated manner with the total problem of environmental quality. Several proposals have been made to achieve this result. Senator Edmund S. Muskie's Senate Joint Resolution 68 to establish a Select Senate Committee on Technology and the Human Environment is designed in part to accomplish this purpose. Such action by both Houses of the Congress might bring about a significant improvement in the ability of the entire Federal Government to deal with the environmental problems we face.

Without hysteria, without despair, without callous indifference, it is vitally important that we understand the urgency of these problems. Some of our country's most distinguished scientists have warned that time is literally running out, that we have set in motion processes of environmental destruction that we are now all but powerless to stop.

I hope that these predictions are wrong. I believe we have begun to take the steps which are necessary to reverse the deterioration of our environment. But I believe that all of us—in the Congress, the executive branch, the States, the local governments, private industry, indeed every sector of our society—need to recognize the dimensions of the threat and redouble our efforts. Unless we do, the predictions of our scientific colleagues may well be tragically right. And then no effort, no matter how well conceived, will suffice.

Cochairman JACKSON. Now we will hear from Dr. Lee.

STATEMENT OF DR. PHILIP LEE, ASSISTANT SECRETARY FOR HEALTH AND SCIENTIFIC AFFAIRS, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Secretary LEE. Thank you very much, Senator Jackson, Congressman Miller, and other distinguished Members of the Congress.

Secretary Cohen deeply regrets that a last-minute call to the White House made it impossible for him to be with us at this time, but he hopes to be joining the group later in the morning.

With your permission, I will submit a statement for the record and present an oral summary at this time.

Among the many issues today which are cause for serious public concern, there is none more urgent—in terms of consequences for present and future generations—than the protection of our environment.

The Department of Health, Education, and Welfare places high priority on the activities which it conducts for the preservation and protection of environmental quality. This department has been given responsibility for a number of areas in this field—air pollution control, food and drug quality, standards of drinking water, radiation

control, the control of insect vectors of disease, to name a few. All of these programs are vitally important to a major aspect of the broad environmental quality issue—namely, the protection of health.

I am speaking of health in the broadest context. The World Health Organization defines health as a “state of complete physical, mental, and social well being, not merely the absence of disease or infirmity.” Many eminent scientists concerned with health have emphasized that our efforts to achieve and maintain a clean environment may decide our ability to survive on this planet.

Despite the intense interest of the Congress—as well as that of the executive branch and parts of the private sector of our society—many of the problems of environmental quality have not been solved. Indeed, they grow more complex and their solution seems further from our reach.

Our economy grows, our urbanization increases, and our population continues to expand. And, I should just like to comment at this time that yesterday the President met for the first time with his newly established Committee on Population and Family Planning, chaired by Secretary Cohen and cochaired by Mr. John D. Rockefeller III, brother of our distinguished panelist today, and the broad areas that Secretary Udall spoke of are of specific and particular concern to that committee.

The actions we apply are not adequate to enable people to live in a changing nation in full enjoyment of physical and mental health, well being, and comfort.

I believe the most important reason for exercising wisdom, constraint, and caution in our uses and abuses of the environment is people's health and welfare, and indeed their survival. On the other hand, health is not the sole reason for environmental quality management. The esthetic needs of society and the impact of environmental quality and control on economic and social welfare must also be taken into account.

To deal with the breadth of problems it is clear that a correspondingly broad program of action is needed. To protect the quality of our environment, we must give attention to pollution of air, land, water, and food, and the management of our basic resources; we must provide more rationally for our housing needs; we must improve arrangements of the varied services and facilities of our urban communities; we must give appropriate attention to maintenance of natural beauty; and develop improved institutional arrangements for implementing these actions at various levels of government, in industry, and in our society in general.

We all recognize that these complex problems and relationships are difficult to comprehend. But, we have come far in recent years in developing our understanding and basic policies. The Federal Government, including both the executive and legislative branches, have made it clear that we must preserve and improve environmental quality in the interests of public health and our human and economic welfare. Considerable progress has been made in implementing programs for the improvement of environmental quality in such diverse fields as pollution control, consumer protection, housing, and food quality. These programs have, in many instances, appropriately involved other levels of government and the private sector, and I think we have the widest possible public support for our efforts in these directions.

National policies regarding environmental quality must provide for both public and private involvement in efforts to improve the quality of our environment. The Federal Government cannot, and should not, be expected to have total responsibility for these efforts. State and local government, industry, the scientific community, conservation and health organizations, and the general public must all be involved.

Among the activities in which the Federal Government should play a prominent role are: (1) the development of goals and broad national leadership; (2) the conduct and support of necessary research and development; (3) the extension of both technical and financial support to States and local governments in their essential functions in this field; (4) the encouragement of State and local control efforts; and (5) the exercise of regulatory authority where State or local action is either ineffective, inadequate, or inappropriate.

Many Federal departments and agencies are capable of contributing to the Nation's efforts to improve the environment. Each can make a contribution and should do so.

This broad participation on the part of Federal agencies need not result in a Federal effort that is amorphous, unstructured, and uncoordinated. We see two patterns of Federal effort in this broad field. In certain discrete, well-defined programs, activities are organized under the "lead agency" concept. In these instances—for example, air and water pollution control, food and drug regulation—primary responsibility for the organization and conduct of these segments of the overall environmental quality programs is assigned to a single agency which has an obligation to use not only its own resources, but also to provide the leadership in achieving effective use of the resources available elsewhere in Government and in the private sector.

In many areas, this cannot be used as a general formula for setting organizational patterns. For example, water resources development involves the interests and functions of many agencies of Government and includes such diverse elements as pollution control, disease vector control, wildlife conservation, public and industrial water supply, navigation, and flood control. For these elements of the broad environmental quality problem, different mechanisms of organization and coordination are most appropriate and must be used.

The Executive Office of the President has played a significant role in achieving coordination through such agencies as the Bureau of the Budget and the Office of Science and Technology, as Dr. Hornig indicated. I believe these arrangements are good and can be made better.

There are two other related problems that I would like to mention briefly.

First, we need to find better ways of resolving the conflicts of interest which mistakenly place short-term economic gain ahead of long-term environmental management. And, certainly Mr. Rockefeller and Secretary Udall spoke eloquently on that this morning.

I think that industrial and business leaders are increasingly coming to recognize that sound public policy, such as environmental management, is not in conflict with sound corporate policy. Similarly, we in the Federal Government need to understand that the advancement of commerce and industry can be pursued along with protection and restoration of the environment.

The second problem which I would like to mention relates to the organization of the Congress. Recognition must be given to the fact

that the current organization of the Congress tends to fragment interest in environmental management and provides no real mechanism for dealing with a broad approach to problems of environmental quality in concerted manner. Again, Mr. Rockefeller, I think, spoke very clearly and eloquently on this point. I think this is a matter to which the Congress must give attention if we are to achieve a unified national policy and program in this field.

In summary, I would like to bring three general suggestions to your attention.

First, the various departments and agencies of the executive branch should examine their activities in the environmental quality field to insure that they are obtaining necessary and appropriate attention and the priority they deserve, and that such programs be strengthened where appropriate, through reorganization of similar measures.

The Department of Health, Education, and Welfare has had these matters under almost continuous scrutiny for the past decade or more and has taken successive measures to implement programs in the environmental quality field. Our most recent step in this direction was taken just this month, through the creation of the Consumer Protection and Environmental Health Service, with responsibility for identifying hazards in the environment, developing and promulgating criteria and standards for the control of such hazards, and mounting programs that will promote and achieve compliance with the objectives developed.

Second, the executive branch as a whole should continue its intensive efforts to promote and achieve a greater degree of coordination of environmental quality programs being conducted in various departments and agencies of the Federal Establishment.

Third, I urge that the Congress intensively examine its own organization toward the end of improving its ability to deal in a comprehensive and coordinated manner with the total problem of environmental quality. I note that there have been a number of proposals made in the Congress to achieve precisely this result. The proposal forwarded, for example, by Senator Edmund S. Muskie in Senate Joint Resolution 68 to establish a Select Senate Committee on Technology and the Human Environment would appear to be designed to accomplish the purpose I have outlined. Consideration by both Houses of the Congress of this and similar suggestions might, in my view, bring about a significant improvement in the ability of the entire Federal Government to deal with the environmental quality problems we are facing.

Thank you very much.

Cochairman JACKSON. Thank you, Dr. Lee. That's a very fine contribution to the panel discussion this morning.

Your cochairmen feel that they should defer asking questions until our colleagues in the House and Senate have had an opportunity to ask any they may have, so the Chair will start out by turning to Senator Muskie to ask the first question.

Senator MUSKIE. Thank you very much, Mr. Chairman.

First of all, I would like to compliment Senator Jackson and Congressman Miller for conceiving this forum for discussing this important national problem.

Second, I think we have had an excellent series of papers here this morning, expressing themselves in the broadest possible terms. We have

had, I think, the broadest possible concept of the environmental quality discussed here this morning.

Before I ask a question, like all Members of Congress, I would like to make a little speech in order to lay the background for the question. We have had a lot of discussion here about the need for a national policy of environmental policy, and speakers have, I think, nibbled away at (1) the problems of degradation with which we are confronted; (2) the contributing causes; (3) the inadequacy of our organizational structures in the Congress and executive branch, and elsewhere for dealing with it; (4) our reluctance to make the necessary investments of money and resources to do the job. But, I don't think any one of our speakers has yet explicitly proposed what our policy for improvement of environmental policy ought to be.

Let me put it in this way: In recent legislation I think the Congress has done at least these things in establishing a national policy: First, that an enhancement, not degradation of our environment, ought to be the goal of our environmental quality program. Second, that the first responsibility for carrying out a program of environmental quality enhancement rests with State and local government. Third, that we ought to avoid the straightjacket of Federal standards and Federal enforcement in dealing with such things as air and water quality.

Now, in the past in developing national policies we long ago defined water as a national resource, but ever since we have continued to exploit it without regard to future requirements. Years ago we defined land as a national resource and yet we have continued to exploit it and this can be said about minerals, about timber, and now about air, estuaries, and the oceans.

Thus far the so-called natural resource policies have been designed not to work toward enhancement or protection of these resources, but to indicate the maximum levels of exploitation which we will permit.

So, the question that I would like to ask you gentlemen—and I'm not going to direct it against any one of you, simply inviting a concert of responses—is this: When we get down to the point, somebody is going to have to say that no longer will we permit a continuing degradation of these resources. Secretary Udall has been confronted with this very specific problem in connection with water quality standards.

The 1965 act reestablishes national policy that our objective shall be the enhancement of water quality. So, what did the Secretary get involved in? The question was whether enhancement permits the degradation of any stream. Although we adopted a policy of enhancement, when we came to the question of whether in any given specific instance a stream shall be permitted to be degraded to serve some economic goal, immediately the pressure set in. I think Secretary Udall has developed a very realistic and pragmatic policy in response to those pressures. But, when you say that we need a national policy of environmental quality improvement, what are you suggesting in terms of a point in time at which enhancement begins to take over as a substitute for further degradation?

Cochairman JACKSON. Who wants to volunteer first?

Secretary UDALL. Well, Senator, as usual, you put your finger on the key issue and there's no question but that our whole history as a people until recent years was that of developing, exploiting, by whatever generation that happened to be running the show, of using up

resources that in truth, if it had a proper moral sense, a proper sense of stewardship, should have been willed and passed on to subsequent generations.

And, I think to me this gets at the heart of national policy. There was underlying this, as I read our history, an assumption in the beginning with the frontier country that any development and any growth was good and we applauded anybody who cut a tree or gouged out the earth. This was advancing the cause of the country. We then came into the industrial era, the industrial revolution, with all that we could do with machines and processes. Manufacturing threw off all kinds of effluence, and we began to defile air, water and litter landscape in a much more rapid way than we did as a primitive country. We then proceeded on a broad assumption that this was inevitable, that an industrialized nation of the kind that we were, that was aggressive and was active, that it had to be a dirty, unclean country; and I think that is what we are in the process of doing. I don't think we have done it; I don't think we have such a national policy, but I think we wouldn't be having this meeting today and it wouldn't have been called by people who have never sat together as a group if there wasn't the dawning of the belief that we are capable, we have the wealth, we have the scientific know-how, we can develop the technology to manage our affairs in this Nation so that we produce what we must produce and at the same time, as you have suggested, that we stop the degradation, that we no longer accept that as an assumption and that we put in a new assumption that we can enhance the environment and truly pass it on to the next generation, to our children. That's what we are talking about—improve and enhance.

But, we all talk about this. We give speeches on it and some of the legislation that we pass embodies this, but we don't have a national policy on this and let's not kid ourselves.

Cochairman JACKSON. Anyone else like to comment?

Secretary Baker?

Secretary BAKER. Mr. Chairman, to be back here today for this colloquium, I flew across about a thousand lakes in northern Wisconsin and Minnesota yesterday. Many of them are showing signs of aging. Part of which is that we have simply not yet met Senator Muskie's challenge with respect to sedimentation, the handling of human waste and other things.

I'm reminded as a part of an answer to your question of the fact that Congress for a hundred years had never done a thing about soil erosion until, as a result of drought and dust storms, dust itself was blowing into the windows of the Capitol, into the Senate Chamber and the House Chamber, and the Congress did act, and the executive branch did act and they decided that the Nation would be devoted to stopping dust storms at their source. I suggest, Mr. Chairman, that it takes a national awareness and a national dedication and at the moment we achieve this we switch from degradation to enhancement.

Cochairman JACKSON. If you will yield at that point, I would say the dust storm occurred with a great depression, and I think there were two action-forcing processes at work, don't you?

Secretary BAKER. Undoubtedly true.

Cochairman JACKSON. Along with all the great social reforms.

Secretary BAKER. Now, there is one other very important item it seems to me, Senator Muskie. Secretary Udall started his discussion with it earlier this morning. It relates to cost effectiveness or cost-benefit calculation or a total systems approach or whatever you want to call it. We have got to get all of these environmental and end results or national purposes that we want spelled out into the calculation formulas that are used in determining what programs we can use dollar inputs for, both in the private sector and the public sector. Very, very important in that calculation is a determination of valuing future goods related to short-term goods.

Cochairman JACKSON. Dr. Hornig?

Dr. HORNIG. It seems to me, Mr. Chairman, that one of the problems we encounter when we try to discuss Senator Muskie's question is that we can't always define the words "enhance" and "degrade" in any simple fashion; and that the concept that we really need to build into everything we do is that of the best overall management of the environment for maximum benefit of society, and that's going to be a hard thing to achieve.

I don't know how to write it down in simple terms, but, the big step I think we can take is to build into our entire process, including our production processes, the notion that environmental costs are real costs and we have to invent ways of putting environmental costs into the basic economic calculations, for instance, when industrial firms must make choices among production processes. At the moment one picks that process which produces for the consumer at minimum costs. This is the economically best situation in a market. On the other hand, that's the stage at which one can avoid the problem by picking another process which may be a slightly more expensive one. That's part of the costs, more expensive in producing the product for a consumer but less expensive in terms of its total costs to the environment and to the society.

Therefore, it seems to me that rather than a set of simple hard rules that will stick in all circumstances, what one needs is a constant consideration of environmental costs in every single thing we do and an affirmation by both the Executive and the Congress that we mean business on it, and that we will consider explicitly the environmental effects in all our policies, whether they apparently affect the environment as degradation of streams—that's rather easy—or not. And, this is what I think makes it so hard, how to say this in a general form that can produce action.

Cochairman JACKSON. Dr. Lee?

Dr. LEE. I would like to add just a few words. I think that Senator Muskie, as usual, has touched on a key issue, and it points out it seems to me a deficiency in the way in which we have looked at the impact of the environment on the individual; and I think Secretary Weaver in relation to this touched on really a most important point.

We really have to look at—we are talking about—the enhancement of the environment, of preventing degradation. We must think of this, it seems to me, in terms of the goal, one of the basic goals of our society which is really the enhancement of the individual; and the creation of a society in which each individual is permitted the opportunity to develop to his full potential and live a life that provides opportu-

nity, a life of dignity and, as Secretary Weaver so eloquently stated, social justice. And, these are very much related to the environment, and if we looked particularly at the urban environment today, we see that we have made some efforts, particularly in relation to education, to provide greater educational opportunities for all young people in this country.

Congress has enacted most significant legislation to enhance that objective. They have initiated programs such as the Headstart program, to reach youngsters at the earliest stages of their development, but, when we find these individuals in the kind of environment that we have created, particularly in the urban area, the overcrowded housing with mountains of solid waste that must be disposed of, lacking in adequate space for any kind of reasonable recreational opportunities, the serious housing problems, we see factors in the environment that have far more importance on the physical and mental health than any of our health programs that are related, for example, to the delivery of medical care or the direct health services that we provide.

These can do more to enhance the opportunity and the dignity of individuals, to make it possible to achieve what is, I think, clearly and has always been a goal of our society, this opportunity for each individual to develop his full potential. And, it seems to me, we must both in the executive branch and in the Congress give a good deal more attention to this interrelationship. We in the health area have given a great deal of consideration to the subtle health effects of many of the environmental pollutants. We have given consideration to some of the obvious environmental hazards such as the automobile, and there Congress has taken very forceful action and we have got a national program. We have not, I think, adequately dealt with these very complex but exceedingly important interrelationships, and it's here where I think the enhancement of the environment is so essential, not just prevention of future degradation, but a very vigorous and obviously very costly program for environmental enhancement because of what it means to each individual in our society.

Cochairman JACKSON. Thank you, Dr. Lee.

Cochairman MILLER. I would like to make a little comment on Secretary Baker's statement, and I want to congratulate you on it. It was a very fine one. You pointed out that we have to be shocked into some of these things to do them, to enhance the environment. If we could get active groups, maybe acting selfishly, we would get further along because I have in mind one of these very groups.

Secretary Udall—one part of his Department can't build a new dam until another section of it, Fish and Wildlife Service can pass upon it, telling what effect it is going to have on fish and wildlife. And, if the effect is going to be too great, this is written into the cost that becomes a cost of building the dam. Isn't that right?

Secretary UDALL. That is correct.

Cochairman MILLER. But, how is this brought about? It was brought about because fishermen primarily were interested in preserving their sport, and they loved it, and they put the pressures on the country. Now, you can say, "Well, this might be for commercial fishing or something else." It wasn't commercial people that did it.

We can't shoot ducks because we were depleting the ducks, and we got a treaty that protects ducks, and we have more ducks today than we have ever had.

Having put in 4 years as executive officer of the California Division of Fish and Game, I know the pressures that came from one group insisting that we enhance the environment, but I don't think Secretary Weaver, we have done that as far as human beings are concerned. Now, can't we get this country alive, make it alive in the situation and perhaps get it to give us the same consideration to protect the environment for people that we do for wildlife?

Secretary BAKER. Mr. Chairman, I couldn't agree with you more. We think, protecting and enhancing, the environment for people is one of the real keys. This means the activation, as Senator Muskie said, also of the State and local government and private enterprise and the landowners. But they have got to have a climate or a framework and a set of national goals in which to operate. This can lead to a situation in which those who want to do the right thing, will not be exploited by others that want to do the wrong thing. And, that's why we need Federal and State enactments and regulatory measures.

Cochairman JACKSON. Secretary Weaver?

Secretary WEAVER. I just want to make one comment in addition, apropos particularly to what Congressman Miller was saying. It seems to me one of the—and this is not an inclusive analysis, but just an ad hoc one—when we approach this as a matter of operations, there are two areas that come immediately to mind. First, the obvious deficiencies in what now exists. These are things that people pretty well know.

They can be articulated and they can become the basis of goals and then the basis of action. It seems to me there is something beyond that, and that is what I would like to call raising the horizons of expectation of our people to realize that we can have a much better environment than we do have and this is one of the reasons why, for example, I'm so high on developing new communities in this country, because starting fresh, you can get new institutional arrangements. But you can never get these kinds of innovations within any established environment, and certainly this is true in the urban area. So, I would say this is one of the ingredients that has always to be considered, not only of correcting what we now see as deficiencies, but also achieving that which we have not achieved before but which we are capable of achieving.

Cochairman JACKSON. Thank you, Dr. Weaver.

Any further comment on this question?

We will limit each Congressman and Senator to one question, because—

Secretary UDALL. One speech and one question.

Cochairman JACKSON. One question can lead to senatorial habits on the part of the panelists. [Laughter.]

Mr. ROCKEFELLER. This problem of just how much degradation we do permit is a fantastically challenging question. Most resource uses do involve multiple use conflicts. What it really comes down to is how much we allow uses to impinge on one another. In general, I believe we must seek constructive compromise, but there is a point beyond which we can't compromise without damaging the very ecological foundation of our total environment.

One of the obvious areas where we have to compromise is in the impact of roads and highways on natural beauty and scenery. We must impair the natural environment to build the roads we need, but there must be a limit. This is where it becomes difficult. I believe that this question of balance of competing needs can serve us as a test for our discussion through this whole meeting.

Thank you.

Cochairman JACKSON. Thank you, Mr. Rockefeller.

Did you have a question, Dr. Lee?

Dr. LEE. Just one additional comment, Senator.

It relates to the problem of standards that Senator Muskie raised in certain areas such as the automobile exhaust emission problem, which is a national problem and is extraordinarily difficult to deal with at State or local level. We feel there are certain types of air pollution problems that must be dealt with in terms of national standards and national programs for controlling. Congress certainly has concurred in this policy.

Cochairman JACKSON. Congressman Daddario?

I might say that Congressman Daddario was one of the prime movers in getting this colloquium together, and I want to compliment him.

Mr. DADDARIO. Mr. Chairman, I'm heartened by the prospect here of the Congress getting a more comprehensive view of a very complicated matter and one which I believe will be helpful to us as we approach our legislative activities as the process of legislation goes on, and I'm pleased to see that there is a general consensus among the panel members that the Congress needs reorganization, but that when it comes to the agencies downtown, according to somebody called Petronius Arbiter, that there is a method for illusion of progress.

Now, my question, Mr. Chairman, in a sense touches on some of the points already raised by Senator Muskie and some of the answers to that question and the proposals made. I would like to know how to evaluate the very long-term future needs for the environment which is within the present market economy, oriented toward the immediate future in some cases, and as Mr. Miller has pointed out in some cases, forestry and wild animals, we have been able to establish continual cropping as a policy. We deny ourselves some short-term profits in order to assure a perpetual supply, but how can society provide incentives for such conservation and achieve the self-discipline to defer immediate gains?

Proof of future need and proof of the deteriorating effect of present policies are apparently necessary. What uncertainties are we willing to accept? What are the chances of reducing these uncertainties so that the long-term risk benefit judgments would be simpler? How can our economic system which holds that a dollar of profit today is preferable to a dollar of profit at any time in the future be compatible with long-term environmental management?

Cochairman JACKSON. First volunteer?

Secretary UDALL. Well, Congressman, this, of course is another of the very basic questions that has always been before the country, and we had an answer. It has been an ad hoc answer and in the main we have saddled the future with present mistakes and the generation that has been running things has all too often simply done what was best for it

economically but it has been living off the future, as I mentioned earlier.

But the real complex problem—because you get into the decision-making process whereby so many of the activities that man conducts in a complex society like ours—is that you have to have some kind of regulation that represents a policy. I happen to think just to be real specific that the aluminum beer can, for example, is a disaster. It doesn't degrade. It will be there a hundred years from now, shining in the sun, and yet there is nothing to prohibit its manufacture.

Now, I don't want to hurt the aluminum industry. I think they have a great future. There are a lot of other things they can do.

Cochairman JACKSON. They buy a lot of power from the Department of Interior.

Secretary UDALL. But, if science can come up with containers that readily degrade and disappear or are reusable, and we can systematize this, we ought to do things that way because it probably, if we really work hard at it, won't be any more expensive, and we won't foist on our grandchildren a mess of some kind as we do so frequently today.

Cochairman JACKSON. Any other comments?

Secretary UDALL. I hate to use such homey examples.

Secretary BAKER. Mr. Chairman, I'll take a run at it, if you like.

Cochairman JACKSON. Secretary Baker?

Secretary BAKER. The answer, Congressman, I think to your question is that in our private and public research and budgeting processes, the decision of where resources are allocated we must identify, specify very carefully, and quantify both the long- and short-range benefits of environmental factors and value them at their true value. On the other side of the equation to the extent that the prevention of pollution is a cost rather than long-range benefit, that this cost be identified, specified, and quantified, and cranked specifically into the decision process. In part this is the same comment you were making in your letter to the Post earlier this week in which you said: (Excerpt from the Washington Post newspaper, July 17, 1968).

LETTERS TO THE EDITOR

FUNDING FOR RESEARCH

Your July 3 editorial "Crisis in Science" continues a misunderstanding of the Federal funding for research as contrasted with development projects. The total Government outlay is relatively stable at about \$17 billion per year. As I stated on the floor of the House on June 5, "R & D" will have to accept some cuts and cannot be expected to continue to grow at past rates. But the portion of these moneys which is used for basic research—the vital ideals and fundamental information upon which future solutions to many problems of society will be based—is only about \$2 billion. (The \$5.7 billion figure you quote includes applied research.) These basic research dollars do double duty when they are spent in universities, for the training of graduate students in science must include performance of research.

Thus, when the major research funding agency, the National Science Foundation, is cut 20 per cent, from \$500 million to \$400 million; and when agencies such as NASA and the DOD reduce their support of mission related academic research because of overall budget constraints, fundamental science does indeed face a crisis.

Scientific research resources are a combination of manpower, facilities, management, and money. The money is the only variable over a short time span. If it is not provided in an amount consistent with the other resources which have been slowly and carefully built up since World War II the entire national resource of trained scientists and engineers will deteriorate.

In a crowded, technical world we need more knowledge—much more—to guide our applications of technology, to correct past errors in environmental exploitation, to feed 300 million Americans by the year 2000, to maintain our economic strength in world markets, to save our cities, and to aid emerging nations.

In this period of fiscal constraint, let us pick and choose among engineering development projects if we must (i.e., the SST, post-Apollo space exploration, oceanography, nuclear electric power reactors). But let us also recognize that basic research expenditures are long term commitments to a continuing pursuit of knowledge and understanding. The system of science has served this Nation well in the past and will do so in the future if we have the commonsense to differentiate between continuing research support and deferring some development projects. Future U.S. strength in scientific research must not be endangered by a knee-jerk reaction to a current budget crisis.

EMILIO Q. DADDARIO,
*Chairman, House Subcommittee on Science,
Research and Development.*

Cochairman JACKSON. Dr. Hornig?

Dr. HORNIG. Mr. Chairman, in the first place, I would like to compliment Congressman Daddario's question as so profound and far-reaching that I would hesitate to give an absolute answer to it, but there are some ingredients that one ought to consider.

One of the central problems in weighing the future against the present is that we don't know about the future. The reason we can't muster political forces and the reason we can't make decisions is that for the most part the information is not there. It is a great thing to talk about systems analysis, but the trouble with that is that you have to put in some facts. And, if you do the analysis when the facts aren't available, you are in trouble. And, the point I want to make is that this is a problem we have to approach forcefully. This is what we mean by research, uncovering the facts and relationships that allow us to make sound decisions in the Executive and in the Congress. We can say right now that it looks, you know, as if the carbon dioxide content of the atmosphere is going to rise 25 percent by the year 2000 if we keep on burning coal and oil at the present rate. Neither I nor any sane man would come to the Congress to ask that tomorrow we stop burning coal and oil in this country on the basis, though, of the estimates as they are made now; but, we have to face the fact that some day we may even be faced with decisions as drastic as that. One of the ways of achieving your goal of putting long-term benefits ahead of immediate profits is through the setting of standards, and this we already do in several areas. But, the minute one sets standards which cost people money, the question immediately comes, what is the basis for those standards? If they don't have a strong credible basis, not only to the Congress, but to the public, we can't make and can't enforce the standards, and so again it needs a basis in sound research that gives us clear understanding of what the nature of these long-term liabilities are.

Third, I would like to point out another role of research. It is providing alternatives. Some of these things have the air of inevitability. They are inevitable unless we have alternate ways of doing them.

For example, if it were one day necessary to cease burning fossil fuels, maybe in 2100—I don't think we will have to face that problem, but it is perfectly conceivable that that problem might arise—then the critical thing would become the availability of other forms of energy such as atomic or nuclear energy.

Now, of course, there may be hazards there, too. But, I don't see how we will ever approach these problems rationally except with a solid well-founded research and development program focused on them to identify the long-term problems and to provide us with the alternatives for their solution.

Secretary WEAVER. May I add a word?

I would agree completely with Dr. Hornig. I would like to point out two things, however. The first one is that while it is perfectly true that these long-term problems are problems that do require research, do require analysis, there are many other problems of various terms which we know sufficiently now to have a basis for some action, and I'm sure he didn't mean to imply it, but I have seen people who take this analysis and come from that to the idea we have got to wait until we get all the answers in before we start doing anything.

Second, I would like to observe that I am all for the systems approach, and I have some of the same reservations that Dr. Hornig has. One of them is when we start talking about putting things into this analysis, we have yet to know how to quantify long-term benefit and how to quantify certain of those things that relate to human beings and to people, and we just don't have that knowledge now; and my final word of caution would be what I call the GIGO principle. That is, "garbage in and garbage out."

Cochairman JACKSON. Dr. Weaver, thank you.

Secretary Lee?

Dr. LEE. Mr. Chairman, I just wanted to add several points to those that were made by Dr. Hornig with respect to the standards and research and development because we would feel these are two very important components in achieving the objectives within not only a market economy, but really a very pluralistic society in which there is a balance between public interest and private sectors which are intimately interrelated. It seems to me we need not only use the information gained from the research to better understand the consequences, but also to use this information to disseminate it to the public effectively and also to use it in our educational programs.

I think this is an area where we have yet failed to achieve a major objective and I think this colloquium will serve a very important purpose in this area of public education.

There is another element in this I think that's very important, and that is that we need to continue to monitor the environment as we develop new research, new technologies, to solve some of the problems, to make sure that these haven't created new or additional problems themselves; so that needs to be an additional factor. This is an element in many of our efforts to date, but it is one where at the present time for many of the environmental factors we have not yet developed sufficiently sensitive tools to adequately monitor even the environment today, let alone what the consequences are.

But, I would just like to underline the importance of this research and development not only in terms of standard settings, but as Dr. Hornig indicated, providing us with the alternatives, and certainly the research and development money in a number of areas. Space and defense are two good examples that have provided major innovations, major advances, and I think that it is a major incentive to industry to help solve some of these extraordinarily complex problems.

Cochairman JACKSON. Thank you very much.

Any further comments?

If not, the Chair will turn to Senator Allott, senior member of the Interior Committee, for a question.

Senator ALLOTT. Mr. Chairman, may I avoid the question and make a short statement, and I think we will save time.

I would like to comment first of all to my good friend Mr. Daddario that I don't think there are at present complete answers to his questions. I think they are questions which we must keep in the forefront of our minds, but I don't think that there are any complete answers to those questions at the present time.

I want to say first of all that the concept of a colloquium such as this, I think, is very valuable because it means that in considering the whole area of resources, we are in this country in the last few years particularly considering where we are going to be 200 years from now or even 10 or 12 or 15 years from now, and this must be taken into consideration.

We are prone in this country—and no one can avoid it—to formulate decisions by what one man called gusts of emotion. We underwent the Nader syndrome for a while and we are very much subject to that. We talk about saving and preserving man's total environment and yet Mr. Baker, I'm sure you will agree with me that in preserving man's total environment we have neglected one of the greatest and most important things these last few years, and that is the soil itself. We have not neglected it completely, but we certainly have not put our emphasis upon it.

Those of you who fly over the vast areas of the West, a great deal as I do, must get heartsick at seeing the continual erosion of valuable soil. We talked about water, Secretary Udall and the chairman of this committee; we have always been interested in this. We talk about pollution. Senator Muskie, who just left, did a very valuable service and yet with all of the emphasis upon water pollution there are areas almost within a stone's throw of where we are now today that not only are polluting the waters, but under the authority of State law are increasing the pollution of streams and estuaries and basins and rivers right around us.

This brings me to a very pragmatic thought, and, the only thing I think I can really contribute to this: Everyone is prone to being proud of their own work, whether he be a member of the executive branch or whether he be a Member of the Congress of the United States. If he takes a lead in a particular area of legislation, it becomes known, for example as the Muskie bill, or some other bill. To me in this whole area the most important thing which has been badly overlooked is the area of legislative oversight. We tend to institute and integrate programs and then finding that they have their weakness, tend to continue the justification of a continuation of the same pattern instead of accepting, as is fully proper with an intelligent man, I believe, the idea that as we get into an area and gain experience and gain knowledge and gain facts, that it almost of necessity requires the application of this new knowledge and these new facts.

I would be the first to say, as Senator Mansfield has said several times in some very outstanding speeches on the floor, that Congress

has abrogated its responsibilities to a great extent with respect to legislative oversight.

I think the executive branch is just as guilty of this as Congress in not taking new fresh looks. The fact that it is called a new program doesn't mean that it is a fresh look.

So, if we keep our minds, it seems to me, upon the concept that anything we do has got to be done within the total environmental approach and if we in Congress particularly could open our minds and others too to the concept of legislative oversight, I think the results that we will produce in the next few years will be quite dramatic.

Cochairman JACKSON. Thank you, Senator Allott.

Secretary UDALL. Mr. Chairman, as a former member of Congress, I would like to comment on that, and I agree wholeheartedly with Senator Allott. I find it extraordinary, having been in the Congress and then downtown, the advantage that we have because of superior personnel and staffing and so on. The best money that Congress could spend is money on acquiring the staff, and the expertise to give it the insight it needs. You can't really provide the kind of overview that Senator Allott is suggesting that is incisive unless you have scientific people, unless you have highly competent people. For my part, I think Congress ought to be much less bashful about spending more money on strengthening its staff so it can provide the kind of oversight that is needed.

Cochairman JACKSON. Thank you, Mr. Secretary.

Congressman FULTON?

Mr. FULTON. I think we need a new approach. Pollution and the concentration of people seem to have a direct correlation. The question is: Are governmental units such as States obsolete? Can we deal with these problems in terms of States and their present units? Maybe we ought to talk of regions. Second, when building a city, we are always talking of a patchwork based on 16th, 17th, 18th, 19th century patterns.

New York City has big new buildings that service 15,000 to 20,000 people in a day. Why shouldn't a new city be just like a new building? Can we have a completely controlled environment for our new cities? Shouldn't we concentrate our few major sources of contamination?

My question is: Is it possible to take an entirely new approach and talk of putting people in large groups in a completely controlled environment? And, second, of concentrating the polluters, the businesses, firms, or activities which cause great pollution, can we put them into their own separate category?

Cochairman JACKSON. Gentlemen?

Secretary WEAVER. I don't know whether I can be completely responsive to this, but I would like to point out two things in connection with the organization of government.

The first is that we do now have States and local government and the Federal Government, and we do have many problems in pollution. And, in all of these areas in which each one has situations where it can be most effective. I think one of the great problems is that with rare exceptions—and we are getting some notable exceptions—so few of the States since we have become urbanized have looked at what can be done within the existing organizations. There are many things that the States can do and can do best and there are many things which are

problems within the boundaries of existing governments, particularly within the boundaries of the State governments.

So, I would think that that would be a very important thing to consider.

As far as the new towns or new communities or new cities are concerned, I certainly would hope that one of the things that we develop would be new approaches. Here again, if they are going to do this, the States are going to have to act, because the States are going to have to give them the authority to take these new approaches. So, I would say, sir, that within the framework of what we have, there is leeway for a great many new approaches, and a great deal of constructive action within the existing institutions. Some of them are going to have to be modified, but again I would not want to imply that we should wait for the major modification before we take the steps that are necessary and possible now.

Cochairman JACKSON. Thank you, Secretary Weaver.

Any other comments?

Senator Hansen?

Senator HANSEN. Thank you very much, Mr. Chairman. I appreciate the fact that a number of very profound questions have been asked here this morning and in order to accommodate those few of us who can't think too profoundly, I propose to suggest a rather simple one or two.

It seems to me that one of the things that has been happening in this country is that we are trying to react to some circumstances that have sort of come upon us and, so far, to which we have given all too little concern. I refer to the fact that we have had a very sharp expansion in our population; we have seen an intended concentration of people, and Mr. Fulton has already referred to the fact that with increasing urbanization we find a lot of other problems that go hand in hand with that. And, I suspect some of the toughest and most perplexing ones that face us today come as a result of these concentrations of people. I would suggest that before we go all out and spend our last dime—and I don't mean to say that we are about to do that—but, before we spend too much on trying to find out how best we can accommodate ourselves and protect our environment to these strong population forces, we ought to give a little concern to what government might do in order to reverse this trend somewhat. I have been most impressed with what Mr. Rockefeller has done and some of the studies he has undertaken, and the ORRRC study, the ORRRC Commission, Outdoor Recreation Resources Review, I think pointed out that despite the fact that we do need to give protection to many areas of the country, the No. 1 need is to bring some recreational opportunities near where the people are.

Now, that's one way to approach the problem.

Another way is to try to disperse our population a little. And, I know Lewis Mumford makes a real point, in my opinion, in saying that we can't hope to accommodate ourselves to this increasing urbanization; that one of the responses we must make is to break down these large urban concentrations of people into smaller groups so that we can identify it.

My question stated simply to the panel is: How much attention, how much consideration should Government give to such things as

population control? So far most of the concern, it seems to me, is to recognize that people are born and if they do not have sufficient means to provide their youngsters with the sort of bringing up that they would need, that it must become the duty of society to step in. Would we not be well advised to see what can be done on the part of government, No. 1, to bring about a little more dispersal of our people, and secondly, to try to come to grips with this population explosion.

Cochairman JACKSON. Gentlemen?

Dr. LEE. I might just say a few words about the present policies of the Federal Government in the area of population and family planning, and these really date to President Johnson's State of the Union Message in 1965 in which he really opened up this whole area for policy consideration and program development.

Since that time we have developed policies domestically that emphasize solely equality of opportunity and making access to information and services available so that individuals might have the freedom of choice to decide on both the spacing of their children and the size of their families. This cannot be described as a population policy. It could be described really as a family planning policy and because there are estimates ranging up to 5 million women in this country, particularly in low-income areas, who at the present time, do not have adequate access, perhaps 80 percent, adequate access to services, this has been a priority area in terms of domestic program development. Both in the Children's Bureau through maternal and child health grants, maternal infant care projects and through the Office of Economic Opportunity efforts have been made to support State and local programs, particularly to provide these women the services that they obviously desire because when they are made available, for example, in some of the public hospitals, as many as 90 percent of the women return for followup care, when before less than half returned, where they continued to utilize the family planning services.

At the present time this year actually the President asked for more than a doubling of the funds to be made available to expand these services domestically and has created this Advisory Committee on Population and Family Planning to advise him as to how to accelerate these program developments.

The other area, and it is one that is extremely important from our society's standpoint, and one that seems, I think, to a good many of us needs much more public debate and discussion, is the question of a population policy. Should we have in this country zero population growth? Is that an ideal that we should strive for? Should we strive for a more rapid rate of population growth than we have today? Should we strive for a lower rate of population growth? We simply, I don't think, have the information that we need at the present time on the health aspects, on the social aspects, on the economic and other aspects to answer that question, but certainly it is one that needs to be widely discussed.

When we examine our own problems domestically and we look at the world's problems, we see, of course, an even more serious immediate problem; but long-range, the world's population problem, of course, is our own, and we ultimately cannot escape the consequences of continuing rates of population growth throughout the world that exists today.

This again is an area that has been discussed and debated in the United Nations, in the Congress. We have explicit policies in both the foreign aid program and in the food-for-peace program that make funds available for this particular purpose so that we have made a great deal of progress in the last 3 years, but there needs to be much more public discussion, I think, and debate of the very issues that you have touched on.

Secretary BAKER. Mr. Chairman?

Cochairman JACKSON. Yes, Secretary Baker?

Secretary BAKER. In addition to the family planning or birth control or population increase phase, I would like to respond to the other part of the Senator's question, and that is where in the space of the continental United States and Alaska and Hawaii is the population going to live?

Secretary Weaver pointed out a recent Gallup poll said 57 percent said they wanted to live in small towns and the open countryside. Over the past several years the Federal Government with many enactments by Congress has put special emphasis on this aspect of the answer to your question.

Now, in areas such as Wyoming, for example, the population decreased, according to the census from 1960 to 1967, by almost 5 percent.

If, as I said in my original statement, population overcrowding is in itself a form of serious pollution, then it may be that the Nation ought to have done something to enable Wyoming to provide economic opportunities for its people so it wouldn't have to lose nearly 5 percent of its population in less than 7 years.

Now, such things as rural industrialization, specific policies to locate government contracts and big employing government installations in areas of less dense populations instead of more dense population and outdoor recreation that you have mentioned; these are parts we think of as a total overall environmental policy, as some research has now indicated.

Population overcrowding itself is a form of pollution, and certainly new cities, new towns, new communities—as Secretary Weaver has just pointed out, located 30, 80 miles from already overcrowded population centers are part of the answer to eliminating that kind of pollution environment.

Secretary WEAVER. I would like to put a footnote to that.

Cochairman JACKSON. Dr. Weaver?

Secretary WEAVER. I think "overcrowding" is a rather complex problem. Obviously it seems clear to me in a democracy any governmental policy which has to do with dispersal of population has to be based upon a basic principle and that is that people have freedom of choice and that these choices are really viable choices.

I would like to also suggest that while it is true that a great deal of the growth—and this is already a trend in our society—of the urbanized population will not be in the central cities. It will be in the suburban and the urbanizing areas around them—I hope some of it will be in the new communities that we want to create. We will still have our large centers of population. They form such a very vital and very necessary part in modernization that we can't just wipe them off the books and forget them. This is not an either/or situation. It is

a both situation, and just as there are problems from concentration, there are also great problems from too much dispersal and failure to get services which are required in a modern society to people who don't have some degree of concentration.

It is also a problem of getting the cultural institutions and the other types of institutions that have to be supported by concentrations of people so that it is not just a question of cutting out and getting rid of the concentration. It is trying to keep it from getting larger, and it is trying to make concentration more viable while creating new patterns that will respond to the needs of our people.

Cochairman JACKSON. Secretary Udall?

Secretary UDALL. I would like to agree with Secretary Weaver on the city thing, and I think it's highly significant that Congress is supporting the new communities, new towns idea, which it wasn't a few years ago, but we need to rehabilitate and we can rebuild and make much more livable even the worst of our cities. I have a suggestion, though, that I would like to toss back at the committee. There is no problem when one looks at the future of our country that cuts across all of the committees that you represent more than this question of population increase and population growth. I would like to see a colloquium next year sometime, perhaps on this subject, because we have assumed, and the Department of Commerce puts out the figures and they become gospel as to what growth is, although we now have three or four sets of figures, quite rightly. But there is one reputable demographer, Dr. Bogue of the University of Chicago, who predicts that these sharp trends of the last 5 or 6 years indicate that our population, if these trends continue, will level off within the next decade at about 225 million. Yet, all of our projections that we all talk about are to the effect that population is going to double by the year 2000, 2010, you name it. But, what are the consequences of this?

The truth of the matter is that our population has dropped very sharply since 1960 or 1961. It is below the low point in the depression of 1935. It is going on down. You can watch it month by month, and this population policy is being set by younger generations. They are marrying later. They are having fewer children. They have a different outlook, different values, apparently, with regard to life. What are the consequences of this to the environment, to all of our areas of national policy? I would like to see the Congress really take a look at this because I think it is enormously significant in terms of the future of the country.

Secretary WEAVER. Still, when you say the population is declining, you mean the rate of growth.

Secretary UDALL. Yes.

Cochairman JACKSON. Leveling off.

Secretary UDALL. Yes. What actually is happening, our death rate, through improved health, was going down and down. That has begun to level off, and the birth rate has been breaking very sharply, so it is declining. That's what I am saying.

Cochairman JACKSON. The projections are not quite standing up. This is what it really boils down to, isn't it?

Secretary UDALL. Yes. Well, Dr. Bogue's main point is that all of the statistics of the 1950's, we ought to throw them away and we have a whole new group of factors operating.

As a matter of fact, Phil Lee can tell you what research is going to do in terms of new birth control techniques in the next 5 years, and it would astonish you, some of the things that we are going to be doing. So, why shouldn't we look at this in terms of its significance across the board to all of our policies?

Cochairman MILLER. But, to maintain the population today, we have got to make still these changes. We have gone into the environment and ecology, and the fact that it is not going to be as great as we anticipated it would be 10 years ago doesn't mean that it isn't going to be very burdensome by the year 2000.

Secretary UDALL. Quite so.

Cochairman JACKSON. Well, I think too, Secretary Weaver and Secretary Udall have brought out this last few minutes the problem of congestion in the cities. I'm convinced that there is a direct relationship between congestion and violence. I am further convinced that the mere fact that we may rebuild a given area, if we rebuild it, does not resolve the problems caused by congestion. I think we are going to have problems. Do you have any comments on that, Mr. Secretary?

Secretary WEAVER. Well, I would say that I think we have to define what we mean by congested. Certainly there is a point where you get these high densities which makes it impossible to get a viable and a successful and a normal and a decent life. These could be high densities of a neighborhood or high densities within a given structure. But, I might say also that sometimes when we didn't have such high densities, we were already a pretty violent Nation. So that I would suggest that congestion is not the only cause for it.

Cochairman JACKSON. I fully agree.

Secretary WEAVER. And, that we could get rid of congestion and we still won't necessarily get rid of violence. I think it is a matter of getting the amenities of life and getting the satisfying sort of a social environment, whether it is in one area or the other, and congestion is a complicating factor, I would say.

Cochairman JACKSON. I didn't mean to make it the exclusive cause.

Secretary WEAVER. Yes, I understand.

Cochairman JACKSON. My observation is that when we allocate our resources, let us make sure that when we invest in new housing and new developments, that we try to provide for open spaces. The mere fact that we build some super public housing project that is brand new doesn't mean that we are really solving some of the basic problems. I think it is rather unfair, for example, to ask a family with six or seven children to grow up on the sixth floor of a large apartment house. That's pretty difficult these days.

Secretary WEAVER. Very difficult.

Cochairman JACKSON. And, that's what I had in mind. When we think of renewal, I do think we need to consider the other factors in the environment and make possible new cities and move out into the open spaces as much as we can.

Secretary WEAVER. Or, bring the open spaces into the cities.

Cochairman JACKSON. As long as there is open space.

Well, to violate the Chair's own rule, I just wanted to make an observation: It seems to me that we are doing a good job here in raising the substantive issues. We are getting a pretty good description of some of the long-term problems and immediate problems we face. I do

hope, however, that the panel in response to the questions that are being put today will give some thought to the possible action-forcing processes that can be put into operation.

I know Don Price will probably allude to this problem this afternoon.

I think Laurance Rockefeller has given us a good start by suggesting that there be a Commission on Environmental Policy and Organization. We need to talk about how we can get something underway, it seems to me, and we need to think in terms of what those action-forcing processes might be in the executive branch of the Government, and then I think too another point is the role of the private sector.

All of us who have had to deal with legislation involving the quality of the environment in one form or another know that there is no substitute for well-organized private groups who are dedicated to the public interest in sounding the alarm so we can get and have support. I think it would be a great shame if this colloquium today had no follow-on. I hope you gentlemen will be thinking about action-forcing processes in this whole discussion.

As I say, I think we are doing an excellent job of raising the substantive issues.

Congressman Blatnik?

Mr. BLATNIK. Mr. Chairman, thank you. You captioned the morning session so effectively and I would agree with you thoroughly. If I may reserve my comments for the afternoon, there's a quorum call on the floor.

Cochairman JACKSON. There were probably two or three by now.

Congressman Ottinger?

We will resume, by the way, at 2 o'clock.

Mr. OTTINGER. I would like to thank you, Senator Jackson, and Congressmen Miller and Daddario for arranging for this opportunity and to follow on with your statement just made and perhaps make a suggestion on an action, because I think we have heard some very interesting statements from each member of the panel expressing their concern for various aspects of the environment. Yet, the facts of life are that virtually everyone on the panel has responsibility for some very serious element of aggravation damaging the environment.

The Agriculture Department is promoting pesticides that we are learning now are building up in the bones of animals and in human beings that are very dangerous.

Interior I don't think has done what it could on strip mines, importation of impure oil, or action on the redwoods.

HEW, in the field of pollution and pesticides and so forth with respect to their danger to health.

HUD, in putting the renewal projects in a way that damages the environment.

Science Adviser, of course, has an overall responsibility within the State itself.

Laurance Rockefeller raised the question of the problem of the highways and their damaging effect on the environment, yet is promoting publicly the Hudson River Expressway that would go right

down the shores of the Hudson River. The State of New York has just put through a power bill which specifically by its terms allows the placement of powerplants without regard to the effects on environment.

We have three departments not represented that are very very principal in this. The Department of Transportation that finances highways without regard to their effect on environment. The Federal Power Commission that licenses powerlines overhead, crisscrossing our Nation; the Corps of Engineers that builds dams, damaging all kinds of elements of the environment. I think the question is how do we make it possible for these various departments, for the States, for the private interests also not represented to tackle these problems more effectively; and, I make two suggestions:

One, I think we need to have an intervener or lobbyist on behalf of these environmental considerations, and that there ought to be a commission that can intervene in the proceedings of each one of these departments where it affects the environment and at least get a public focus on it. If there is going to be a license presented to the FPC for powerlines, have this commission, with expertise built in, with staffing pattern, actually be able to go in and stop the proceedings for some time and raise the question of damage to the environment. Perhaps it would be too much to give them a veto power, but perhaps give them, with respect to the Commission, where they do have a serious objection, to require two-thirds of the majority of the Commission or some other consideration with respect to the departments so that we do get a meaningful focus, and we do have a chance for these organizations that we have mentioned that can be lobbyists, whether it is fishermen or what it is, to become active on behalf of the environmental considerations.

Secondly, a matter of vehicle for better communications between the scientific community and the public sector, both executive and legislative. To make us better aware of the threats to our environment such as one just becoming known now in the scientific community with respect to pesticide residues in our bodies, and we have started an effort on this.

I and Congressman Miller, Congressmen Blatnik, Reuss, in a bipartisan effort—on the Republican side, MacGregor, O'Konski, and Senators Muskie, Nelson, and Hansen—are getting a group with the Smithsonian Institution tentatively to do some of the coordinating between the scientific community and Congress, and we would hope to get some industrial participation in that, to focus on these problems that create a panel for all of us to be able to test out our ideas and proposals against a really distinguished scientific group.

I'd appreciate your comments on both these suggestions.

Cochairman JACKSON. Well, the Chair would observe, I'm afraid that to respond in full to all of the questions you have posed would take the balance of the afternoon. I'm not sure that the agenda provides for a question that will take so much time, but I commend you for raising these questions.

Mr. OTTINGER. It is really two questions: One of communication, and the other of intervener.

Cochairman JACKSON. Yes; but in fairness here, I think certain comments have been made with reference to the panelists, and I think they should have an opportunity to respond. I think that question was put first, if they have any brief comments, because the hour is growing late, and I think they should do that now.

First, Secretary Baker?

Secretary BAKER. Since I was mentioned first, Mr. Chairman, in reference to pesticides inside our bodies, the statement is not strictly accurate as it stands, I'm afraid.

First, there are really no scientific results that indicate a dangerous buildup at this time among the population of the United States of pesticide chemicals in the human body.

Second, the statement overlooks a major effort that is underway in the Department of Agriculture and in the experiment stations around the country to develop nontoxic control measures such as sterility techniques, sex attractants, biological controls in addition to safer chemical methods.

Cochairman JACKSON. Anyone else wish to respond?

Secretary Udall?

Secretary UDALL. Congressman Ottinger has been one of the most vigorous battlers for a better environment, and I want to indicate to him my feeling that there is room for improvement in terms of the decisionmaking process. I don't know but that a good congressional group sometimes represents an intervener, and it can sometimes be very effective. In fact, Congress is, in a sense, a watchdog and a supervisor of all our activities.

I am sure that if it were not for some of the congressional pressures that were present, many of the executive agencies would make what would probably be wrong decisions easier and not have to defend them, but I think a general vigilance both of congressional people and of the groups and organizations interested in the environment, that this is probably going to be the big factor. One of the things that I take the most encouragement from is simply the growth of sentiment in the Congress, the number of conservationist Congressmen, the number of organizations, however they define themselves, that are interested in the city problem, that are interested in the total environment problem and their vigor and growth.

The fact that an organization like the Sierra Club has increased, doubled its membership in 2 years, says something about the country that is rather healthy, it seems to me.

Cochairman MILLER. Tell them where the Sierra Club is located.

Cochairman JACKSON. It might reveal where they operate, too.

Well, the Chair would like to make an observation in the middle of this. The subject matter that we are discussing, it seems to me, leaves room for dissent and difference of opinion, as always. We are not dealing in absolutes. I know from my own personal experience in the House and Senate in 28 years that there are always those who have their own version of what conservation should consist of, and what the quality of the environment should be. If you disagree, you are an anti. The longer you struggle with this, the more you realize that there are three sides. There is your side, there is the other side, and there is the right side.

I want to make that observation because I don't think that it is possible to get unanimity of agreement. I don't think you should.

Mr. OTTINGER. I think the question is what kind of device can you use to make it more effective. I wasn't trying to focus into the individual criticism of the departments, but there isn't enough of an effective mechanism to intervene on behalf of these questions.

Cochairman JACKSON. But, I am pointing out that there isn't within Mr. Udall's Department or within Mr. Freeman's Department a program that they can come up with but what there won't be some disagreement. We have been struggling with the redwoods bill and do I need to give any more examples? I'm trying to point out that there are differences of opinion. I think that there are, as Secretary Udall mentioned, a growing number of people who are deeply concerned about conservation, and I think this is all to the good. But, I think we must be careful and not try to get around to the point where we are dealing in absolutes, black or white. That's my observation. With that comment, I think Laurance Rockefeller would like to say something.

Mr. ROCKEFELLER. I think that black-and-white approach is a disaster. Any of these issues where you are looking for constructive compromise, if you take a black-and-white approach, you are never going to resolve it. You have a lot of hostility and you don't represent the public constructively. I think this is true of whether we have storage power on the Hudson or whether we have an expressway. The question is, How can we best meet the multiple needs of the people and preserve natural values and reduce public costs?

In other words, black and white is not the way to approach these problems. We are looking for the creative emerging areas.

Cochairman MILLER. Mr. Rockefeller, it has been my experience with freeways, as we call them in California: the fellow who has to give up his home or the person who lives right along the freeway and gets a lot of noise hollers very loud about them, but you never hear from the fellow two or three blocks off the freeway who now gets to his office in 20 minutes where it use to take him an hour.

Mr. ROCKEFELLER. That is particularly true in New York. We have a railroad track between the homeowners and the freeway. They are already blighted by a four-lane railroad track.

Cochairman MILLER. So, I find that the great majority of the people like freeways, although they do destroy certain esthetics of the country, but we have got people to take care of and they come first.

Cochairman JACKSON. Any further comments?

With that we will recess until 2 p.m.

(Whereupon, at 12:55 p.m. the colloquium recessed until 2 p.m. the same day.)

AFTERNOON SESSION

Cochairman MILLER. Please come to order.

I want to welcome you back to the afternoon session.

Mr. Price has agreed to summarize what has taken place this morning, and try to put it in the form that he is perfectly capable of doing. I don't know of anyone more capable than he is in doing this for us, and he will go on.

Will you proceed?

SUMMARIZATION STATEMENT OF DON K. PRICE, DEAN, JOHN FITZGERALD KENNEDY SCHOOL OF GOVERNMENT, HARVARD UNIVERSITY

Mr. PRICE. Thank you, Mr. Chairman. There was this morning a certain amount of play back and forth between Members of the Senate and House on the one hand, and the executive branch on the other over the issue, and there was an attempt to filibuster longer. I don't think a professor ought to get into this and make it a three-way fight, so I will do my best to be extremely brief, even though to be at the same time brief and useful in setting the comments this morning into some sort of order is not too easy a chore.

If I am to try that, I have to select very arbitrarily several groupings of topics, and I think I will pick four.

First, to define limits of the problem; second, the question how Government acts on the problem; then, third, a question logically coming before the action and more fundamental, how do we know what we are doing?

And, finally, what are the—how do we make decisions as distinct from knowing the facts within the structure of Government?

Now, first, what is the problem anyhow? It is attempting to start out with a very clear notion, and each one of us probably does this by saying the problem is the aspect of it that he is interested in. But, a century or more ago George Perkins Marsh boldly said that the problem with the environment was the fact that humans were involved in it.

The problem has become so broad that it's hard to know where to stop. This morning we saw that it included not only the maintenance of the quality of the outdoor environment that we think of as the pristine environment of this continent before man began to spoil it, but it soon became clear that that problem made no sense. We could not really beautify the natural wilderness without taking into account the new structure of our cities and our industrial system. The internal social problems of the cities come into it, at least in a peripheral way and maybe more; and finally, I was interested to see that the discussion clearly tended this morning toward the same conclusion that some committees of the American Association for the Advancement of Science came to some months ago when they decided that the study of environmental quality could not be tackled without simultaneously considering the population problem.

Nobody in the AAAS summed it up quite so neatly as the phrase that someone used this morning that population is the real pollution of the environment, but still it came to the same thing.

And, yet, having said what I have just said, which is to take for granted the validity of each person's addition to this subject matter, I am left with a vaguely uneasy feeling that if we see the continuous complex here as one set of interconnecting realities that have to be understood as a total system, we may be broadening our interests so much that it's impossible to act on it at all.

This, I think is a problem which in my capacity as an outliner of what went on rather than a testifier in my own right I do not propose to try to solve, but I think it is enough to say that you can either try to look at all reality as the system which you are undertaking to deal with, or in order to make it manageable you can think of it as a set of inter-

secting circles and come into focus on one of those circles. And, that would be my temptation, my personal inclination, but I think it would be then necessary to emphasize that you have to worry about those intersections too.

Enough on point 1.

My second point for noting the topics that were touched on either this morning or in the literature that was handed to us as we came in is: How does the Federal Government act in this business anyhow?

The first thing that I think strikes the observer who tries to be just a bit detached is to see by comparison with a generation ago how strong the impulse is not to take over for the direct operation by the Federal Government everything that you want to see accomplished, but to rely as much as possible on the collaboration or the participation of private institutions on the one hand, and on the other hand State and municipal and county agencies in a program of this breadth.

I think one might sum it up by saying that something like 30 years ago we came to the conclusion in this country that our local problems could not be solved without Federal action and we are now very painfully learning that our national problems cannot be solved except by State and local action. Obviously, the two have to go together.

Now, clearly the problem when we are dealing with the private interests of the country which need somehow to be brought into conformity with the public interest, if that can be defined, is how we get them to act on the basis of these long-range, broader calculations with respect to what they are doing so that they do not act in terms of immediate, short-range, individual, or corporate profit, but act in a way in which the long-range larger interests are concerned. And, I think that someone this morning mentioned at least each of a half dozen different ways to go about it. The most obvious and one in which we are already in a sense engaged is the simple exercise in persuasion to the extent that exercises like this colloquium today have their effect on public opinion. This alone will accomplish something. How much it can be relied on is a matter, of course, of considerable disagreement.

Then, I suppose if we were to put in the order in which they were emphasized chronologically in our history the several other tactics or approaches, the first one was to define rights and leave it up the courts to defend them. So that if somebody pollutes your backyard, you can sue him. This is an approach which has its usefulness, but clearly given the large-scale pervasive long-range problems that we deal with today; this one is no longer a feasible, exclusive means of reliance any more than when we decided a century or so ago that we could not go on relying on private suits to prevent the lack of safety in, say, the regulation of steamboats. It's too late after the thing blows up for the passengers concerned to get their rights, and so we proceed to the next approach which is Government regulation, a regulation by the action of some department, agency, or independent regulatory commission of the Federal Government.

That immediately raises the question: What are your standards? And, I think we will have to come back and have a word about that in just a moment.

But, it is significant, I think, that we no longer propose to rely strictly on governmental regulation. We look for other ways because we

see that the problem is no longer one of clear-cut categories of good and evil. We no longer on the one side think of anything that is done for industrial profit as beneficial to the Nation, nor on the other side do we say that industrial developments which to some extent pollute our environment are for that reason absolutely bad and must be prevented as a matter of criminal punishment.

So, a lot of thought has been put on how to develop incentives of a financial nature of one kind or another so that Government policy can make it profitable for private institutions not to pollute the environment or to use the phrase that Senator Muskie preferred so strongly, how actually to "enhance the quality of our present environment."

Then there is, I think, still another stage, although these aren't necessarily stages in order of merit, and someone alluded briefly to it. How do you set up the rules of the game so that within any large corporate enterprise they themselves will see the internal tradeoffs involved, so that within their system they will be required to take into account and make adjustments for steps taken which will harm the public interest in the long run, even at some short-run costs to their profit and loss statement.

Finally, there is a tactic or an approach which has received a good bit of attention recently in technological and scientific literature. Mr. Weinberg, I think, called it the technological fix. Several people raise the question as did Secretary Udall: Why cannot we hold the scientists' feet to the fire until they can come up with a beer can that will dissolve the day after you drink the beer? I am paraphrasing. I wish he were sitting here so he could correct me, but he will forgive me if I exaggerated a little, but the general idea is quite clear.

You try to avoid facing up to the conflicts of interest inherent in the problem by seeing if you cannot work your way around it, and this is, of course, an extremely useful approach whenever it is a feasible one, and it is often more feasible than settling the conflicts of political and economic interests that get built into our system.

Well, that is probably a bit longer than I should have devoted to the Federal Government in relation to private institutions.

The relation to the States and local agencies is perhaps at least as difficult. We have a well-developed pattern. I don't know whether "pattern" is the right word; system or pattern, either one, implies something much too neat. We have a great chaos of grants, grant programs designed to get the States and the cities and the counties to do particular things in the interest of programs in which we are interested. It is an indispensable part of our whole system of government, and it has taken special force in recent years as we have found ways to add to this system, which it would be impolite but not inaccurate to call a form of interlevel bribery, the possible assertion of Federal jurisdiction in the case of nonperformance at the State and local level. But, as we find types of activity which technologically cut across State and local lines so much that State and local agencies as presently constituted are not appropriate agencies, but which we do not want the Federal Government to take over for direct administration, we begin to hear pleas as we heard again and again this morning for considering whether some new special areas of jurisdiction need to be visualized or created.

Do we need general purpose metropolitan governments? Do we need a greater number of special purpose authorities in various fields of technology or economic development? And, if so, by what system of incentives do we break this log jam? Because, you could count on the fingers of your two hands the important numbers of major local government consolidations that have been made, if you except the school boards, within the past generation.

Now, the problem of knowing the procedures of action is a difficult enough problem, but I think that it was entirely appropriate for the President's science adviser to emphasize that we need to do something even more fundamental, that is, worry about how we know what we are talking about in this field. How do we set standards? How do we know what we want to do until we can define more accurately our problem and develop some better measurements for it?

The old disposition was to legislate in absolute terms.

At lunch today Secretary Cohen was recalling the famous case of the cranberries where a combination of a statutory definition and a secretarial interpretation led to the enforcement of an absolute standard, a zero tolerance with respect to one part of our natural environment that had been according to law polluted by an insecticide. As a result an awful lot of turkeys didn't get their cranberries that Thanksgiving, and the economy of Cape Cod was severely damaged.

Now, if we cannot legislate in terms of absolutes, how do we define the problem that we are dealing with? This is easy enough with respect to certain types of small problems. With the big problems it is very much harder. It gets especially harder when you move away from the physical or the chemical pollution and you get into the esthetic type of consideration. Or, you might mention equally as difficult the type of consideration in which you want to worry about your own social and political environment. You could do a lot of things if you gave up political freedom in this country but if you considered that a part of the human plus environmental system that you are dealing with, that has to be cranked into your system of calculations somehow. So, the problem of devising the right information system, the right definition of data, the right system of indicators. There has been a lot of talk lately about social indicators out of a conviction that narrow economic statistical considerations are not an adequate guide to economic policy, and here we are talking about a field in which it is not enough to know about the chemical industry and the biology.

We want to know about very much broader human and social considerations, and we are not prepared by the main categories of our thinking, nor by the nature of our data gathering patterns in the Federal Government or in our private educational and research institutions. We are not really prepared to put the information up in such a way that the more difficult and subtle problems can be dealt with. Even admitting, as I would cheerfully do, that Secretary Weaver was right, that there are some things so obvious and compelling that we don't want to wait for a lot of sophisticated marginal types of data to be provided before we are willing to act.

Now, in a way the data problem corresponds to a broader system of thinking, the nature of our whole social patterns of thought in this country. We have been very good on developing specific tech-

niques, the more obvious types of technology that were required for the industrial and economic development of the continent.

Even more, perhaps, the agricultural development. But, when you move from the problems that you can visualize in terms of quantitative measurements of the economy in terms of the physical and the chemical and biological problems, we find it very much harder to put those things together either in our philosophical thinking, in scholarly discussions or, on the other hand, in the processes of policy-making that go on in the Halls of Congress or in the offices of the executive branch.

It is obviously true that the development of the specific techniques has proved to be not only the basis of our accumulation of wealth which now makes it possible for us to ask these more sophisticated questions about our environment, to have very much higher standards of environmental control to insist on. It is equally true that those specific quantitative objective and scientific methods have given us the great powerful intellectual tools by which to add to our technology and then to increase our quantitative and objective understanding of our social institutions. And yet, taken alone, these approaches are never completely enough to satisfy the human being who wants to ask questions about the ideal purpose of human society.

And, until we find ways to define social welfare and the public interest by the definition of purpose and in forms of statistical measurement that will let us take them into account in our formal calculations, we shall simply have to go on making a special effort to define them in general terms and to insist on them in the methods by which our political decisions are made. That, of course, brings me to the fourth topic that it seemed to me we discussed this morning in that most interesting series of presentations. And, this is: How do we, as a people, decide on problems like this? There are at least four things that were discussed; four general approaches. There have been several proposals put forward. I will not attempt to credit them to particular authors or to define them specifically because that would be an invidious task and the qualifications are not necessary for the moment.

One is the organization of a special short-term commission to define the problem, to help publicize it and help bring public attention to it, and this has always been a useful and desirable technique for bringing problems to the attention of the American people. We do not in this country rely nearly so much as other democracies do on the party platform or the defined program of a particular administration. We are much more bipartisan than that even in an election year, and some special effort to define and publicize the problem is, of course, an acceptable technique. Whether it is needed, given the great upsurge of interest that has already taken place, is a matter that is perhaps still open to debate.

The second topic that was suggested was the creation of an intervener within the framework of Government, somehow. Representative Ottinger, I think, brought this out; some special body authorized by law if not by a constitutional status to be a watchdog for the environment; an intervener in the system is, I think the term that was used, to review the plans and projects of the various departments and agencies of Government with power at least to delay for critical attention if not to issue orders to stop entirely. Something like an om-

budsman, with more power. This proposal had its counterpart in certain discussions in the first Hoover Commission, although I do not think the Commission ever came out with quite such a clear-cut proposal on public works projects. And, whether such an entity could be created given the range and variety of problems, and the issue as to whether our main difficulty is doing too many wrong things, or not doing enough of the right things soon enough, is obviously a question to call for further discussion.

Within the executive branch and as presently constituted, each of the several techniques for coordination and overall review that have become commonplace and popular were touched on in one way or another.

The presidential staff agency: Do we need something really to replace the old National Resources Planning Board? The Council of Economic Advisers and the President's Advisory Science Committee each touched upon part of it, but without its breadth and focus on this kind of problem. Do we need something much better than it ever hoped to be?

Anyhow, the question of a presidential staff agency is a perfectly legitimate proposal. And then finally you have the proposal that comes naturally out of the belief that, in any problem as broad and complex as this, especially when it intersects with other problems which seem to many people equally broad and equally complex, it is impossible ever to separate the function out and assign it all to a single department. So, you need at the very least an interdepartmental committee or set of committees authorized to try to reach agreement, perhaps under Presidential direction; or, you even might call for a special statutory council taking its place alongside of the Space Council and others—the National Security Council, others that have been set up from time to time or proposed.

Dr. Hornig made one of the strongest points against such a statutory approach, but there will, of course, be many who will take issue with that, and that will remain for decision.

And, finally, while others outside of the executive branch were talking about the reform of the executive, executive representatives were finding it much more to their taste to suggest that Congress too might have an eye to its own organization in these matters. Quite obviously there is some point in this suggestion. This meeting itself is evidence of the recognition on the part of two key congressional committees that there are problems of mutual interest that cut across present jurisdictions. How far it would be possible to go on from this kind of occasional informal exchange of views toward either special nonlegislative committees like the Joint Committee on the Economic Report, perhaps in conjunction with some development within the President's Office, how far pieces of jurisdiction could be carved out for legislative committees, how far the burden of coordination could be forced on the Appropriations Committees—all of these, of course, are subjects that will be very much on our minds as we proceed to discuss further this remarkable range of topics that was opened up this morning.

There was little sentiment evidenced—I recall none—which said that we cannot deal with this problem in some fashion within the limits of our present constitutional system. But, heaven knows the range of possible action within that is great enough so that it leaves us, Mr. Chair-

man, with plenty of agenda for this afternoon, and I daresay for many years to come.

Thank you.

Cochairman MILLER. Thank you very much.

Have any members of the panel any comment to make on Mr. Price's summary?

Mr. Rockefeller?

Mr. ROCKEFELLER. I think he rose to the occasion as you indicated he would, with distinction.

Cochairman MILLER. Now, a number of people, guests have indicated that they would like to ask questions and have submitted the questions, and I'm going to call upon them and I'm going to ask that they come up and take Mr. Allott's chair and use that microphone, and the first that I'm going to call upon is Dr. Harvey Brooks.

Dr. BROOKS. Mr. Chairman, I would like to perhaps begin by throwing out several questions which I jotted down on a card.

First, I wondered to what extent we should attempt to rely on interact mechanisms such as tax policies and other types of incentives to encourage more rational land use, and to what extent will direct intervention of governmental bodies be required?

I know that Secretary Weaver brought up the question of land use. I'd also like to raise the question of whether we could spell out in somewhat greater detail what we would consider to be the essential ingredients of an urban land-use policy?

A third question I would like to raise is: in view of the apparently well-documented popular preference for rural and small community life, is there any way that national planning for land use and for categorical aid to cities can be responsive to this preference; or, must we dismiss it as impractical nostalgia?

And, finally, I'm wondering whether any of the panelists would care to try to spell out more specifically than I think was spelled out this morning, the element that should compromise a national environmental policy that might be sufficiently concrete to serve as a basis for action and for decisionmaking? For example, does it mean one standard for the environment? Or, does it mean a whole series of different standards for different circumstances? And, indeed, is the enhancement of the environment itself a sufficiently well-defined standard so that it's a criterion that can be applied in practice?

Cochairman MILLER. Do any of you gentlemen want to respond?

Dr. Brooks, you have asked some very provocative questions.

May we have your thinking on it?

Dr. BROOKS. I don't know whether I can really comment on this. I guess I would have to say in response to my first question that my own belief is that we are going to have to invent ways of relying much more on incentives and less on regulatory mechanisms in many of these problems simply because I think the problems are so complex and their character changes so rapidly that to try to specify them and delineate them by rules and regulations may in fact produce in many cases as many secondary effects as the secondary effects of technology that we worry about. And, I have a feeling that we haven't been as clever as we could be, as we can be about using indirect incentives to induce more rational behavior or more desirable behavior with respect to management of the environment.

On the answer to my third question, regarding the popular preference for rural and small community life, I guess I really don't have any answer to that except that I feel strongly that in some of our present emphasis on dealing with our central city problems, which are certainly very difficult, we may be failing to take into account these other deep-seated preferences which are very likely to result in people behaving somewhat differently in response to some of the things we do than we might have expected in terms of the purposes of the programs when they were initiated.

I guess I really just don't have the courage myself to answer my fourth question, which is the most difficult one; namely, what are the elements of a national environmental policy?

I might, however, raise a couple of subsidiary questions with respect to this, which I think are worth throwing out. I think one of the problems that we have is that in the past our attitude toward the introduction of new technology has tended to place the presumption on the effects of the technology, to place the burden of proof, so to speak, on the person, on the deleterious effects.

In other words, we introduce technology in the absence of proof that it has deleterious effects. We may have to be gradually moving in the direction of essentially placing the burden of proof in the other direction; that is to say, proving lack of deleterious effects before we introduce technology on a full scale. We have already moved very far in that direction in the few cases such as drugs and food additives and other such things. But, we may have to move in that direction in other fields. Still, I think one could also move too far in that direction and place a presumption so much against new technology that in fact the disincentives to innovation would create more penalties to the society than the protection to the environment that might be afforded. And, indeed, I think one has to point out in this connection that some of the problems of the side effects are side effects of nontechnology rather than of technology.

In fact, I think one could make a certain degree in case that the automobile safety problem is at least in part the side effect of an absence of a certain kind of technology in the design of automobiles and indeed in the design of highways and of traffic control systems. I think one could cite other cases where in fact the side effects that we are worried about can be as described as much to lack of technology as to technology.

Well, I think I have raised enough questions, perhaps.

Cochairman MILLER. All right. Do any of you gentlemen want to respond?

Dr. LEE. Mr. Chairman, I would like to just respond on one facet of Professor Brooks' comments, and this is with respect to his last statement dealing with introduction of new technology and demonstrating the lack of deleterious effects. In some areas, and this is specifically in the drug area, it is not only necessary to demonstrate safety but it is also necessary in this case, to demonstrate effectiveness, and so that it may be that we would even go one step beyond Professor Brooks' and have to demonstrate a positive beneficial effect or an enhancement of the environment as suggested earlier by Senator Muskie rather than just an absence of deleterious effects. And, just one other general comment on his last point about the elements of an

environmental policy. It seems to me that this is one of the purposes of this discussion, is really to initiate the broad public dialog that will, hopefully, eventually lead to such a policy, sharpen the issues and lead us to a more precise discussion, more specific, as I think Don Price has so clearly pointed the way in his summary discussion.

Dr. BROOKS. I might add one comment. I certainly agree with your point about the demonstration of the positive effects. I would say not only the effects in enhancing the environment but I think in fact there is a tradeoff problem here and that in the introduction of new technology not only do we have to ask the question earlier in the game: What will the side effects be? But, also why introduce the technology anyway? What will be the benefits, not necessarily to the environment, but if we are going to have to pay a price in environmental deterioration then we have to ask, you know, for what benefits are we paying that price? And, the price you are willing to pay certainly ought to be, in some way, geared to the benefits that society is going to derive.

Cochairman MILLER. Thank you very much, Doctor.

Dr. CAIN. I'm sitting in for Secretary Udall, Mr. Chairman, and I would like to comment very briefly on the first point that Professor Brooks raised, the question of the carrot or the stick, and I would like to suggest that we are going to have to have a mixture of incentives and regulations which will, I think, vary widely because the uses of natural resources vary greatly.

I would like to illustrate very briefly. Take the question of incentives and of the tax benefit for oil industries because of the problem they have with exploration which is very expensive. This same kind of a tax benefit is, I understand, being sought by the people who would develop the oil shale resources, but they don't need explorations—they exist. You see, so we have to discriminate. Take another case. Industries will find it very expensive to install the equipment that will abate pollution of one sort or another, air, water, solid waste, et cetera. Now, I have a belief that within a small competing sector of industry, let's say papermills, for example, the cost of pollution abatement is not critical if all firms in that sector have to meet the same costs. This can be only accomplished by some kind of regulation that is applicable in each and every State where this kind of industry functions. Now, this will not always be the case, but still within the regulatory line we need the power to discriminate with respect to the incentives in order to encourage more rapid adoption, you see. So, this is the point I want to make there.

We can't have a standard for anything, in my opinion. We have to approach the best possible combination we can get based on the mixture of resources and uses which exists in reality.

Thank you very much, Mr. Chairman Miller.

Cochairman MILLER. Thank you very much, Dr. Cain.

I guess we will ask you to vacate that seat.

Dr. S. Dillon Ripley?

Mr. KARTH. Mr. Chairman, while he is taking his seat, may I make an observation?

Cochairman MILLER. You may.

Mr. KARTH. Mr. Chairman, I have heard a good many oral statements, and I want to congratulate Mr. Price. I thought that was a very brilliant oral statement that you made, and Mr. Daddario and I were wondering at your great ability to listen during this morning's session and to come up with such a fabulous résumé of what happened. I want to congratulate you for it. It was evident, I think, Mr. Chairman, that Mr. Price does not head up an agency, and as a result of that must appear before Congress for appropriations, and it was also quite evident that he is not a Member of the other body, some of whom I don't know and might otherwise have identified him, except that he was so explicit and to the point, and I say that because I'm refreshed with your frankness and your positivity. I think that we have really been skirting all around the issue this morning. I was not privileged to sit in during the entire meeting, but I do think we skirted around it and avoided tackling the problem head on because it seems to me that a good deal of our problem today with finding a balanced environment or making sure that we have one is the exclusive interest of large groups, even individuals and organizations, that are not in the public interest, and I don't think, really, that we have to have a 5-year study because these are readily identifiable. We could study, I suppose, the other 10 percent that aren't for 5 years, and as a result of that avoid coming to task with the other 90 percent, but I doubt seriously that that's the way to approach it.

In conclusion, Mr. Chairman, let me just say that in addition to talking about incentives of one kind or another, I think that we have got to come to the conclusion, if you'll permit me to say so, that just greater profits for example, that is greater immediate profits, in any one of these areas that pollute our environment—and I use our environment in broad, general terms because there are so many different areas—without insisting on major technological change that would prevent or avoid pollution, I think is to beg the thought. I think that we have got to consider some hard and fast rules, too, as we consider incentives, and I'm not sure which should precede the others.

Maybe the hard and fast rules because we could still continue to debate the incentives forever such as we have continued to debate the incentives for a good many years in the past and currently and presently do.

So, I don't think, Mr. Chairman, it is so much identifying the problem. I think it is probably applying some truth serum to it, and I'm grateful, Mr. Price, and I can't wait to get a copy from the reporter of your statement.

Mr. PRICE. I thank Representative Karth for his compliment, but I think I should say that when I was as a bureaucrat appearing before congressional committees, I probably was not nearly so explicit.

Cochairman MILLER. Thank you.

Dr. Ripley?

Dr. RIPLEY. Mr. Chairman, I'm greatly honored to be here and to be able to open my mouth in this fascinating colloquium on environment, and assumedly environmental quality, and I think that the Joint Committee shows prescient intuition in having these hearings in a room which is singly devoid of environment and which resembles to me an Egyptian sarcophagus.

Cochairman MILLER. I'm glad that none of the members of the Joint Committee are present from the other body.

Mr. DADDARIO. We will see that they hear about it, though.

Dr. RIPLEY. You see, Mr. Chairman, and Mr. Daddario, where we look in the audience, we look at a stone wall and there is also something symbolic about talking about environment and looking at a stone wall. You merely look at our happy faces, so you don't have quite the same impression. But it does occur to me that having mentioned an Egyptian sarcophagus opened the lid of Pandora's box; I don't think anyone in this room has used the word "international," and to speak about environmental quality without at least referring to the fact of the international components and consequences of even our activity as Americans in considering our own acreage and our own problems with environment, appears to me to be somewhat shortsighted. I would like to suggest that, first of all, I'm most impressed by all of the speeches of the panelists this morning, and particularly by the private sector represented by Mr. Rockefeller, who has had such notable experience in this area.

I would like to suggest that the suggestion made by him and summarized by Mr. Price of a commission or committee, whatever you want to call it, is a very valid and valuable one, but I would like to demur to the extent of saying that I do not think that such a commission should be a temporary one. I would like to see it a long-lasting one because of this fact: That it is apparently within the experience of temporary commissions that after some time they render a report, the report then is published and joins the other reports on some peoples' desks and is noted, and then the commission disappears and has no opportunity of reviewing from time to time the results or the continuing activities suggested by the report. An example of this is the fact that in the past 4 or 5 years the United States has contemplated a single engineering activity which is likely to have more long-range biological consequences than any other that I can think of during the lifetime of man as an evolved animal.

Certainly we are contemplating reversing something that happened about 15-odd million years ago; namely, the isthmus of Panama, by setting up the interoceanic canal system which has a terminal date. The Congress encouraged it to render a report, but was without any reference to the fact that the biological consequences of that, the ecological consequences are totally left out of the reckoning, and from my own point of view I have attempted as best I could in my own small corner to draw the attention of the canal commission that this was not only a domestic problem but an international one of far-reaching consequences, and that the biological predictions alone would probably take a generation to attempt to accomplish, let alone, of course, the problems of long-range estimating of whether or not there is any real utility in creating such an interoceanic canal. What are the economics of this? Here is another dimension which has not, of course, been rationally considered. Now, this sort of thing, if it could be part of the purview of a commission which was a continuing one and which would have the opportunity of working both with representatives of the legislative and the executive branch of the Government as well as with panels from the private sector in various ways, the complications of which I am probably totally ignorant, would, it

seems to me, be extraordinarily valuable because we have arrived at a time in affairs when we have no sensible understanding of the biological consequences of what we are doing; and when, on the other hand, we have developed no real incentive to biologists to go into this field.

Paul Weiss, who is in the audience today, reminded me once of the fact that many years ago in the beginning of the century there was a small group of dedicated people in the Rockefeller Foundation who decided to tackle the problem of microbiology effect, and that this, after an ensuing time of 30 years, produced a whole wealth of discoveries and so on which have revolutionized current-day biological thought. And, these discoveries in themselves have then produced a kind of vogue for going on and refining and delineating still further the original discoveries so that a whole generation of biologists is being brought up to go on in effect doing what had been done a generation before.

The subject of environmental quality involves a kind of ecological study which is still in the formative state, still in the dirty grassroots kind of area of biology which is not in general as attractive to biologists. It is only beginning to be now. It is just the beginning of a ground swell of opinion in the biological fraternity that this is of great importance.

So, I think it may take us a generation perhaps to achieve even the beginnings of the kind of training, the kind of production of original minds and talents that will be able to perform the sorts of biological monitoring, the sorts of biological control studies which we sit here, all in white collars, continually discussing and participating in a gaseous interchange in attempting to stress the urgency of.

Now, I agree that, unless we do have such interchanges, and unless such commissions and committees are formed, and somehow public opinion can become concerned, there will be none of the followup. But it is beginning to be slightly too late, and I do not agree with Secretary Udall who said this morning that we have the scientific know-how and the technological and management skills. We simply do not, and the sooner we get on with it the better.

Cochairman MILLER. Thank you.

Are there any comments by the panel?

Dr. Bennett, do you have anything you would like to say?

Dr. BENNETT. Yes, I would like to say that I think the rediscovery of ecology is an excellent thing, but I think one must differentiate between the undoubted need for all of the basic understanding that we can acquire in this important area of biological study and those problems that we face for which we do have technologies which for various reasons we cannot apply.

So I don't think that there really is any dichotomy when one discusses some of the things that can be done to deal with the improvement. Our transportation system; some of the things that can be done to deal with some of the more pressing urban problems; some of the things that can be done to improve our educational system; some of the things that can be done to make the American public better aware of the significance of almost every activity in our society upon the environment, both to the present and the future; and the need for a continual scientific effort to improve and sharpen our understanding of these problems, and to improve our ability to understand on a long-

range basis what the effects and side effects may be of changes that we contemplate.

So that I would say that there is an undoubted need for improvement in the support of the science of ecology, for the improvement in the support of training and education for individuals with the ecological point of view. But the very fact that Dr. Ripley states that many of these studies will require a generation I think implies exactly what was said this morning: that we simply cannot wait on certain of these issues, particularly some of our manmade issues in the urban areas, before we begin to take action.

I think there is abundant evidence that there are actions that could be taken based on what we know now and that this is not exclusive of the need to continue to increase our knowledge. I think one of the most impressive things about the whole Federal effort in this whole area since there has been a focused effort has been the fact that the problems have proved to be far more difficult and complicated than anyone contemplated at the time it was decided to attack these problems. Therefore, I think that we do have a continuing need for research not only in ecology, but in a number of other areas.

We have a continuing need for demonstration programs and we certainly have a continuing need for action programs based on the very best and most complete knowledge that we can acquire at this time.

Cochairman MILLER. Thank you.

Do you want to answer?

Dr. RIPLEY. I think Dr. Bennett is absolutely right and it reminds me of the fact that I attempted once to coin a phrase called social biology. I would perhaps demur about using the word "ecology" simply in context. I think at least social biology tries to get at some of the ideas involved. Thank you very much.

Cochairman MILLER. Mr. David Gates, I believe, is in the audience, is he not?

Mr. Gates, would you like to make an observation at this point?

Mr. GATES. Thank you, Mr. Chairman, ladies, and gentlemen.

It is a pleasure because I feel very strongly about these issues. All of man's actions are essentially contrary to the basic laws of ecology. Man does not cycle his resources. This is one contradiction. Man does not strive for diversity as the natural ecology system does, and this is contrary to all of evolution. Diversity gives stability within the plant and animal communities. And, by not striving for diversity, man is literally cocking the trigger on disaster. This has been demonstrated time and time again in man's history where large monobiotic communities have been developed and serious consequences have ensued.

Man must in turn exploit. He has no choice. This is his only way of life. And the question that we are faced with is a matter of conservative exploitation; how to exploit and live with real rationale.

Today the shortage of ecologists is acute. The number of people in this Nation and other nations that can cope with the urgent matters of ecology and take advantage of all aspects of modern science as it relates to ecology are very, very few indeed.

Now, the consequences of man's history, of our scientific history in recent years has been perhaps somewhat inadvertent. We have gone strongly in the direction of the physical sciences. We have gone strongly in the direction of technology and engineering. I don't say

that this is not good. It probably was a wise thing to do. But, at the same time, we have seriously overlooked the strengthening of certain parts of the biological sciences, particularly the ecological sciences, the sciences dealing with plants and animals in their very complex communities at the interaction with the environment. This being the case, it's my personal feeling that strong, very strong action is needed in order to correct the deficiency.

It's not enough to say that we need ecology or that it's a great thing or we need to strengthen it. It demands much more than that or we will continue to be in very serious difficulty with the world in which we live.

Thank you.

Cochairman MILLER. Thank you.

Any comments?

Dr. Cain?

Dr. CAIN. There's a point here, Mr. Chairman, that bears on what Dr. Ripley and Mr. Gates and others have said I would like to comment on very briefly. It's a question of sophistication or lack of sophistication of ecology; and as an ecologist I would like to see it progress rapidly from natural history by the use of the most sophisticated techniques available to it, but nevertheless, there are many cases in which the general knowledge which exists is meaningful and can be put to use. My illustration is this: Within the department I work in there is a program in rainmaking, which is a good deal more sophisticated than the Indian dances, and this is several million dollars a year. What the goal is there and the hope and the prospect is perhaps to increase the precipitation in a certain area by 10 or 15 or sometimes hopefully 20 percent. But the effect of this is really not given any real consideration. For example, I received in one connection the answer. But that kind of variability is within the annual experience with respect to precipitation. But if it's economically important to put 10 percent more water on a watershed in 1 year, it will be done every year, and then any ecologist can point out that a 10-percent change in precipitation can change the boundaries between two kinds of ecological systems by hundreds of feet in altitudes or perhaps hundreds of miles in surface direction, depending upon conditions. And so this is a generalized knowledge which ecology has, so I don't argue against increased sophistication, and goodness knows, increased support for ecology, but there is a lot known that needs to be put to work that is not being put to work.

Thank you.

Cochairman MILLER. I believe, Doctor, that the Hanford plant of atomic energy raised the temperature of the Columbia River by about 2°, and this did not help the salmon in the river, did it?

Dr. CAIN. Well, this is not a simple question to answer. Let me say that the Bureau of Commercial Fisheries, whose complete data have been available for examination have drawn annual curves of water temperature at different points on the Columbia and they know from their physiological experiments the temperatures at which a certain amount of heat becomes critical to salmon at a certain stage, and they know now that the Columbia approaches this threshold of catastrophe for salmon because of the addition of heat, particularly when this comes at low river flow in hot weather times.

And, the drawing off of water from the Columbia to some other distribution or the addition of any great amounts of heat to the Columbia by any source whatsoever, Hanford or otherwise, will be critical for salmon.

Cochairman MILLER. Thank you.

Mr. GATES. May I say one more thing, please.

Not only do we need to strengthen ecology, and we will not solve all our problems by doing so, this is certain. But, I think a new, almost new industry is needed and that is an industry of landscape management or ecological management, or ecological engineering, if you wish, and this is in order to couple the ecologists working on the fundamentals with the needs of society.

The Brookings-type institute, the Rand-type corporations, this type of thing in the field of ecological management, landscape management, if you wish.

Cochairman MILLER. I would just like to say that about a little over 10 years ago the Academy of Sciences rendered a very extensive report on oceanography, and at that time the oceanographers were in about the same minor position that the ecologists are today. But, thanks to some good leadership and men like Dr. Wing sitting out there someplace, we are getting along pretty well in this field, and I wish you the same success.

Mr. GATES. Thank you very much.

Cochairman MILLER. Dr. Rolf Eliassen?

I particularly want to welcome Dr. Eliassen because he is from Stanford. It is just across the bay from my district.

Dr. ELIASSEN. And we have been working on a number of problems in your district, especially. This pertains to one of the matters that you have been so concerned with, what is enhancement. We heard the term "enhancement" here today mentioned by Secretary Udall and others. This definitely has its merits, particularly on the lakes and streams of the polluted east and other areas. But, what is enhancement?

The Department of the Interior interprets enhancement as enhancement which means improving the condition of a certain area. Now, Los Angeles, for instance, treats its sewage and discharges its treated sewage after a primary treatment, into the ocean, 5 miles out into the ocean. And, as you know, Mr. Miller, considering perhaps Half Moon Bay or some of the other places to take all of the things from the valley, the San Joaquin Valley and the peninsula over into the ocean there, the point is, that, through mathematics, through computer studies we have been able to show that the limit of, let's say, pollution would be very small within this large body of water. We have got to look upon the ocean as a sink. A specific point is Guam where some of my colleagues have been designing a sewage treatment plant. They are very poor, the people in Guam, and they want Federal support for a sewage treatment plant. The Department of Interior has added, well, they cannot discharge that sewage out to sea without having secondary treatment. This means a very complex process of treatment which costs a considerable amount of money. Now, by preliminary treatment and a long outfall sewer you can put that out beyond the reef where there is nothing but the sharks, and the ecologists—they need food for the sharks, I think.

Protection of the people isn't involved. So, what I am saying is when we interpret the term "enhancement," we have got to look at what our resources are. We have got to look at the economy of this whole area. This is true also, of somebody mentioned industries, and you know all the petroleum refineries—Phillips and Shell and the others there—will give a fair degree of treatment and will not contaminate the environment to the extent that any noticeable thing is detectable, you might say.

Still, it's not enhancement. Now, here we have got to be very careful when we formulate policies that we just don't take one word like "enhancement" and say we will not give any Federal support to any project unless it enhances the water, enhances the Pacific Ocean. The Pacific Ocean is a resource that we are going to use. The same is true of the Atlantic and the gulf or the Mississippi River at New Orleans where they are doing nothing now, and something would be there. So, my question is: "Will such an interpretation be applied rigorously or will there be some compromise in the interpretation of it?" Right now there is no compromise. This is the promulgation and this is it. I think this is retarding the progress of environmental control, environmental pollution and also placing an untoward burden on cities which have so many other needs for so many thing besides sewage treatment.

Cochairman MILLER. Do any of you have any comment?

How about you, Doctor?

Dr. LEE. I can just only say, Doctor, but you are not hurting the sharks.

Dr. ELIASSEN. That's all right, Doctor, but you are not hurting the health of the people.

Dr. LEE. I think actually in the situation you described and obviously in other areas where you can discharge pollutants in such a way that removing it from the immediate environment enhances that environment without harming the peripheral environment perhaps in terms of, or human exposure as such and other exposure as such, that it's not harmful, so that if you look at the total you are perhaps enhancing it.

Dr. ELIASSEN. I hadn't looked upon it that way. I wish the Department of Interior would look upon it that way because it would help a lot of cities.

Dr. LEE. Don't get us in a jurisdictional dispute on that.

Dr. ELIASSEN. Let's put it back in the Department of HEW.

Dr. LEE. We should point out that he is not a consultant to HEW.

Cochairman MILLER. I can tell. I was very much interested in what he had to say, although he didn't say so exactly, he mentioned the oil plants, a number of them on San Francisco Bay and they have done a very good job in correcting pollution.

Dr. ELIASSEN. Yes, sir.

Cochairman MILLER. Would you be interested in knowing why they went into this?

Dr. ELIASSEN. Yes, sir.

Cochairman MILLER. Well, when they used to have oil slips and pleasure boats had become quite a problem; there were marinas along the shore and you would have an oil slip and go down and everyone would find oil on their boats. The first thing you know they started a few lawsuits and all of this. Then the companies used to say, "We had

an oil slip, just send your boat over to a certain place and they will scrape it and repaint the boat." They came to the conclusion that it was a little cheaper to spend some money to avoid oil slips and anything else. I was there when it happened.

Dr. ELIASSEN. Now, of course, the State quality water control board is getting on these, and the oil refineries are doing something.

Cochairman MILLER. They spent millions of dollars getting rid of this.

Dr. ELIASSEN. And, Standard Oil——

Cochairman MILLER. They were way ahead. They used to be one of the worst violators, but they found it cost them more money to have these boats fixed up maybe two or three times a year instead of putting in some good sumps and recovering it.

Mr. Karth?

Mr. KARTH. Mr. Chairman, I'm certain the doctor is a much wiser man in this area than I am, but I would just like to say, Doctor, that up in my area where we do have refineries that certainly the source of disposal of the effluent or residue is not as clean as apparently you are accustomed to seeing it some other places in the country. We have had several rather scandalous situations up there where even migratory wild fowl, for example, was captured and killed by the effluent.

Dr. ELIASSEN. Where is this, sir?

Mr. KARTH. This is in St. Paul, just south of the Twin Cities. And, again, I think it gets back to the question of whether or not we do have the available technology in some instances, but hesitate to apply it as a rule of thumb. And, I would hope that in these areas—and this was my point before—in these areas that we do not hesitate, that we don't have to take 5 years to study it, that we can apply uniformly these rules and promulgate new regulations if necessary; but, up there I know that the situation is not nearly as clean as the chairman here calls my attention to out in California, and I suppose for good reason. They haven't had to clean up some boats.

Dr. ELIASSEN. As I said in my preliminary remarks, inland rivers and lakes are desperately in need of enhancement. I'm thoroughly in accord with this enhancement philosophy in so many parts of the concentrated areas of the country. But, it is not a universally applicable thing.

Mr. KARTH. No; I agree with your analogy that you drew with regard to Guam. I think that is correct.

Cochairman MILLER. Thank you very much, Doctor.

Dr. Philip Abelson?

Dr. ABELSON. The speakers this morning outlined a bewildering list of problems. In fact, if you dwelled on them long enough you would be convinced that there are so many of them, the system was so overloaded, you couldn't do anything.

Cochairman MILLER. You wouldn't want to be like one of my colleagues from Illinois who, when we get through talking about some of these things on the floor says, "George, let's get out of here and go back to cornrowing in Illinois. It's much simpler."

Dr. ABELSON. So, I was much pleased when Dean Price put the very sensible question, "well, what is the problem?" And, in fact, all these, I believe these various structures of the Commission and so on that

were proposed, before you start creating those various mechanisms you ought to ask yourself what the dickens you are trying to do.

So, it would seem to me that the first thing is to make some choices as to what are the real No. 1 problems and to isolate them into doable pieces and especially to ask, among other things, what is doable.

Cochairman MILLER. Gentlemen?

Any of you have any observation?

Mr. ROCKEFELLER. As our social aspirations and standards go up progressively we may well find that more and more is doable. What we feel we can't do today perhaps we can tomorrow. When one looks back 10 years, we see that this is true. Certainly, 10 years ago we wouldn't have hoped of spending the money in the recreation and natural beauty area that we are spending today. So I think that social evolution and rising aspirations are important factors in our considerations.

Dr. ABELSON. Certainly I agree with that and, of course, what is doable goes with time.

Cochairman MILLER. Thank you very much.

Dr. Russell Train?

Mr. TRAIN. Thank you for the "doctor," but it's only mister.

Cochairman MILLER. That's all right. I get called doctor, too, sometimes.

Mr. TRAIN. Dr. Ripley anticipated my first point, which was an omission in the discussion this morning of the international aspects of any national environmental policy. I think this point is obvious in the case of the oceans, the atmospheres. No intelligent political boundaries can be drawn.

Also, in the case of major national programs, such as foreign economic assistance, some of these have major environmental impacts. And, these should be taken into account in determining policy.

On the question of standards raised by Dr. Brooks and others and what should be the elements of a national environmental policy, I tend to be suspicious of efforts to fix standards, at least in this kind of context. I think you can take one thing like water and perhaps get at it, or air, but in terms of a national environmental policy, I repeat, I'm suspicious of talk of absolute standards. I think that there must be a great deal of diversity in whatever we get at.

Dr. Eliassen has pointed to the need for this, and so have others.

I would like to suggest that perhaps one approach that might be taken is to look at the process and to try to develop in our decision-making processes that recognize the complex interrelationships of the problems we have been talking about, so that the highway planner does not only look at the engineering aspects but also at the sociological, if you will, among others.

What does a highway do to a given community? I don't think that you can arrive at fixed standards of this sort, but I think you can get at the process, and if we can arrive at intelligent processes of this sort, I'm confident that out of those processes the standards and goals will evolve. I'm inclined to think that machinery eventually will be very useful both in the Congress and in the executive departments. In the Congress, the nature of a watchdog committee on the Joint Committee on the Environment and perhaps in the executive department branch,

a Council of Environmental Advisers. It may well be we are not ready for this yet, and I think there is a great deal of merit in the suggestion of Mr. Rockefeller for a commission representing the legislative, the executive, and the public. And, I would urge that the makeup not be limited to the scientists and the technologists because with all due respect, I think those gentlemen have created some of the problems with which we are confronted.

I would plead also for the generalists. I'm not sure whether this should be a temporary commission or a permanent commission. I think it should be created and kept in being until such time as the next step becomes plainer than it is now.

Thank you very much.

Cochairman MILLER. Any comments, gentlemen?

Thank you very much, Mr. Train. I'll give you the "mister" this time.

The next is Mr. Holloway?

(No response.)

Dr. John Cantlon?

DR. CANTLON. Thank you for this opportunity. I would like to point out that with all of the discussion this morning and largely those this afternoon, one possible policy item that might be incorporated in your deliberations and decided on now has received relatively small attention. It would be possible now to have as a national policy that none of the species now present in the United States or in larger areas, if we could make it operationally possible, would be put under any serious jeopardy. This is a very clear-cut, very simple policy statement and yet it has very far-reaching implications. One could amplify this same position a bit further and assert that one of the ecosystem types; that is, none of the particular arrays of species will be permitted to be put into great jeopardy. Why would these be legitimate policy positions? I think you will find most of the scientists who have thought seriously about this matter would maintain that the life support system on this planet is absolutely inconceivable without a very large number of species making it run, keeping its homeostatic properties in operation.

Furthermore, I think you would find none of the scientists today could give you a legitimate list of the absolutely irreducible miniota essential to keep this planet healthy.

This suggests that we do not know which species we should insist remain as a part of our information and which we can permit to be lost. The analogy here is that one could indiscriminately permit a few wayward teenagers to tour the world's libraries, destroying books at random. These books, of course, could contain the essential information for our culture. The genetic information contained in the species of our biotas are just as real, just as legitimate, and far more valuable than probably the bulk of our cultural information. Therefore, it seems to me one could arrive at a reasonable defensible policy statement. We will not permit any species to be put in serious jeopardy unless it is done in a willful act as a result of a hearing, which has the opportunity for review. Now, I could amplify this, but I would prefer to keep it short.

Cochairman MILLER. Thank you. Any comments, gentlemen?

Mr. FULTON. I have a comment.

Do you include man in your species?

Dr. CANTLON. Of course.

Mr. FULTON. When you are speaking of species, do you mean productive species or do you mean species that are in the whole ecology? How do you define your species?

Dr. CANTLON. Well, if someone could tell me what a productive species is, then I think I could answer your question; but I think my point is just the fact that we cannot discriminate. No one at the moment could tell us which species are absolutely essential on this planet.

Mr. FULTON. Wouldn't it be amazing if we adopted that policy for animals and then kept on engaging in killing people.

Dr. CANTLON. Well, I assume that no one visualizes the human race as being in any great jeopardy as disappearing from this planet. As a matter of fact, the reason that we are all here is that we have put a fairly major piece of the earth's other species in jeopardy.

Mr. FULTON. My final point is this: How would you come to make a program for such a proposition as you envision? How would you make it practical?

Dr. CANTLON. I think that we could take some fairly clear-cut and relatively easily attained steps in this direction.

For instance, we heard from Secretary Weaver this morning about the major expansion of the northeastern urban complex. The northeastern urban complex lies across one of the major ecosystem types in this country. It's conceivable that we have already strained seriously major pieces of this system. Therefore, we should set aside representative pieces large enough to maintain the population's normal reproductive functions. This means that preserving species from extinction is not slapping them in zoos or arboreta. This is not what I have in mind at all. A very major piece of the ecological information which we may be desperately seeking a hundred years from now or 50 years from now as a solution pathway to some of our environmental problems—

Mr. FULTON. Without getting too involved, you would then preserve mosquitos, bedbugs?

Dr. CANTLON. Absolutely. No one has convinced me yet that mosquitoes are worthless creatures by any means. Ask any fisheries biologist about the role of mosquitoes.

Mr. FULTON. Would you preserve voters, too?

Dr. CANTLON. Voters? They are the best kind.

Mr. FULTON. That's all.

Cochairman MILLER. Senator Jackson?

Cochairman JACKSON. Maybe we better get the humane society working in behalf of mankind, too, instead of just the animals alone. I would like, Mr. Chairman, to quote from the President's remarks at Glassboro State College on June 4 in which he said:

Scientists from this country and the Soviet Union and from 50 other countries have already begun an international biological program to enrich our understanding of man and his environment. I propose that we make this effort a permanent concern of our nations. I propose that the United States scientists join with the scientists of the Soviet Union and other nations to form an International Council on Human Environment.

I want to open up the dialogue a little further here, if I may. Maybe some of you might have some comments, Mr. Chairman, on that.

Cochairman MILLER. Have you any comments on this, gentlemen?

Cochairman JACKSON. Isn't it fair to say that this is an international problem? Could that be responded to?

Dr. BENNETT. I would like to say that, of course, it's an international problem and indeed one of the strongest points that was made this morning when Dr. Lee was discussing the population problem is that of all these problems this is the one which we will not be able to escape unless it is really brought under some sort of control all over the world. So far as the International Biological Program is concerned, we are participating in that; and at the present time the National Science Foundation is preparing a program memorandum for the Bureau of the Budget which it is preparing in cooperation with the International Biological Program Committee of the National Academy of Sciences and the various other executive agencies that are concerned in this which we hope will make it possible to place in the Federal budget funding for this program which at the present time is expected to last for at least 5 years.

Finally, I think that there is accumulating evidence that we have a great deal to learn from other countries because we do have these problems in common. As an example, in the OECD, the Organization for Economic Cooperation and Development, which contains most of the developed countries of Western Europe, we are presently participating in a series of cooperative planning programs that will enable us to exchange information on these problems that are common to the developed countries. These include such things as traffic safety, water pollution, and various environmental problems, and problems of urban development.

I might also say that we are fortunate Japan is also a member of this organization because there is a great deal we can learn from Japan.

Additionally, we do have a number of bilateral agreements, particularly the Department of Interior has one with Germany which bids fair to be profitable to both participating countries because we are working on common problems.

So I think, both from the point of view that these are problems that are international and from the point of view of the fact that cooperation in this endeavor which is an endeavor in the public sector in the sense that inevitably governments are going to have to foot the bill for a great deal of this, that there are very great opportunities.

At the present time our office, in cooperation with certain elements of the State Department, is making an effort to draw up a proposal for this Council on the Human Environment that the President suggested in his speech at Glassboro, and we hope to draw it up in such a fashion that rather than it being a token it really will result in an arrangement that will be profitable to us, because we certainly can use all the knowledge we can get from the experience of others.

Cochairman JACKSON. Dr. Cain?

Dr. CAIN. Mr. Chairman, I would like to read a few brief words that relate to the international biological program and tie in with recent expressions. After I read them, I'll identify who wrote them.

This says the ultimate aim of the International Biological Program is to improve human welfare, which is why the section concerned with

human adaptability, which is one of said sections, is working in close contact with the World Health Organization, which is cooperating in the implementation of certain parts of the section's program and especially in work connected with the genetics of isolated populations, a subject of tremendous importance in that it provides valuable terms of reference for human medicine. The International Biological Program is not, therefore, an experiment in cooperation between the world's biologists designed to obtain data for storage in archives. On the contrary, its philosophy is the survival of mankind and its aim is to instill into political leaders—excuse me, but that's the way it says it—a sense of biology which primitive man still possesses, which has been completely eliminated by industrialized man whose intellectual background makes him seek productivity solely in terms of the figures of which he is a master.

This is a quotation from A. A. Socolov, and is part of a publication on the International Biological Program issued last year.

Cochairman JACKSON. They have politicians in the Soviet Union, too!

Dr. CAIN. It is, however, pertinent to the remarks Dr. Cantlon was making, and the remarks made about the International Biological Program.

Mr. FULTON. I was going to ask about the words, "primitive man." Does that apply to political leaders?

Cochairman MILLER. Well, time is growing short.

Have any of you gentlemen anything?

I'm going to close shortly—anything you would like to say about this morning's session?

Dr. Malone?

Dr. MALONE. Mr. Chairman, I would like to strongly support this international point of view. I don't think we need to wait. Should it seem desirable to implement Mr. Rockefeller's suggestion of a commission, I would urge that serious consideration be given to making this an American commission, and start right now; if we really believe this is international, then let's include Mexico and Canada and as far south as seems appropriate.

Thank you.

Cochairman MILLER. Thank you, Doctor.

Anyone else?

We would hope to receive additional comments from any of you. Unfortunately we couldn't go down through the full list. You can address them to either Senator Jackson or to me. The results of this meeting will depend much on the additional thinking of all of the sectors of society. Perhaps we have taken a significant next step toward a national policy for environment. In any event, your presence is a good omen for the future and I want to thank you for all coming here.

Mr. Daddario—I want to say first that if anyone deserves credit for putting this together, it's Mr. Daddario. You will agree with me?

Cochairman JACKSON. I agree wholeheartedly and I complimented him this morning, and I state that what I said this morning, he was really the moving force, George, behind the meeting today.

Cochairman MILLER. There's no question of it, and I want to say, of course, that Mr. Daddario is the chairman of the subcommittee of the Committee on Science and Astronautics and I work on the theory,

the old western theory, when I was a boy in the Sacramento Valley, and we weren't worrying about a strip city and we didn't keep a watchdog, and did the barking ourselves. So, I appointed a watchdog and he has done a lot of good for me.

Mr. DADDARIO. Well, it goes without saying, Mr. Chairman, that this meeting could not have taken place unless Senator Jackson and you had agreed to put your formidable presence behind the idea that we should have this meeting or thank the staff, which has done a magnificent job in getting you all here, or each of you as a participant, and I personally want to thank all of you, but I do think it is important to take into consideration what Mr. Miller has just said in urging all of you to send your thoughts to us.

One of the most important developments from this point will be the digesting of the activities already taken place here, add to it additional information which we will hope will come from you and then do the necessary staff work so that we can at some time in the near future provide each of you with not only the proceedings from these hearings, but a projected report upon which we would like some comment, hoping that we could get some kind of a consensus from which we could then move, we would hope logically, on to determinations which ought to lead to progress in these areas which cause all of us concern and about which we are not particularly in contention excepting as to what we ought to do.

As Dr. Abelson said, the doable does change, but it offers us opportunities to do things now and to make the changes so that there will be more things to do in time ahead.

I appreciate the opportunity to make those comments, Mr. Chairman.

Cochairman MILLER. Well, before I just talked to Senator Jackson, and we have decided that perhaps early next year after we have had a chance to digest some of this, we will try and have another meeting of this kind to resolve those things that we feel are best for the people of this country and all of us.

I again want to thank you for being here.

(Whereupon, at 3:57 p.m., the meeting was concluded.)

APPENDIX I

90th Congress
2d Session

COMMITTEE PRINT

A NATIONAL POLICY FOR THE
ENVIRONMENT

A REPORT ON THE NEED FOR A NATIONAL POLICY FOR THE ENVIRONMENT: AN EXPLANATION OF ITS PURPOSE AND CONTENT; AN EXPLORATION OF MEANS TO MAKE IT EFFECTIVE; AND A LISTING OF QUESTIONS IMPLICIT IN ITS ESTABLISHMENT

A SPECIAL REPORT
TO THE
COMMITTEE ON INTERIOR AND
INSULAR AFFAIRS
UNITED STATES SENATE
TOGETHER WITH A STATEMENT
BY
Senator HENRY M. JACKSON



JULY 11, 1968.—Printed for the use of the Committee on Interior
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STATEMENT BY SENATOR HENRY M. JACKSON

Over the years, in small but steady and growing increments, we in America have been making very important decisions concerning the management of our environment. Unfortunately, these haven't always been very wise decisions. Throughout much of our history, the goal of managing the environment for the benefit of all citizens has often been overshadowed and obscured by the pursuit of narrower and more immediate economic goals.

It is only in the past few years that the dangers of this form of muddling through events and establishing policy by inaction and default have been very widely perceived. Today, with the benefit of hindsight, it is easy to see that in America we have too often reacted only to crisis situations. We always seem to be calculating the short-term consequences of environmental mismanagement, but seldom the long-term consequences or the alternatives open to future action.

This report proposes that the American people, the Congress, and the Administration break the shackles of incremental policymaking in the management of the environment. It discusses the need for a national environmental policy and states what some of the major elements of such a policy might be. It also raises a number of questions implicit in the establishment of such a broad-based and far-reaching policy.

The report does not purport to deal exhaustively with these subjects. Rather, it attempts to place some of the fundamental questions concerning the need for and the elements of a national environmental policy in the arena of public debate. If the report is successful in encouraging discussion and in refining some of the issues involved, it will have performed a worthwhile purpose. In the last few years, it has become increasingly clear that, soon, some President and some Congress must face the inevitable task of deciding whether or not the objective of a quality environment for all Americans is a top-priority national goal which takes precedence over a number of other, often competing, objectives in natural resource management and the use of the environment. In my judgment, that inevitable time of decision is close upon us.

If we are to make intelligent decisions which are not based on the emotion of conservation's cause célèbre of the moment or on the error of simply perpetuating past practices, there is a very real need to develop a national capacity for constructive criticism of present policies and the development of new institutions and alternatives in the management of the environmental resources of land, air, water, and living space. Developing this capacity will require that representatives from all elements of our national life—industry, the university, Federal, State, and local government—participate in forming this policy. It will require the creative utilization of technology to improve environmental conditions and to prevent unanticipated future instances of costly abuse. It will also require that government,

business, and industry pay closer attention to a far greater range of alternatives and potential consequences when they make environment-affecting decisions than they have in the past.

Finally, it needs to be recognized that the declaration of a national environmental policy will not alone necessarily better or enhance the total man-environment relationship. The present problem is not simply the lack of a policy. It also involves the need to rationalize and coordinate existing policies and to provide a means by which they may be continuously reviewed to determine whether they meet the national goal of a quality life in a quality environment for all Americans. Declaration of a national environmental policy could, however, provide a new organizing concept by which governmental functions could be weighed and evaluated in the light of better perceived and better understood national needs and goals.

This report was prepared for the use of the Senate Interior Committee by Prof. Lynton K. Caldwell, Department of Government, Indiana University, with the assistance of Mr. William J. Van Ness, special counsel to the committee, and the Natural Resources Division, Legislative Reference Service, Library of Congress. Professor Caldwell's contribution was, in part, made possible through an arrangement with the Conservation Foundation.

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“Scientists from this country and the Soviet Union—and from 50 other countries—have already begun an international biological program to enrich our understanding of man and his environment.

“I propose that we make this effort a permanent concern of our nations. I propose that the United States scientists join with the scientists of the Soviet Union and other nations to form an international council on the human environment.”—*From President Lyndon B. Johnson's Commencement Address at Glassboro State College, Glassboro, N.J., June 4, 1968.*

PREAMBLE

It is a major function of the Congress to propose and consider policies "to provide for the common defense and the general welfare of the United States." Today, a challenge to the safety and welfare of the United States and of the American people has arisen. The challenge is the rapid deterioration of the environmental base, natural and manmade, which is the indispensable foundation of American security, welfare, and prosperity. Congress has recognized this challenge, and in accord with its responsibilities is preparing a response. Numerous proposals are now before the Congress to deal with what some of our best informed scientists and political leaders describe as an "environmental crisis." The purpose of this report is not to "view with alarm," but to raise the issue of whether there is a need for a national environmental policy and to discuss some of the major elements which might be considered for inclusion in such a policy. This report is intended to bring the issue of environmental policy into as sharp a focus as the complexity of its subject matter permits, and to identify some of the basic questions that would be encountered in shaping a national policy.

The threat of environmental deterioration, which the President of the United States has described as "a crisis of choice," is largely the result of the unprecedented impact of a dual explosion of population and technology upon limited resources of air, water, land, and living space. This challenge has not occurred before in American history nor in the history of civilization. Today the threat this challenge presents is widely recognized. Calls for action have come from many sectors of American society: from labor, from business, from agriculture, from science, from civic bodies, from religious, cultural and ethnic groups, from public agencies and from the elected representatives of the people. Symbolizing the national concern, the Department of the Interior entitled its 1968 Conservation Yearbook "Man—An Endangered Species?"; and the Chamber of Commerce of the United States has issued a call for action in a pamphlet bearing the headline "The Need: To Manage Our Environment." These publications, together with many others listed in appendix A, document the evidence and provide an understanding of the dangers and costs of environmental deterioration. When these dangers and costs are understood, the need for a continuing effort to refine and establish a countervailing policy is apparent.

Therefore, the issue before the American people and their elected representatives is the kind of policy that will meet the need. To be effective, a national policy for the environment must be compatible and consistent with many other needs to which the Nation must respond. But it must also define the intent of the American people toward the management of their environment in terms that the Congress, the President, the administrative agencies and the electorate can consider and act upon. A national policy for the environ-

ment—like other major policy declarations—must be concerned with principle rather than with detail; but it must be principle which can be applied in action. The goals of effective environmental policy cannot be counsels of perfection; what the Nation requires are guidelines to assist the Government, private enterprise and the individual citizen to plan together and to work together toward meeting the challenge of a better environment. At the risk of some oversimplification, the task may be summarized in these terms:

- (1) To arrest the deterioration of the environment.
- (2) To restore and revitalize damaged areas of our Nation so that they may once again be productive of economic wealth and spiritual satisfaction.
- (3) To find alternatives and procedures which will minimize and prevent future hazards in the use of environment-shaping technologies, old and new.
- (4) To provide direction and, if necessary, new institutions and new technologies designed to optimize man-environment relationships and to minimize future costs in the management of the environment.

The challenge of environmental management is, in essence, a challenge of modern man to himself. The principal threats to the environment are those that man himself has induced. A national policy for the environment is thus above all else a national policy for the welfare and survival of man. It is one more step in the journey of the American people from political independence toward knowledgeable self-determination in its most fundamental and democratic sense.

A NATIONAL POLICY FOR THE ENVIRONMENT

Introduction

This report is based upon the assumption that the threat of environmental mismanagement and deterioration to the security and welfare of the United States has been established. (See app. A.) There are differences of opinion as to the severity and relative urgency of various hazards to the environment. Some scientists believe that man's environmental relationships have reached a point of crisis; others do not see the condition of the environment generally as having yet reached a critical stage. But there is, nevertheless, general consensus throughout most walks of life that a serious state of affairs exists and that, at the least, it is approaching a crisis of national and international proportions. The focus of this report is therefore on national policy to cope with environmental crisis, present or impending, rather than with documenting the facts related to environmental deterioration.

PART I

Requirements for Policy Effectiveness

Effective policy is not merely a statement of things hoped for. It is a coherent, reasoned statement of goals and principles supported by evidence and formulated in language that enables those responsible for implementation to fulfill its intent. This section of the report describes some of the interrelating conditions that appear necessary to an effective national policy for the environment. The discussion will be developed under the following five headings:

- (1) Understanding Imminent Need.
- (2) Recognizing Costs.
- (3) Marshaling Relevant Knowledge.
- (4) Facilitating Policy Choice.
- (5) National Policy and International Cooperation.

1. UNDERSTANDING IMMINENT NEED

An effective and enlightened environmental policy is a response to the needs of man in relation to his environment. The response may involve the control of man's behavior on behalf of the larger interests of mankind where those interests are clearly perceived and widely held. Man's relationships with his environment are, of course, multitudinous and complex. Control by governments, by international organizations, or by other institutions, cannot feasibly be extended to every aspect of the environment nor to more than a fraction of the actual points of impact of individual man upon his environment. Policy effectiveness consequently depends very largely upon the internalization, in the human individual, of those understandings, values, and attitudes that will guide his conduct in relation to his environment along generally beneficial lines. A major requisite of effective environmental policy is therefore intelligent and informed individual self-control.

There is substantial evidence to indicate that large numbers of Americans perceive the need for halting the spread of environmental decay. It is also evident, however, that few recognize the connection between the conditions which they deplore and the absence of any explicit and coherent national policy on behalf of environmental quality.

Man is confronted by a circumstance that is totally new in human history. He has rapidly completed the occupancy of the easily inhabitable areas of the earth while his numbers have increased at an exponential and accelerating rate. Simultaneously, unprecedented economic power and advances in science and technology have permitted man to make enormously increased demands upon his environment. In no nation are these coincidental developments more dramatically evident than in the United States. And yet many

Americans find it difficult to understand why sound environmental management should now suddenly become "everybody's business." Long-accepted ways of thinking and acting in relation to one's surroundings are now being called into question. Understanding of what has happened can be helped by a simple exercise in arithmetic.

At the time of the American Revolution the total human population of the present-day continental United States could hardly have exceeded 3 million individuals. The demands of the American Indian and European colonists on the Atlantic seaboard were very light when contrasted with current exactions. By the close of the 20th century, if the population of this same area approximates 300 million, the daily stress man places on the environment will, on the basis of mere numbers, have increased 100 times over. Technology has alleviated some forms of stress (as on forests for fuel or on wildlife for food), but it has greatly increased environmental stress in general. The net result has been enormously increased demands upon the environment in addition to the increase in population. Calculation of an average per man-year stress upon the environment, estimated from A.D. 1700 to 2000, and adjusted for technological factors at particular historical periods, would be a powerful persuader of the need for a sensitive and forward-looking national environmental policy. The exponential increase in the pressure of man and his technology upon the environment, particularly since World War II, is the major cause of the need for a national environmental quality effort.

The rate at which the Nation has changed since 1890 when the frontier officially ceased to exist has been unexceeded by any other social transformation in history. Scarcely one long generation removed from the last days of the frontier, America has become an urbanized and automated society with publicly institutionalized values in social security, labor relations, civil rights, public education, and public health that would have been utopian less than a century ago. In the absence of a system for adequately assessing the consequences of technological change, who could have predicted the many ways in which applied science would transform the conditions of American life? Powerful new tools applying the discoveries in chemistry, physics, biology, and the behavioral sciences were put to work for improving the health, wealth, comfort, convenience, and security of Americans. Utilizing the vast natural resources of the American environment, the world's highest standard of living was achieved in an amazingly short period of time. Unfortunately, our productive technology has been accompanied by side effects which we did not foresee. Experience has shown us that there are dangers as well as benefits in our science-based technology. It is now becoming apparent that we cannot continue to enjoy the benefits of our productive economy unless we bring its harmful side effects under control. To obtain this control and to protect our investment in all that we have accomplished, a national policy for the environment is needed.

Although Americans have enjoyed prodigious success in the management of their economy they have been much less successful in the management of natural resources. As a people we have been overly optimistic, careless, and at times callous in our exactions from the natural environment. The history of soil exhaustion and erosion, of cut-over forest lands, of slaughtered wildlife document a few of our

early failures to maintain the restorative capacities of our natural resources. Fortunately many of these early failures have been corrected or are now being remedied. But our exploding population and technology have created more subtle dangers, less easily detected and more difficult to overcome.

These more recent dangers have been documented in testimony before the Congress and in the reports of scientific committees (app. A). They confront us with the possibility that the continuation of present trends affecting, for example, (a) the chemistry of the air, (b) the contamination of food and water, (c) the use of open land and living space, and (d) the psychophysical stress of crowding, noise and interpersonal tension on urban populations, may infinitely degrade the existence of civilized man before the end of this century. These are not the exaggerated alarms or unsubstantiated predictions of extremists; they are sober warnings of competent scientists supported by substantial demonstrable evidence. The practical course is, therefore, to forestall these threats before they have outgrown our technical, economic, legal, and political means to overcome them. Fortunately, we still have a choice in this matter. We still have a relatively wide range of alternatives available in managing the environment.

It may be contended that the problems of the environment must wait until more urgent political issues are resolved. Problems of national security, poverty, health, education, urban decay, and underdeveloped nations have just and appropriate claims for priority in national attention and public expenditure. Yet many aspects of these problems involve environmental policy. Three of the most urgent—the slums and ghettos of the great cities; increasing disability and death from diseases induced by environmental factors (for example, cancer, emphysema, mental disorders); and the decline and decay of rural areas (for example, in Appalachia) furnish persuasive reasons for a national environmental policy. Before billions of dollars are spent in attempts to alleviate these social ills, it would be wise to be sure that environmental factors causing or accompanying these conditions are properly identified and remedied. We may otherwise worsen the state of our economy and environment without solving the underlying social problems.

In summary, within the present generation the pressures of man and technology have exploded into the environment with unprecedented speed and unforeseen destructiveness. Preoccupied with the benefits of an expanding economy the American people have not readily adopted policies to cope with the attendant liabilities. Popular understanding of the need to forestall the liabilities in order to preserve the benefits is now becoming widespread, and provides the political rationale for the development of a national policy for the environment, and for a level of funding adequate to implement it.

2. RECOGNIZING COSTS

The nation long ago would probably have adopted a coherent policy for the management of its environment, had its people recognized that the costs of overstressing or misusing the environment were ultimately unavoidable. This recognition was arrived at belatedly for several reasons: *First*, environmental deterioration in the past

tended to be gradual and accumulative, so that it was not apparent that any cost or penalty was being exacted; *second*, it seemed possible to defer or to evade payment either in money or in obvious loss of environmental assets; *third*, the right to pollute or degrade the environment (unless specific illegal damage could be proved) was widely accepted. Exaggerated doctrines of private ownership and an uncritical popular tolerance of the side effects of economic production encouraged the belief that costs projected onto the environment were costs that no one had to pay.

This optimistic philosophy proved false as many regions of the Nation began to run out of unpolluted air and water, as the devastation of strip mining impoverished mining communities, as the refuse of the machine age piled up in manmade mountains of junk, as the demand for electricity and telecommunications arose to festoon the Nation with skeins of cables strung from forests of poles, and as the tools of technology increasingly produced results incompatible with human well-being. Under the traditional "ground rules" of production, neither enterprise nor citizen was called upon to find alternatives or to pay for measures that would have prevented or lessened ensuing loss of environmental quality. Payment continued to be exacted in the loss of amenities the public once enjoyed, and in the costs required to restore resources to usefulness and to support the public administration that environmental deterioration entailed. When the public began to demand legislation to control pollution and to prevent environmental decay, the reaction of those involved in environment degrading activities was often one of counter-indignation. Businessmen, municipalities, corporations and property owners were confronted with costs in the form of taxes or the abatement of nuisances that they had never before been called upon to pay. They were now about to be penalized for behavior which America had long accepted as normal.

What is now becoming evident is that there is no way in the long run of avoiding the costs of using the environment. The policy question is not whether payment shall be made; it is when payment shall be made, in what form, and how the costs are to be distributed. Hard necessity has made evident the need for payment to obtain air and water of quality adequate to meet at least minimum standards of health and comfort. Scientific knowledge and rising levels of amenity standards have added to public expectation that protection against environmental damage will be built into the products and production costs of manufacturers.

Lack of a national policy for the environment has now become as expensive to the business community as to the Nation at large. In most enterprises a social cost can be carried without undue burden if all competitors carry it alike. For example, industrial waste disposal costs can, like other costs of production, be reflected in prices to consumers. But this becomes feasible only when public law and administration put all comparable forms of waste-producing enterprises under the same requirements. Moreover it has always been an advantage to enterprise to have as clear a view as possible of future costs and requirements. When public expectations and "ground rules" change, however, as they have been changing recently on environmental quality issues, the uncertainty of resulting effects upon business costs, and the necessity

for adjustment to unexpected expenses and regulations, is disconcerting and hardly helpful.

A national policy for the environment could provide the conceptual basis and legal sanction for applying to environmental management the methods of systems analysis and cost accounting that have demonstrated their value in industry and in some areas of government. It has been poor business, indeed, to be faced with the billions of dollars in expense for salvaging our lakes and waterways when timely expenditures of millions or timely establishment of appropriate policies would have largely preserved the amenities that we have lost and would have made unnecessary the cost of attempted restoration. A national system of environmental cost accounting expressed not only in economic terms but also reflecting life-sustaining and amenity values in the form of environmental quality indicators could provide the Nation with a much clearer picture than it now has of its environmental condition. It would help all sectors of American society to cooperate in avoiding the overdrafts on the environment and the threat of ecological insolvency that are impairing the national economy today.

It is not only industrial managers and public officials who need to recognize the unavoidable costs of using the environment. It is, above all, the individual citizen because he must ultimately pay in money or in amenities for the way in which the environment is used. If, for example, he likes to eat lobster, shrimp or shellfish, the citizen must reconcile himself to either paying dearly for these products or indeed finding them unobtainable at any price, unless we find ways to preserve America's coastline and coastal waters. The individual citizen may also have to pay in the cost of illness and in general physical and psychological discomfort. And these costs, of course, are not incurred voluntarily.

In the interest of his welfare and of his effectiveness as a citizen the individual American needs to understand that environmental quality can no longer be had "for free." Recognition of the inevitability of costs for using the environment and of the forms which these costs may take is essential to knowledgeable and responsible citizenship on environmental policy issues.

In summary, the American people have reached a point in history where they can no longer pass on to nature the costs of using the environment. The deferral of charges by letting them accumulate in slow attrition of the environment, or debiting them as loss of amenities will soon be no longer possible. It is no longer feasible for the American people to permit it. The environmental impact of our powerful, new, and imperfectly understood technology has often been unbelievably swift and pervasive. Specific effects may prove to be irreversible. To enjoy the benefits of technological advance, the price of preventing accidents and errors must be paid on time. From now on "pay-as-you-go" will increasingly be required for insuring against the risks of manipulating nature. This means merely that provision must be made for the protection, restoration, replacement, or rehabilitation of elements in the environment before, or at the time, these resources are used. Later may be too late.

3. MARSHALING RELEVANT KNOWLEDGE

For many years scientists have been warning against the ultimate consequences of quiet, creeping, environmental decline. Now the decline is no longer quiet and its speed is accelerating. The degradation is destroying the works of man as well as of nature. We are confronted simultaneously with environmental crisis in our cities and across our open lands and waters. The crisis of the cities and the crisis of the natural and rural environments have many roots in common, although they may erroneously be viewed as extraneous to one another, or even as competitive for public attention and taxation. In fact, both crises stem from an ignorance of and a disregard for man's relationship to his environment.

An effective environmental policy in the past might have prevented and would certainly have focused attention upon the wretched conditions of urban and rural slums. It would surely have stimulated a search for knowledge that could have helped to correct and prevent degraded conditions of living. It is now evident that the fabric of American society can no longer contain the growing social pressure against slum environments. Today, remedial measures are being forced by social violence and by the social and economic costs of environmental decay; but it is not certain that the remedies take full account of the nature of the ailment. The pressure upon the urban environment is acute and overt; it is dramatized, it has obvious political implications, and it hurts. Conversely, the degradation of natural and rural environments is more subtle. Stress may reach the point of irreparable damage before there is full awareness that a danger exists. What is needed therefore is a systematic and verifiable method for periodically assessing the state of the environment and the degree and effect of man's stress upon it, as well as the effect of the environment and environmental change on man.

One would expect to be able to look to the universities and to the great schools and institutes of agriculture, engineering, and public health as constituting an environmental intelligence system. Unfortunately however, no such system exists. Man-environment relationships per se have seldom been studied comprehensively. Various disciplines have concerned themselves with particular aspects of environmental relationships. Geographers, physiologists, epidemiologists, evolutionists, ecologists, social and behavioral scientists, historians, and many others have in various ways contributed to our knowledge of the reciprocal influences of man and environment. But the knowledge that exists has not been marshaled in ways that are readily applicable to the formulation of a national policy for the environment. At present, there are many gaps in our knowledge of the environment to which no discipline has directed adequate attention.

It should not be surprising that there is a lack of organized knowledge relating to environmental relationships. Society has never asked for this knowledge, and has neither significantly encouraged nor paid for its production. By way of contrast, public opinion has supported the costs of high-energy physics as reasonable, even though direct and immediate applications to public problems are relatively few. But public opinion has been guided in part by the judgment of the scientific community and of the leaders of higher education. Only

recently have the scientific community and the universities begun to interest themselves institutionally in man-environment relationships, perceived in the totality in which they occur in real life.

Environmental studies in the universities are as yet largely focused on separate phases of man-environment relationships. This, in itself, is not undesirable; it is in fact necessary to obtain the degree of specialization and intensive study that many environmental problems require. The inadequacy lies in the lack of means to bring together existing specialized knowledge that would be relevant to the establishment of sound policies for the environment. There is also need for greatly increased attention to the study of natural systems, to the behavior of organisms in relation to environmental change, and to the complex and relatively new science of ecology. There is need for synthesis as well as for analysis in the study of man-in-environment.

A reciprocal relationship exists between the interests of public life and the activities of American universities. Public concern with a social problem when expressed in terms of public recognition or financial support, stimulates related research and teaching in the colleges and universities. Research findings and teaching influence the actions of government and the behavior of society. This relationship has been exceptionally fruitful in such fields as agriculture, medicine, and engineering. It has not, as yet, developed strength in the field of environmental policy and management. Nevertheless a beginning is being made in some colleges and universities, and in a number of independent research organizations and foundations, to provide a more adequate informational base for environmental policy.

Recognition of the need for a more adequate informational base for environmental policy has not been confined to academic institutions or to government. Speaking to the 1967 plenary session of the American Institute of Biological Sciences, Douglas L. Brooks, president of the Traveler's Research Center, declared that "*** We need to recognize environmental quality control as a vital social objective and take steps to establish the field of environmental management as a new cross-disciplinary applied science professional activity of extraordinary challenge and importance."

To date, action by Government to assist the marshaling of relevant knowledge has been uncoordinated and inconstant. With the exception of defense and space-related technical investigations, the amount of money made available for environmental research has been relatively meager and has been allocated largely along conventional disciplinary lines. Specialized aspects of research on man-environment relationships have been well funded by the Atomic Energy Commission, the Department of Defense, and the National Aeronautics and Space Administration. But much of this work is highly technical and is appropriately directed toward problems encountered in the missions of these agencies. More broadly based are the interests of the National Science Foundation, but the Foundation's resources for funding academic research relating to environmental policy are small. For a brief period the most promising source of support for the kind of knowledge needed for environmental policy effectiveness was the U.S. Public Health Service. In the mid-1960's, the Service began to assist the establishment of broadly based environmental health science centers in selected universities. But a shift of emphasis in the Public Health Service brought this effort to an untimely standstill. The

National Institutes of Health fund a significant body of health-related environmental research, but little of it appears to be policy-related.

The Science Information Exchange of the Smithsonian Institution, surveying the general field of Government-funded research for the Senate Interior and Insular Affairs Committee, found (not unexpectedly) that there were heavy concentrations of research where Government funding was heaviest—notably in physical science and the biomedical aspects of the environment. Government-funded research of broadly cross-disciplinary or policy-oriented character appeared to be almost negligible in volume and in funding. It is probable that policy problems are investigated in the course of substantive research; but it is evident that we have not yet made a conscious decision to organize and fund the effort which students of environmental policy and management see as the necessary first step to an adequate environmental information system.

To provide facilities and financial support for new research on natural systems, environmental relationships and ecology on an independent, but publicly financed basis, a National Institute of Ecology has been proposed by a group of scientists associated with the Ecological Society of America and assisted by the National Science Foundation. The functions proposed for this institute are worth restating in brief, as indicative of the contribution that ecologists would like to make toward strengthening the Nation's capacity to cope with its environmental problems. Defining ecology to be " * * * the scientific study of life-in-environment," the proponents of a National Institute of Ecology state that it is needed (1) to conduct large-scale multi-disciplinary field research beyond the capacities of individual researchers or research institutions, (2) to provide a central ecological data bank on which ecologists and public agencies can draw, (3) to coordinate and strengthen activities of ecologists in relation to ecological issues in public affairs, and to promote the infusion of ecology into general education at all levels, and (4) to perform advisory services for government and industry on action programs affecting the environment. The principal purpose of the proposed institute is not, however, to study public policy or education, but to do more and better ecology.

These efforts and proposals, and many others unreported here, are constructive contributions to the task of marshaling the knowledge needed for an effective national policy for the environment. They do not, however, add up to a national information system, nor do they necessarily present information and findings relative to the environment in forms suitable for review and decision by the Nation's policy-makers. The ecological research and surveys bill introduced by Senator Gaylord Nelson in the 89th Congress would have established a national research and information system under the direction of the Secretary of the Interior. Similar proposals have been incorporated in a number of bills introduced in the 90th Congress, including S. 2805 by Senators Jackson and Kuchel. (See app. B.) An important difference between the proposals before the 90th Congress and the efforts and proposals described in the preceding paragraphs is that in pending legislation the knowledge assembled through survey and research would be systematically related to official reporting, appraisal, and review. The need for more knowledge has been established beyond doubt. But of equal and perhaps greater importance at this time is

the establishment of a system to insure that existing knowledge and new findings will be organized in a manner suitable for review and decision as matters of public policy.

In summary, to make policy effective through action, a comprehensive system is required for the assembly and reporting of relevant knowledge; and for placing before the President, the Congress, and the people, for public decision, the alternative courses of action that this knowledge suggests. With all its great resources for research, data processing, and information transmittal, the United States has yet to provide the financial support and operational structure that would permit these resources to implement a public policy for the environment.

4. FACILITATING POLICY CHOICE

The problem of organizing information for purposes of policy-oriented review leads directly to the need for a strategy of policy choice. Environmental policymaking presents certain organizational difficulties. It must draw heavily upon scientific information and yet it embraces important considerations and issues that are extraneous to science policy. Insofar as environmental policy is dependent upon scientific information, it is handicapped by the insufficiency of the research effort and the inadequacies of information handling described in the preceding paragraphs. In a review of U.S. science policy by the Organization for Economic Cooperation and Development, the European examiners cited environmental problems as one of the areas of inquiry that American science was not well organized to attack. The criticism was directed not at the accomplishments of American science in support of major technical undertakings; it was instead concerned with the absence of a system and a strategy adequate to deal with the problems of the environment, and of social relationships and behavior, on a scale which their comprehensive and complex subject matters require.

Insofar as science is an element in environmental policymaking, the Office of Science and Technology affords a mechanism for enlisting the resources of the scientific community, for establishing study groups and advisory panels on specific issues, and for presenting their recommendations to the President. In the coordination of scientific aspects of environmental policy, the Federal Council of Science and Technology, in association with the Office of Science and Technology, is the more general of several coordinative or advisory bodies in the executive branch. (See app. C.) The establishment of special councils for marine resources and engineering development, for water resources, for recreation and natural beauty, among other purposes, complicates to some extent the function of policy advice. None of these bodies are constituted to look at man-environment relations as a whole; none provide an overview; none appear fully to answer the need for a system to enable the President, the Congress, and the electorate to consider alternative solutions to environmental problems.

Possible answers to the need for a system to assist national policy choice may be found in legislative proposals to create councils on environmental quality or councils of ecological advisers. These councils are conceived as bridges between the functions of environmental surveillance, research, and analysis, on the one hand, and the policy-making functions of the President and the Congress on the other. The

particular and indispensable contribution of the Council to environmental policy would be twofold. The first would be, using S. 2805 for purposes of illustration, "* * * to study and analyze environmental trends and the factors that effect these trends, relating each area of study and analysis to the conservation, social, economic, and health goals of this Nation." Most proposals call for a report on the state of the environment from the Council to the President and from the President to the Congress. S. 2805, for example, states that the Council shall provide advice and assistance to the President in the formulation of national policies, and that it shall also make information available to the public. The bill further provides that "* * * The Council shall periodically review and appraise new and existing programs and activities carried out directly by Federal agencies or through financial assistance and make recommendations thereon to the President."

From this enumeration of the Council's functions several inferences may be drawn. *First*, the proposed environmental advisory councils are not science advisory bodies. They are instructed in pending legislative proposals to take specified factors, including the scientific, into account in the course of their analysis and recommendations on environmental policy issues. *Second*, the councils are not primarily research or investigating bodies even though they have important investigatory functions. They are essentially policy-facilitating bodies. *Third*, their functions are those of analysis, review, and reporting. Their nearest functional counterpart is probably the Council of Economic Advisers. *Fourth* and finally, councils on the environment, such as proposed by some of the measures listed in appendix B, must be located at the highest political levels if their advisory and coordinative roles are to be played effectively. For this reason the proposals have generally established the Council in the Executive Office of the President. However, the Technology Assessment Board proposed by Representative Emilio Q. Daddario, which would perform many functions similar to those of the environmental councils, would be an independent body responsible primarily to the Congress.

This brings the discussion to the role of the Congress in facilitating policy choice. Some have found the formal committee structure of the Congress to be poorly suited to the consideration of environmental policy questions. Senator Edmund Muskie has proposed a Select Committee of the Senate on Technology and the Human Environment to facilitate consideration of related environmental issues that would normally be divided among a number of Senate committees. Others have proposed that a Joint Committee on the Environment, representative of the principal committees of the House and the Senate concerned with environmental policy issues, should be established to review a proposed annual or biennial report of the President on the state of the environment. Many Congressmen, however, feel that the policy of establishing new committees to deal with each new problem area should be resisted and that the present committees should assume their legislative and oversight responsibilities in this area. Meanwhile the informal and practical operations of legislative business permits the present standing committees to function with remarkable speed and dexterity where the will to legislate exists.

In summary, policy effectiveness on environmental issues will require some form of high-level agency in the executive branch for reviewing and reporting on the state of the environment. No existing

body seems appropriate for this function. To meet this need, and under various names, a council for the environment has been suggested and has been incorporated in numerous legislative proposals. Provision for a policy assisting body in the executive branch suggests to some the desirability of a comparable committee in the Congress.

5. NATIONAL POLICY AND INTERNATIONAL COOPERATION

In his address to the graduating class at Glassboro State College on June 4, 1968, President Lyndon B. Johnson called for the formation of a permanent "international council on the human environment." The ecological research and surveys bill first offered in 1965 by Senator Gaylord Nelson authorized participation by the United States with "other governments and international bodies in environmental research." Similarly, S. 2805 and other pending measures authorize "* * * environmental research in surrounding oceans and in other countries in cooperation with appropriate departments or agencies of such countries or with coordinating international organizations * * *."

These and other expressions of the willingness and intent of the United States to cooperate with other nations and with international organizations on matters of environmental research and policy reinforce the argument for a national environmental policy. Although the United States could cooperate internationally on many specific issues without a national policy, it could do so more effectively and comprehensively if its own general position on environmental policy were formally and publicly enunciated.

The United States, as the greatest user of natural resources and manipulator of nature in all history, has a large and obvious stake in the protection and wise management of man-environment relationships everywhere. Its international interests in the oceanic, polar, and outer space environments are clear. Effective international environmental control would, under most foreseeable contingencies, be in the interest of the United States, and could hardly be prejudicial to the legitimate interests of any nation. American interests and American leadership would, however, be greatly strengthened if the Nation's commitment to a sound environmental policy at home were clear.

PART II

Questions of Implementation

What significance would adoption of a national policy for the environment hold for the future of government in the United States? At the least, it would signify a determination by the American people to assume responsibility for the future management of their environment. It would not imply an all-inclusive Federal or even governmental environmental administration. The task is too widespread, multitudinous, and diverse to be wholly performed by any single agency or instrumentality. There are important roles to be played at every level of government and in many sectors of the nongovernmental economy. Nevertheless a new policy, and particularly a major one, is certain to arouse some apprehensions.

In the Federal agencies, among the committees of the Congress, in State governments, and among businesses whose activities impinge directly upon the environment and natural resources, there would be understandable concern as to what changes for them might be implicit in a national policy for the environment. The objection is certain to be raised that Government is already too large and that there are already too many agencies trying to manage the environment. "Please—not one more," will be an oft-repeated plea. These fears, however, are largely those that always accompany a new public effort regardless of its purpose, direction, or ultimate benefit. Very few people oppose, in principle, public action on behalf of quality in the environment. It is implementation that raises questions and arouses apprehension.

It would be unconvincing to assert that no interest, enterprise, or activity will be adversely affected by a national environmental quality effort. There is no area of public policy that does not impose obligations upon, nor limit the latitude for action of important sectors of society. But while activities harmful to man's needs and enjoyments in the environment must necessarily be curbed, it is also true that all Americans, without exception, would benefit from an effective national environmental policy. In brief, although all would benefit, a relative few might be required to make adjustments in business procedures or in technological applications.

For the foregoing reasons, a report on the need for a national policy for the environment would be incomplete if it did not raise, at least for purposes of discussion, some major questions that the establishment as such a policy would imply. These are mainly questions of how a decision to establish a national policy would be implemented in practice. They are questions to be answered by the Congress and by the President. But in their answers, the policy-determining branches of Government will need to consider a number of issues subsidiary to those major questions.

To better illustrate the issues involved in these questions, reference will be made to S. 2805. No claim of special priority is implied by these references. Many of the bills now pending on this issue have similar provisions. Any one bill might serve as well as any other.

1. WHAT ARE THE DIMENSIONS OF AN ENVIRONMENTAL POLICY AND HOW ARE THEY DISTINGUISHABLE FROM OTHER AREAS OF NATIONAL CONCERN?

This is the fundamental question. It would be unreasonable to expect that its metes and bounds could be defined more clearly than those of the more familiar policy areas of national defense, foreign relations, civil rights, public health, or employment security. The field of definition can be narrowed, however, by identifying those concepts with which it might be confused but from which it should be clearly distinguished.

Environmental policy, broadly construed, is concerned with the maintenance and management of those life-support systems—natural and man made—upon which the health, happiness, economic welfare, and physical survival of human beings depend. (See app. D.) The quality of the environment, in the full and complex meaning of this term, is therefore the subject matter of environmental policy. The term embraces aspects of other areas of related policy or civic action, and it is important that environmental policy and environmental quality, in the broad sense, be distinguished from these related but sometimes dissimilar policies or movements.

Environmental policy should not be confused with efforts to preserve natural or historical aspects of the environment in a perpetually unaltered state. Environmental quality does not mean indiscriminate preservationism, but it does imply a careful examination of alternative means of meeting human needs before sacrificing natural species or environments to other competing demands.

Environmental quality is not identical with any of the several schools of natural resources conservation. A national environmental policy would however, necessarily be concerned with natural resource issues. But the total environmental needs of man—ethical, esthetic, physical, and intellectual, as well as economic—must also be taken into account.

Environmental policy is not merely the application of science and technology to problems of the environment. It includes a broader range of considerations. For this reason S. 2805, in proposing a Council on Environmental Quality, does not stipulate that its five members be scientists, although it obviously would not preclude scientists among them.

One of the few differences in emphasis among the environmental policy bills now before the Congress has to do with the role of ecologists and of the science of ecology in the shaping of national policy. The need for a greatly expanded program of national assistance for ecological research and education cannot be doubted by anyone familiar with present trends in the environment. The science of ecology can provide many of the principal ingredients for the foundation of a national policy for the environment. But national policy for the environment involves more than applied ecology, it embraces more than any one science and more than science in the general sense.

The dimensions of environmental policy are broader than any but the most comprehensive of policy areas. The scope and complexities of environmental policy greatly exceed the range and character of issues considered, for example, by the Council of Economic Advisors. One may therefore conjecture, without derogation to the unquestionable importance of the economic advisory function, that a council

on the environment would, in time, perhaps equal and even exceed in influence and importance any of the specialized conciliar bodies now in existence. For this reason its membership should be broadly representative of the breadth and depth of national interests in man-environment relationships. The ultimate scope of environmental policy, and the relationship of a high-level implementing council to existing councils, commissions, and advisory agencies, are not questions that can be, or need to be, decided now, nor even at the time that a national policy may be adopted. The important consideration is to develop a policy and to provide a means that will permit its objectives to be considered and acted upon by the Congress, the President, and the executive agencies. If we wait until we are certain of the dimensions of environmental policy and of how it will relate to other responsibilities and functions of Government, our assurance will be of no practical value. It will have come too late to be of much help.

2. UPON WHAT CONSIDERATIONS AND VALUES SHOULD A NATIONAL ENVIRONMENTAL POLICY BE BASED?

If it is ethical for man to value his chances for survival, to hope for a decent life for his descendants, to respect the value that other men place upon their lives, and to want to obtain the best that life has to offer without prejudicing equal opportunities for others, then the cornerstone of environmental policy is ethical. That cornerstone is the maintenance of an environment in which human life is not only possible, but may be lived with the fullest possible measures of personal freedom, health, and esthetic satisfaction that can be found. No government is able to guarantee that these values can be realized, but government is able to assist greatly in the maintenance of an environment where such values are at least realizable.

Ethics, like justice, is not easily quantifiable, yet few would argue that society should not seek to establish justice because justice cannot be adequately defined or quantified. Environmental policy is a point at which scientific, humanistic, political, and economic considerations must be weighed, evaluated, and hopefully reconciled. Hard choices are inherent in many policy issues. The sacrifice of a plant or animal species, for example, or of a unique ecosystem ought not to be permitted for reasons of short-run economy, convenience, or expediency. The philosophy of reverence for life would be an appropriate guiding ethic for a policy that must at times lead to a decision as to which of two forms of life must give way to a larger purpose.

The natural environment has been basically "friendly" toward man. Man's survival is dependent on the maintenance of this environment, but not upon the unaltered operation of all of its myriad components. Pathogenic micro-organisms, for example, are not revered by man. Protection against them is a major task of environmental health and medicine. But even here, respect for the incredible variety, resilience, and complexity of nature is a value that environmental policy would be wise to conserve. Frontal attacks upon man's environmental enemies or competitors, identified as pathogens or as "pests," have miscarried too often to encourage the thought that direct action on threats in the environment are always wise, economical, or effective.

The range of values to be served by environmental policy is broad and an indication of how its scope might be defined may be obtained from the provisions of S. 2805 which specify the considerations to which the Council on Environmental Quality should respond: "Each member shall, as a result of training, experience, or attainments, be professionally qualified to analyze and interpret environmental trends of all kinds and descriptions and shall be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of this Nation."

The assessment and interpretation of these needs and interests is obviously a function that the members of the Council would have to perform to the best of their ability. No more than in the election of legislators or in the appointment of judges, would it be possible to stipulate how these or other values should be understood and weighted. The reputations and characters of the individuals appointed to the Council would offer the best indication of how the specifications of the law might be construed. But the findings and conclusions of the Council need not be wholly subjective or based upon speculative data. The methods of systems analysis, cybernetics, telemetry, photogrammetry, electronic and satellite surveillance, and computer technology are now being applied to a wide range of environmental relationships. New statistical and computerized simulation techniques are rapidly bringing ecology from what has been described as "one of the most unsophisticated of the sciences," to what may become one of the most complex, intellectually demanding, and conceptually powerful of the sciences.

In brief, the values and considerations upon which a national environmental policy should be based should be no less extensive than the values and considerations that men seek to realize in the environment. In the interpretation of these values and considerations science can play a role of great importance. But neither science, nor any other field of knowledge or experience, can provide all of the criteria upon which environmental policies are based. The full range of knowledge and the contributions of all of the scientific and humanistic disciplines afford the informational background against which value judgments on environmental policy may most wisely be made.

3. HOW SHOULD THE INFORMATION NEEDED FOR A NATIONAL ENVIRONMENTAL POLICY BE OBTAINED AND UTILIZED?

Of all major questions on the implementation of environmental policy, this one is probably the least difficult. It is in part a technical question; yet to describe it as technical is not to suggest that it can be easily answered. There is no present system for bringing together, analyzing, collating, digesting, interpreting, and disseminating existing information on the environment. There is accordingly no reliable way of ascertaining what aspects of man-environment relationships are unresearched or hitherto unidentified. The question is less difficult than others primarily because it is clearly possible to design an information system, to fund its implementation, and to put it into effect. The particular form in which the data should finally appear, and the method of its subsequent disposition are more problematic.

Title I of S. 2805, and other measures proposed on behalf of a national environmental policy, make provision for the functions of information gathering, storage and retrieval, dissemination, and for

enlarging the available information through assistance to research and training. The detailed provisions of S. 2805 on an environmental information system are numerous and need not be repeated here. The significant feature of these provisions is that they create an information system designed and intended to serve the policymaking processes of government.

Most of the environmental quality bills place this information function under the direction of the Secretary of the Interior. But they relate its data-gathering functions to those of other Federal agencies and they provide for the transmittal of its findings to a high-level reviewing body and to the President and the Congress. In the provision for organizing environmental information into a form that is usable for policy formation, this proposal represents a step toward greater rationality in government and toward the more effective use of modern information systems and technology to serve public purposes.

4. HOW SHOULD A NATIONAL ENVIRONMENTAL POLICY BE IMPLEMENTED AND PERIODICALLY REVIEWED FOR REFINEMENT OR REVISION?

Some innovation and restructuring of policy-forming institutions will be required to achieve the purposes of a national environmental policy. Our present governmental organization has not been designed to deal with environmental policy in any basic or coherent manner. (See app. C.) The extent to which governmental reorganization may be necessary cannot be determined absolutely in advance of experience. But it does seem probable that some new facility at the highest levels of policy formulation will be needed to provide a point at which environmental policy issues cutting across the jurisdictional lines of existing agencies can be identified and analyzed, and at which the complex problems involved in man's relationships with his environment can be reduced to questions and issues capable of being studied, debated, and acted upon by the President, the Congress, and the American people. As we have seen, some of the bills on environmental policy now pending in the Senate and the House of Representatives (see app. B) provide a point of focus for this new area of policy through a high-level board or council. Many of these bills provide for periodic reports on the state of the environment to the policy-determining institutions of the Nation—the President and the Congress—and, as these reports are matters of public record, to the American people who must be the final judges of the level of environmental quality they are willing to support.

As noted in the preceding paragraphs, improved facilities for the finding, analysis and presentation of pertinent factual data are needed. A vast amount of data is now collected by Federal agencies and by private research organizations; but this data is uneven in its coverage of the various aspects of environmental policy. For example, there is a superabundance of technical information on some aspects of environmental pollution, but comparatively little research on the social and political aspects of environmental policy. Much of the data now available is in a form unsuitable for policy purposes. The sheer mass of data, much of it highly technical on certain major environmental problems, is a serious impediment to its use. For this reason the legislative proposals on national environmental policy provide a

system for reinforcing, supplementing, and correlating the flow of information on the state of the environment.

These two major needs, (a) a high-level reviewing and reporting agency and (b) an information gathering and organizing system, are the essential structural innovations proposed in bills now before the Congress for implementing a national environmental policy. Would these additions to the present structure of government be sufficient to implement a national environmental quality program and how in particular would the proposed high-level Council be related to other agencies in the federal structure of government?

New policies and programs imply structures appropriate to their functions and may call for new relationships among existing agencies. To construct a comprehensive structure for environmental administration will require time, and meanwhile the need for leadership in informing the people and in formulating policy recommendations and alternatives grows more urgent. It is for this reason that some of the measures which have been introduced propose that a Council for Environmental Quality be established in the Executive Office of the President. In effect, the Council would be acting as agent for the President. It would need information from the various Federal departments, commissions, and independent agencies that, under prevailing organization, it could not as easily obtain if it were located at a level coequal or subordinate to the divisions of Government whose programs it must review. Reinforcing this consideration is the distribution of environment-affecting activities among almost every Federal agency.

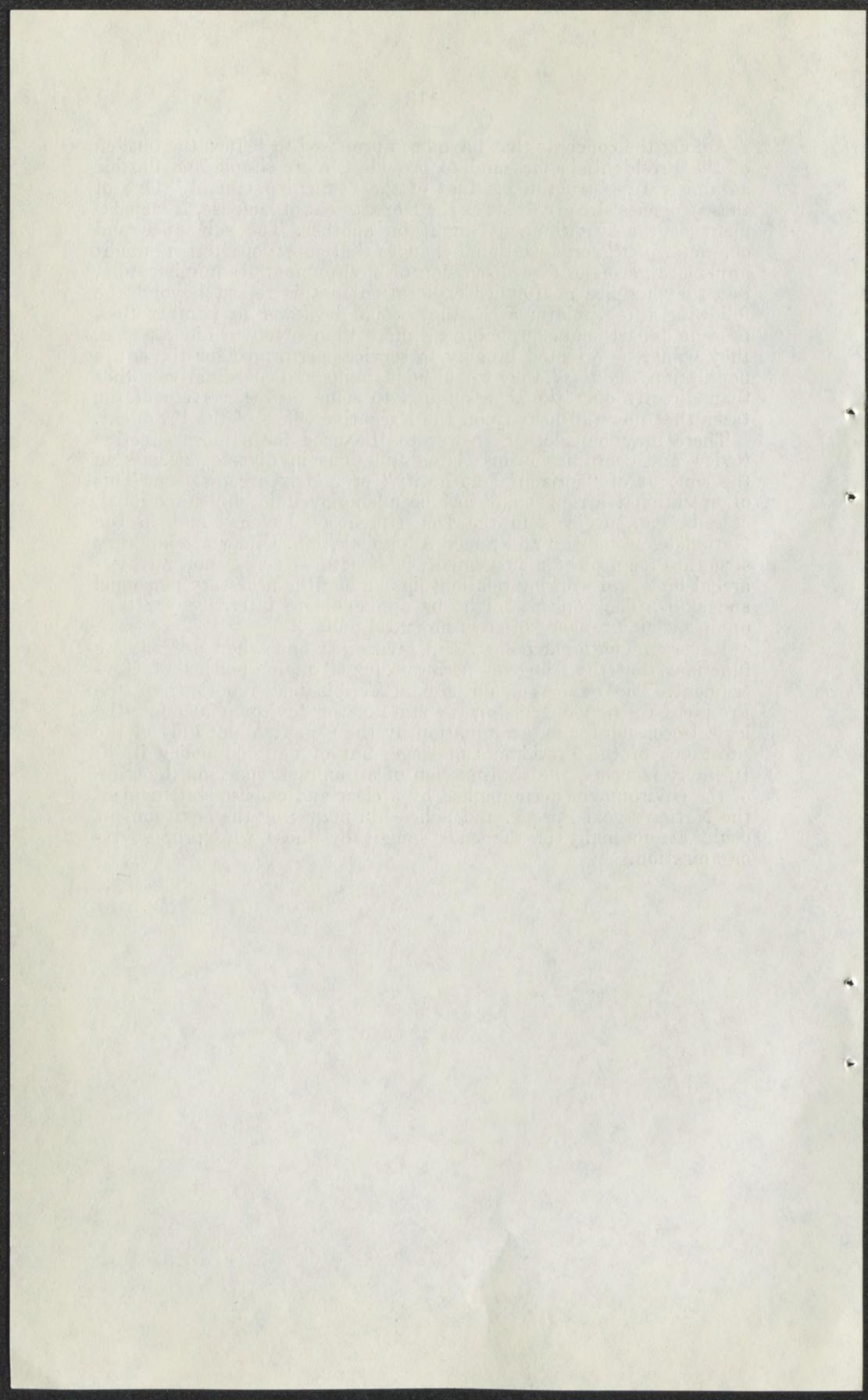
Objection may be raised that there are already too many councils and committees established in the Executive Office of the President. Some students of public administration argue that a simplification of structure and a clarification of existing responsibilities should take precedent over any new programs or agencies. The answer to this objection lies in an assessment of relative priorities. Is each of the councils or comparable agencies now established in the Executive Office of the President more important, of greater urgency, or of more direct bearing upon the public welfare, than the proposed Council on Environmental Quality? What criteria indicate how many conciliar bodies are "too many"? These questions are not merely rhetorical. Although they cannot be answered here, they are obviously germane to the issue of governmental organization and to the way in which national environmental policy is formulated and made effective.

A strong case can be made of a major restructuring of the Federal departments in which public responsibility for the quality of the environment would, like defense or foreign relations, become a major focus for public policy. Proposals tending in this direction and chiefly affecting the Department of the Interior have been made over several decades. A prominent news magazine took up this line of reasoning in a recent editorial declaring that " * * * the Secretary of the Interior ought to be the Secretary of the Environment." But a major restructuring of functions in the Federal administrative establishment cannot be accomplished easily or rapidly. Such a development would be most plausible as a part of a more general restructuring of the executive branch. The multiplication of high-level councils and interagency committees may indicate that a restructuring is needed. (See app. C.) Some of the complexity of present arrangements for policy formulation and review reflects the confusion often attending a transition from one set of organizing concepts to another.

Among the concepts that have been proposed to reduce the burden of the Presidential office and to provide a more simple and flexible administrative structure, is that of the "superdepartment." One of these agencies already exists as the Department of Defense. A Department of the Environment might be another. The substance and character of the organizational changes that superdepartments might imply are germane to a discussion of environmental administration, but they require no further exploration in this report beyond the following three points: *First*, they would be fewer in number than present departments, probably no more than seven to nine; *second*, they would be oriented broadly to services performed for the entire population, and *third*, they would be planning and coordinative rather than directly operational, assuming, to some degree, certain of the tasks that now fall heavily on the Executive Office of the President.

There may be another answer to the need for a more effective review and coordination of related functions in diverse agencies in the concept of "horizontal authority" or matrix organization. This organizational arrangement has been employed in multifunctional, cross-bureau, projects in the Department of Defense and in the National Aeronautics and Space Administration. Under a temporary structure for project management, it structures across normal hierarchical lines and working relationships among the necessary personnel and skills. The concept might be applicable to interagency attack upon specific problems of environmental policy.

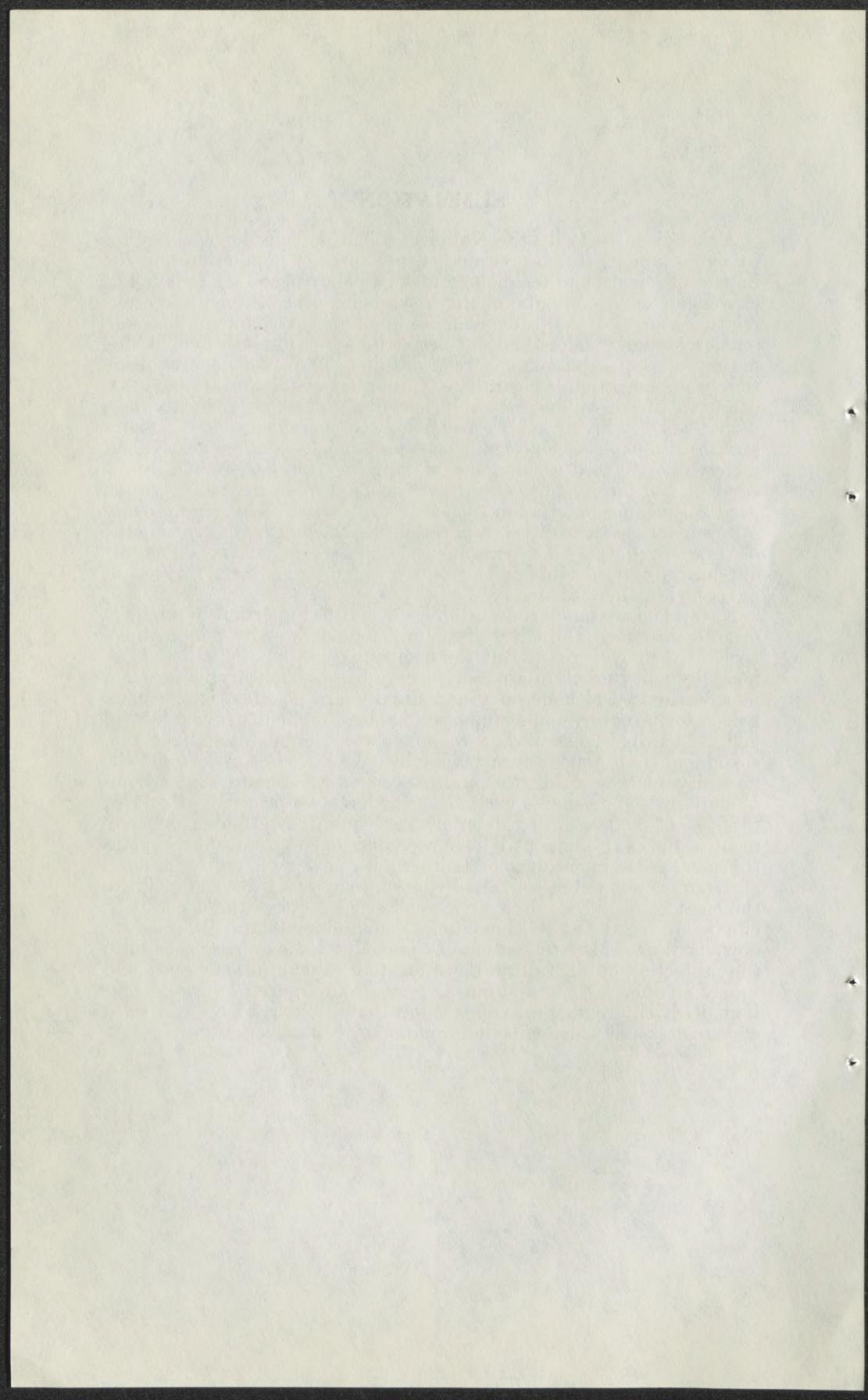
Review of national policy, and revision if and when needed, are functions that the Congress performs for all major policies of Government. The device of an annual or biennial report from the President to the Congress on the state of the environment offers the logical occasion for an examination by the Congress, not only of the substance of the President's message, but of national policy itself. In many respects, the transmission of an annual report on the state of the environment accompanied by a clear and concise statement of the Nation's goals, needs, and policies in managing the environment could attain many of the ends sought by those who propose reorganization.



SUMMATION

Although historically the Nation has had no considered policy for its environment, the unprecedented pressures of population and the impact of science and technology make a policy necessary today. The expression "environmental quality" symbolizes the complex and inter-relating aspects of man's dependence upon his environment. Through science, we now understand, far better than our forebears could, the nature of man-environment relationships. The evidence requiring timely public action is clear. The Nation has overdrawn its bank account in life-sustaining natural elements. For these elements—air, water, soil, and living space—technology at present provides no substitutes. Past neglect and carelessness are now costing us dearly, not merely in opportunities foregone, in impairment of health, and in discomfort and inconvenience, but in a demand upon tax dollars, upon personal incomes, and upon corporate earnings. The longer we delay meeting our environmental responsibilities, the longer the growing list of "interest charges" in environmental deterioration will run. The cost of remedial action and of getting onto a sound basis for the future will never be less than it is today.

Natural beauty and urban esthetics would be important byproducts of an environmental quality program. They are worthy public objectives in their own right. But the compelling reasons for an environmental quality program are more deeply based. The survival of man, in a world in which decency and dignity are possible, is the basic reason for bringing man's impact on his environment under informed and responsible control. The economic costs of maintaining a life-sustaining environment are unavoidable. We have not understood the necessity for respecting the limited capacities of nature in accommodating itself to man's exactions, nor have we properly calculated the cost of adaptation to deteriorating conditions. In our management of the environment we have exceeded its adaptive and recuperative powers and in one form or another must now pay directly the costs of obtaining air, water, soil, and living space in quantities and qualities sufficient to our needs. Economic good sense requires the declaration of a policy and the establishment of an environmental quality program now. Today we have the option of channeling some of our wealth into the protection of our future. If we fail to do this in an adequate and timely manner we may find ourselves confronted, even in this generation, with environmental catastrophe that could render our wealth meaningless and which no amount of money could ever cure.



APPENDIXES

APPENDIX A

DOCUMENTATION ON ENVIRONMENTAL PROBLEMS

Following is a partial listing of recent writings on environmental problems subdivided under five headings: (1) "Technical Reports," (2) "Conferences and Symposiums," (3) "Journals," (4) "News Articles and Speeches," and (5) "Books, Yearbooks, and Pamphlets."

PART I.—TECHNICAL REPORTS

- The Adequacy of Technology for Pollution Abatement.* Report of the Research Management Panel through the Subcommittee on Science Research, and Development to the Committee on Science and Astronautics. U.S. House of Representatives, 89th Congress, 2d session. Washington, 1966.
- Air Pollution: A National Sample.* U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 1562.
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- Effective Use of the Sea.* Report of the President's Science Advisory Committee.
- Energy R. & D. and National Progress.* An interdepartmental study. (The President designated the Director of the Office of Science and Technology and the Chairman of Economic Advisers as Chairman and Vice Chairman of the Steering Committee.)
- Environmental Improvement: Air, Water and Soil.* Department of Agriculture Graduate School.
- Environmental Pollution: A Challenge to Science and Technology.* Report of the Subcommittee on Science, Research, and Development to the Committee on Science and Astronautics. U.S. House of Representatives, 89th Congress, 2d session. Serial 8. Washington, 1966.
- Municipal Refuse Disposal.* Prepared by the American Public Works Association, Public Administration Service, Chicago, 1966.
- Interagency Environmental Hazards Coordination: Pesticides and Public Policy.* Report of the Committee on Government Operations, U.S. Senate, made by its Subcommittee on Reorganization and International Organizations. July 21, 1966. Government Printing Office, Washington, D.C.
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- Report of the Committee on Environmental Health Problems.* Report of the Subcommittee on Air Pollution. U.S. Department of Health, Education, and Welfare, Public Health Service Publication No. 908, 1962, pp. 65-96.
- Restoring the Quality of our Environment.* Report of the Environmental Pollution Panel, President's Science Advisory Committee, The White House. November 1965.
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- Securing Health in Our Urban Future.* Report to the Surgeon General, Public Health Service, by his Advisory Committee on Urban Health Affairs.
- A Strategy for a Livable Environment.* Report to the Secretary of Health, Education, and Welfare by a Task Force on Environmental Health and Related Problems.
- Use of Pesticides.* Report of the President's Science Advisory Committee.
- Waste Management and Control.* National Academy of Sciences-National Research Council. Publication 1400, 1966.
- Weather and Climate Modification.* Report of the Special Commission on Weather Modification, National Science Foundation.
- Weather and Climate Modification Problems and Prospects.* Report of the National Academy of Sciences-National Research Council.

PART 2—CONFERENCES AND SYMPOSIUMS

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APPENDIX B

ENVIRONMENTAL LEGISLATION INTRODUCED IN THE 90TH CONGRESS

The two problems—one with respect to national environmental (or resource) policy and the other regarding executive organization—have been the subjects of a large body of proposed legislation. In the 86th Congress, Senator James E. Murray proposed S. 2549 which called for the establishment of a Council of Resource and Conservation Advisers in the Office of the President. Similar or related bills have been introduced in subsequent Congresses. A partial list of bills introduced in the 90th Congress is given below:

SENATE

- S. 843. Mr. Mondale and others. February 6, 1967. Government Operations.
- Full Opportunity and Social Accounting Act: Establishes a Council of Social Advisers, and directs it to compile and analyze social statistics, devise a system of social indicators, help develop program priorities, evaluate the effectiveness and impact of our efforts at all levels of government, and advise the President in the establishment of national social policies.
- Requires the President to transmit to Congress an annual report on the state of the Nation's social health, specifying progress made, listing goals for the future and specifying policies for achieving these objectives.
- Provides for a joint committee of Congress to review the President's annual report on the state of our social health, just as the Joint Economic Committee exercises oversight responsibility in economic matters.
- S. 886. Mr. Moss and others. February 7, 1967. Government Operations.
- Department of Natural Resources Act: Redesignates the Department of the Interior as the Department of Natural Resources. Transfers various departments from the Department of the Interior and others to the Department of Natural Resources.
- S. 1305. Mr. Allott and others. March 15, 1967. Labor and Public Welfare.
- Provides that the President shall transmit to the Congress by January 20, of each year, a report on science and technology which shall set forth (1) the existing major policies of both Federal and non-Federal research organizations, (2) the impact of major developments of science in the progress of such programs, (3) major goals of the Federal Government and of private research organizations, (4) financial information on the funding of science and research projects across the Nation, and (5) his recommendations for necessary legislation.
- Establishes a Joint Committee on Science and Technology composed of eight Members of the Senate appointed by the President of the Senate and eight Members of the House, appointed by the Speaker, to assist the President by holding hearings and collecting relevant data, in the compilation of material for the report.

S. 1347. Mr. Javits. March 21, 1967. Labor and Public Welfare.

Establish a 12-member Federal Council of Health within the Executive Office of the President, appointed by the President for 3-year terms to (1) make recommendations and continuous evaluation of policies and programs related to the Nation's health, including disaster planning, (2) initiate study and develop measures designed to assure the provision of adequate health manpower, services, and facilities and to moderate the rising trend in the cost of medical care, and (3) to advise and consult with Federal departments and agencies, including the Budget Bureau, on policies and programs concerned with health services, manpower, and facilities.

S. 2789. Mr. Nelson. December 14, 1967. Interior and Insular Affairs.

Authorizes the Secretary of the Interior to conduct a program of research, study and surveys, documentation and description of natural environmental systems of the United States for the purposes of understanding and evaluating the condition of these systems and to provide information to those concerned with natural resources management. Authorizes the establishment of an advisory committee.

S. 2805. Messrs. Jackson and Kuchel. December 15, 1967. Interior and Insular Affairs.

Authorizes the Secretary of the Interior to conduct investigations, studies, surveys, and research relating to the Nation's ecological systems, natural resources, and environmental quality. Establishes a Council on Environmental Quality.

S. 3031. Mr. Nelson. February 26, 1968. Public Works.

Requires the President to make an annual environmental quality report to Congress and provides that the report set forth (1) the status and condition of the major natural, manmade, or altered environmental systems of the Nation, and (2) the current and foreseeable trends in management and utilization of such environments and the effect of those trends on the social, economic, and other requirements of the Nation.

Creates a five-member Council on Environmental Quality, members to be appointed by the President and by and with the advice and consent of the Senate, in the Executive Office of the President and directs it to oversee the program of the Federal, State, and local governments to (1) determine to what extent these activities are contributing to the achievement of environmental quality and (2) gather, analyze, and interpret conditions and trends in environmental quality.

Provides that the principal task of the Council be to develop within a 5-year period comprehensive national policies and programs to improve and maintain the quality of our environment.

S. Res. 68. Mr. Muskie and others. January 25, 1967. Government Operations.

Provides for the establishment of a Select Committee on Technology and Human Environment.

HOUSE

H.R. 258. Mr. Bennett. January 10, 1967. Interior and Insular Affairs.

Authorizes the Secretary of the Interior to conduct a program of research, study and surveys, documentation, and description of the natural environmental systems of the United States for the purposes of understanding and evaluating the condition of these systems and to provide information to those concerned with natural resources management. Authorizes the establishment of advisory committees.

H.R. 3753. Mr. Dingell. January 25, 1967. Government Operations.

Consolidates water quality management and pollution control authorities and functions in the Secretary of the Interior who shall administer such functions through the Federal Water Pollution Control Administration.

H.R. 4480. Mr. Hathaway. February 1, 1967. Government Operations.

Marine and Atmospheric Affairs Coordination Act: Establishes an Executive Department of Marine and Atmospheric Affairs headed by a Secretary appointed by the President with the advice and consent of the Senate. Provides for the appointment of an Under Secretary and three Assistant Secretaries in the same manner.

Transfers to the Department of Marine and Atmospheric Affairs the functions of the major Government agencies concerned with marine and atmospheric affairs.

Establishes as a function of the Department a new coordinating Office of Marine Geology and Mineral Resources.

Establishes a Joint Committee of Congress for Marine and Atmospheric Affairs to carry out the policies outlined in the act.

H.R. 4893. Mr. Moss. February 6, 1967. Government Operations.

Consolidates water quality management and pollution control authorities and functions in the Secretary of the Interior who shall administer such functions through the Federal Water Pollution Control Administration.

H.R. 6698. Mr. Daddario. March 7, 1967. Science and Astronautics.

Creates a five-member Technology Assessment Board whose members shall be appointed by the President.

Gives the Board the duty of (1) identifying the potentials of applied research and technology and promoting ways and means to accomplish their transfer into practical use, and (2) identifying the undesirable byproducts of such research and technology, in advance, and informing the public of their potential in order to eliminate or minimize them.

Provides for a 12-member General Advisory Council to advise the Board, and provides that the Council members be appointed by the President.

H.R. 7796. Mr. Dingell. March 23, 1967. Interior and Insular Affairs; rereferred to Science and Astronautics, April 17, 1967.

Directs the President to submit to Congress beginning June 30, 1968, an annual environmental quality report setting forth the status and condition of the major natural, manmade, or altered environmental classes of the Nation, with a view toward improving man's living conditions.

Creates a three-member Council on Environmental Quality, appointed by the President, to assist in the compilation, coordination, and preparation of environmental data for the report, together with its recommendations for development and improvement of the Nation's environment.

H.R. 8601. Mr. Blatnik. April 17, 1967. Interstate and Foreign Commerce.

Provides for the establishment of regional airshed quality commissions and airshed quality regions when so requested by a Governor of one of two or more contiguous States, and when it is found that there is a threatening air pollution situation in such States, an adequate abatement program does not exist, and that action is necessary to protect the public health. Makes provisions for administration of the airshed quality regions and the commission's duties.

Creates a Federal Air Quality Improvement Administration to administer the provisions of this act and the Solid Waste Disposal Act. Provides that the head of this Administration be appointed by the Secretary of HEW, and provides for the appointment of an additional Assistant Secretary of HEW who shall assist the Secretary in supervising the Federal Air Quality Improvement Administration.

H.R. 10261 Mr. Ottinger. May 23, 1967. Government Operations.

Establishes a Council of Social Advisers, and directs it to compile and analyze social statistics, devise a system of social indicators, help develop program priorities, evaluate the effectiveness and impact of our efforts at all levels of government, and advise the President in the establishment of national social policies.

Requires the President to transmit to Congress an annual report on the State of the Nation's social health, specifying progress made, listing goals for the future, and specifying policies for achieving these objectives.

Provides for a joint committee of Congress to review the President's annual report on the state of our social health, just as the Joint Economic Committee exercises oversight responsibility in economic matters.

H.R. 13211. Mr. Tunney. September 28, 1967. Science and Astronautics.

Creates in the Executive Office of the President a Council of Ecological Advisers composed of nine members to be appointed by the President by and with the advice and consent of the Senate. Directs the Council to study the national environment and national ecology of the Nation and report to the President. Grants it necessary powers.

H.R. 15614. Mr. Rosenthal. February 27, 1968. Government Operations.

Establishes within the executive department a Department of Health to be headed by a Secretary of Health who should be appointed by the President by and with the advice and consent of the Senate. Provides for the appointment of five Assistant Secretaries and a General Counsel to be appointed by the President

by and with the advice and consent of the Senate. Transfers to the new Department are the U.S. Public Health Service, the Vocational Rehabilitation Administration, and St. Elizabeths Hospital.

H. Con. Res. 307. Mr. St. Onge. April 6, 1967. Rules.

Establishes a 10-member joint congressional committee to study all the problems involved in the extraordinary pollution of air and the navigable waters of the United States, including the Atlantic and Pacific Oceans and the Gulf of Mexico, by the extraction, manufacture, transportation, or storage of substances harmful to human, animal, or plant life.

H.J. Res. 1321. Mr. Ottinger. June 13, 1968. Judiciary.

Amends the Constitution by adding a "conservation bill of rights" asserting the "right of the people to clean air, pure water, freedom from excessive and unnecessary noise, and the natural, scenic, historic and esthetic qualities of their environment."

APPENDIX C

FEDERAL ADMINISTRATION OF ENVIRONMENTAL PROGRAMS

The Federal offices, agencies and committees listed below contribute a substantial share of their time and operating effort to administration and study of environment-oriented programs.

1. FEDERAL AGENCIES

Department of Agriculture:

Secretary.

Under Secretary.

Agricultural Stabilization and Conservation Service.
Farmers Home Administration.
Rural Community Development Service.
Forest Service.
Soil Conservation Service.
International Agricultural Development Service.
Agricultural Stabilization and Conservation Service.
Agricultural Research Service.
Cooperative State Research Service.
Federal Extension Service.

Department of Commerce:

Secretary.

Under Secretary.

Assistant Secretary for Science and Technology.
Environmental Science Service Administration.
Environmental Data Service.
Weather Bureau.
Institutes for Environmental Research.
National Environmental Satellite Center.
Coast and Geodetic Survey.

Department of Defense:

Secretary.

Corps of Engineers.

Department of Health, Education, and Welfare:¹

Secretary.

Under Secretary.

Public Health Service.
Office of the Surgeon General.
Bureau of Disease Prevention and Environmental Control.
National Institutes of Health.
National Center for Air Pollution Control.
National Center for Urban and Industrial Waste.
National Environmental Sciences Center.
Food and Drug Administration.

¹ Currently reorganizing.

Department of Housing and Urban Development:

Secretary.

Under Secretary.

Assistant Secretary for Metropolitan Development.

Deputy Assistant Secretary.

Land and Facilities Development Administration.

Urban Transportation Administration.

Office of Planning Standards and Coordination.

Department of the Interior:

Secretary.

Under Secretary.

Office of the Science Adviser.

Office of Ecology.

Office of Water Resources Research.

Assistant Secretary.

Fish and Wildlife and Parks.

Commissioner of Fish and Wildlife.

Bureau of Commercial Fisheries.

Bureau of Sport Fisheries and Wildlife.

National Park Service.

Assistant Secretary of Mineral Resources.

Office of Oil and Gas.

Office of Mineral and Solid Fuels.

Office of Coal Research.

Bureau of Mines.

Geological Survey.

Assistant Secretary of Public Land Management.

Bureau of Indian Affairs.

Bureau of Land Management.

Bureau of Outdoor Recreation.

Assistant Secretary of Water and Power Development.

Bureau of Reclamation.

Bonneville Power Administration.

Southeastern Power Administration.

Southwestern Power Administration.

Assistant Secretary of Water Pollution Control.

Office of Saline Water.

Federal Water Pollution Control Administration.

Department of Justice:

The Attorney General.

The Deputy Attorney General.

Land and Natural Resources Division.

Department of State:

International Boundary and Water Commission—United States and Mexico.

International Scientific and Technical Affairs.

Agency for International Development.

International Joint Commission—United States and Canada.

Department of Transportation:

Secretary.

Under Secretary.

Transportation Policy Council.

Federal Aviation Administration.

Federal Highway Administration.

Federal Railroad Administration.

Office of High Speed Ground Transportation.

Coast Guard.

Executive Office of the President:

The President.

Bureau of the Budget.

Council of Economic Advisers.

Federal Committee on the Economic Impact of Pollution Abatement.

Office of Science and Technology.

President's Science Advisory Committee.

Panel on the Environment.

Federal Council for Science and Technology.

Committee on Environmental Quality.

Committee on Water Resources Research.

Executive Office of the President—Continued

The President—Continued

President's Council on Recreation and Natural Beauty.

National Council on Marine Resources and Engineering Development.

Independent agencies:

Atomic Energy Commission.

Civil Aeronautics Board.

Federal Power Commission.

National Aeronautics and Space Administration.

National Science Foundation.

Tennessee Valley Authority.

Water Resources Council.

Appalachian Regional Commission.

Delaware River Basin Commission.

Smithsonian Institution.

2. QUASIGOVERNMENTAL BODIES

National Academy of Sciences-National Academy of Engineering-National Research Council:

Environmental Studies Board: Oversees all environmental quality studies of the NAS, NAE, and NRC. Provides a forum for development and exchange of new ideas and their application to environmental problems.

Committee on Persistent Pesticides.

Committee on Resources and Man.

Committee on Agricultural Land Use and Wildlife Resources.

U.S. National Committee for the International Biological Program.

Agricultural Board.

Committee on Solid Wastes Management.

Committee on Air Pollution.

Committee on Water Quality Management.

Committee on Remote Sensing of the Environment.

Committee Advisory to the Environmental Science Services Administration.

Committee for the Development of Criteria for Nonrail Transit Vehicles.

Committee on Environmental Physiology.

Committee on Water.

Advisory Committee to the Federal Radiation Council.

Building Research Advisory Board.

Committee on SST-Sonic Boom.

Committee on Ocean Engineering.

Committee on Geography.

Committee on Toxicology and the Advisory Center on Toxicology.

Committee on Hazardous Materials.

Ad Hoc Committee on Human Factors in Environmental Change.

Committee on Urban Technology and Committee on Social and Behavioral Urban Research.

Highway Research Board.

Committee on Hearing, Bioacoustics, and Biomechanics.

3. INTERAGENCY COMMITTEES

Source: Federal Council on Science and Technology:

Interdepartmental Committee for Atmospheric Sciences.

Committee on Environmental Quality.

Committee on Scientific and Technical Information.

Committee on Solid Earth Sciences.

Committee on Water Resources Research.

Interagency Committee on Meteorological Services and Interagency Committee on Applied Meteorological Research.

Federal Committee on Pest Control.

Armed Forces Pest Control Board.

Interagency Aircraft Noise Abatement Advisory Committee.

Federal Advisory Committee on Water Data.

Interagency Committee on Coordination of Sewer and Water Programs.

Steering Committee: United States-German Cooperative Program in Natural Resources, Pollution Control and Urban Development.

APPENDIX D

The following is a draft resolution on a National policy for the environment. The purpose of including the resolution is to illustrate what a national policy for the environment might be, were the Congress to adopt a statement of intent and purpose. The resolution does not explain why such a policy has become necessary at this time; it does not specify means by which the policy might be made effective, nor does it identify the questions of organization and procedure that would be encountered in implementation.

A DRAFT RESOLUTION ON A NATIONAL POLICY FOR THE ENVIRONMENT

The Congress of the United States, acting under the authority of the Constitution and in accordance with its explicit intent to " * * * establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and our posterity * * *" finds that establishment of a national policy for the environment has become necessary.

The Congress finds that the domestic tranquility, the national security, and the general welfare of the United States are threatened by an unprecedented, swift, and pervasive deterioration of the American environment, and that the blessings of liberty to Americans today and to their posterity are threatened by the decay of cities, by the pollution of air, water, and soil, and by the misuse of land and living space in ways that are destructive to economic productivity and to esthetic satisfaction.

Therefore, to insure the tranquility, security, and welfare of the American people, in pursuance of their health, happiness, and prosperity, and in support of their readiness to cooperate with all other peoples and nations in the protection of mankind's common heritage in the life-sustaining environment of the earth, the Congress adopts the following statement of purpose:

It is the intent of the Congress that the policies, programs, and public laws of the United States be interpreted and administered in a manner protective of the total needs of man in the environment. To this end, the Congress proposes that appropriate legislation be adopted and, where necessary that administrative arrangements be established to make effective the following objectives of national policy for the environment:

- (1) To arrest the deterioration of the environment.
 - (2) To restore and revitalize damaged areas of our Nation so that they may once again be productive of economic wealth and spiritual satisfaction.
 - (3) To find alternatives and procedures which will minimize and prevent future hazards in the use of environment-shaping technologies, old and new.
 - (4) To provide direction and, if necessary, new institutions and new technologies designed to optimize man-environment relationships and to minimized future costs in the management of the environment.
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Appendix B

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APPENDIX II

DEPARTMENT OF AGRICULTURE,
Washington, D.C., August 16, 1968.

HON. HENRY M. JACKSON,
U.S. Senate.

HON. GEORGE P. MILLER,
House of Representatives.

DEAR SENATOR JACKSON AND MR. MILLER: Thank you for your letter of July 24 concerning the Joint House-Senate Colloquium on a National Policy for the Environment. In our opinion the meeting was an excellent beginning point of high level discussion in this area of important national concern.

We are anxious to work with you and your staffs to further examine the necessary elements of a sound National Policy for the Environment. As you suggest we will submit to your staff people within a few days a concise statement as to the pattern structured within this Department for dealing with our many missions and programs that have a distinct bearing on managing the environment.

Since the July 17 meeting we have enjoyed excellent cooperation with your staff members. A copy of the transcript of the meeting has been provided to us for review and comment and we are returning it to Mr. William VanNess with our suggested revisions. As was requested, we are supplying your staffs with a set of U.S.D.A. publications dealing with various aspects of managing the environment for their reference. In addition we are pulling together a selected bibliography of printed material on this broad subject from various sources. Copies of this bibliography will be provided your staffs soon.

Your joint efforts in the interest of enhancing our national environment are to be commended, indeed. We look forward to working closely with you in arriving at a workable policy to the future efforts this nation must pursue to adequately safeguard the environment for the good of all Americans.

Sincerely,

JOHN A. BAKER,
Assistant Secretary.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D.C., March 19, 1968.

SECRETARY'S MEMORANDUM NO. 1631—ENHANCING THE QUALITY OF THE ENVIRONMENT

Basic considerations.—Environment describes the living conditions for people. Other forms of life that share the earth are a part of that environment. Enhancing the quality of man's environment in harmony with the productive use of our physical, biological, social, and economic resources is of direct concern to and is a major responsibility of the United States Department of Agriculture.

The Department, in cooperation with other agencies, is committed to improving, protecting, and restoring environmental values in the face of unprecedented demands being made on these values by modern society. Degradation of the environment, either rural or urban, can harm man, and other animal and plant life.

Rural challenge.—Rural resources, for which the Department has the major responsibility, yield food, feed, fiber, forest products, and water for the Nation. They are basic to increasing and maintaining the incomes of farm and other rural people. Rural areas provide the locale of outdoor recreation and natural beauty for the enjoyment of everyone, and they offer opportunities for the growth of Communities of Tomorrow where people may live, work, and play in a healthy, attractive, prosperous, and vigorous environment.

In fulfilling its responsibilities, the Department shall conduct its activities in a manner that enhances the quality of our total environment. To carry out this over-all commitment, the Department will intensify research, regulation, education, and action programs into a total systems approach to carry out environmental objectives. It will emphasize and give priority to those opportunities that contribute most to the improvement of the quality of the environment of the American people such as:

1. Reduction of the Damages and Losses from Pollution to soil, water, and air by agricultural chemicals, crop, livestock, and forestry wastes, sediment, sewage, and mining operations. The Department will continue to work with other Federal, State, and local agencies to minimize air and water pollution from urban and industrial sources.

2. Revitalizing Rural Communities through effective, balanced use of human talents and natural and economic resources to achieve more jobs, with more income for more people. The goal is to build Communities of Tomorrow that can reverse the present trend toward metropolitan congestion and help attain a rural-urban balance in which man can live in harmony with his environment.

3. Maintaining and Improving the Quality of Rural Living as an attractive, healthful place to live, through increased assistance providing equally to all people the services and amenities of contemporary life—such as housing, water supply, waste disposal, power, communication, transportation and education.

4. Expanding Outdoor Recreation to help meet the public demand, and to create jobs and strengthen the economy of the countryside. The Department will expand recreational facilities in the National Forests and provide financial, technical, and educational assistance to rural communities, farmers, and others to establish or enlarge such facilities for public use.

5. Enhancing Natural Beauty through landscaping, screening of residential and industrial developments, rehabilitation of surface-mined lands, protection of soil and plants, and conservation activities generally.

6. Protecting Public Health in both rural and urban areas by controlling pests that ravage food crops and livestock, and transmit human diseases, guarding the wholesomeness and quality of food products against contamination, reducing pollution of soil, water, and air, and providing and improving sanitation and waste disposal systems in rural areas.

Community of interest.—Improving the total environment of rural and urban people depends upon the sustained cooperation of all segments of society. Building upon its historic working relationships, the Department shall continue to encourage and support State and local governments, conservation and other districts, educational institutions, private organizations, and farmers, ranchers, and landholders in the multiple use of natural and human resources for the benefit of everyone. The Department will cooperate fully with other Federal agencies engaged in environmental activities.

To enhance the quality of our total environment, in accordance with the objectives outlined above, the Department will propose and implement, as needed, new policies and programs put forward in the interest of a healthy, attractive, prosperous, and vigorous environment for all Americans.

ORVILLE L. FREEMAN.

DEVELOPING POLICY AND PROGRAMS FOR MANAGING THE ENVIRONMENT—SOME U.S. DEPARTMENT OF AGRICULTURE AND COOPERATIVE APPROACHES

In a number of ways the tendency of man has been to manage the environment for short-term gains rather than long-term advantages. The public and private sectors have fairly recently shown added concern in their environments and additional emphasis is being placed on a balanced program for total resource management.

The research and action programs of the Department of Agriculture have wide application *to* and impact *on* the environment. The Department has long been concerned with the effects of its programs on the environment.

Similar to other Federal agencies, a system of committees, task forces, and advisory groups permit the Department of Agriculture to be constantly aware of changes in needs for environmental management. These needs are recognized, evaluated and where possible incorporated into the programs of the Department.

The purpose here is to provide information and examples of how USDA reviews plans and coordinates its efforts toward improving the environment:

- I. Within the Department.
- II. With other Federal Departments and agencies.
- III. With State agencies.
- IV. Through counsel and advice received by USDA from the public.
- V. Through local action.

I. INTRADEPARTMENTAL COORDINATION AND PLANNING

A. Agriculture/2000 Task Forces

As shown on the attached charts, six Department-wide task forces function to plan, develop and provide general guidance for National missions and programs to meet long term needs of people for the products and services of our Nation's natural resources.

The task forces are chaired by Assistant Secretaries and other members of the Secretary's immediate staff. Generally, the membership is made up of Administrators of Department Services and Agencies. The attached guidelines titled "Resources in Action" and "Communities of Tomorrow" are examples of task force activities. A copy of the 1967 Report of the Secretary of Agriculture, attached, shows how the task force titles relate to USDA goals and to programs involved.

B. Environmental Quality Work Group and Executive Committee

In September 1967 the Office of the Secretary established an Environmental Work Group to serve as a focal point needed for coordinating the many Department activities relating to managing the environment.

Salient features of the memorandum establishing the work group are as follows:

"This memorandum establishes a Departmental Environmental Quality Work Group. It is expected that it will contribute significantly to Department-wide communication and planning on all facets of USDA activities and responsibilities relating to the quality of the environment.

"The new group will not supersede any existing or currently planned groups or individuals functioning in this area; however, their activities should henceforth be coordinated with it. Department personnel designated as representatives to interdepartmental groups related to environment quality should keep the work group informed. Conversely, the work group will be expected to provide counsel and assistance as needed.

"Included among the functions of the Environmental Quality Work Group are:

"Improving communication regarding action, research and education program activities and needs.

"Developing a focal point for locating and interrelating Department and agency responses, reports and other pertinent information. Developing background information for establishing Department positions as needed and, where appropriate, drafting Department responses to outside inquiries."

A Deputy Assistant Secretary serves as chairman and a Department-wide research coordinator serves as executive secretary.

Each of the agencies listed below has designated key people as members and alternates to serve on the Work Group. These people have ready access to the offices of the Administrators and their deputies. In this manner the Work Group can respond rapidly!

Research Agencies:

- Agricultural Research Service.
- Cooperative State Research Service.
- Economic Research Service.
- Forest Service.

Action Agencies:

- Agricultural Research Service.
- Agricultural Stabilization and Conservation Service.
- Consumer and Marketing Service.
- Foreign Agricultural Service.
- Farmer Cooperative Service.
- Federal Extension Service.

Farmers Home Administration.
 Forest Service.
 International Agricultural Development Service.
 Rural Community Development Service.
 Rural Electrification Administration.
 Soil Conservation Service.
 Statistical Report Service.

Other :

National Agricultural Library.
 Office of General Counsel.
 Office of Information.
 Planning Evaluation and Programming Staff.
 Research, Program, Development and Evaluation Staff.

To provide a smaller group to counsel with the chairman an Executive Committee comprised of Associate or Deputy Administrators was also established.

The continuing flow of requests and many departmental activities indicate the Work Group and the Executive Committee are performing a vital function.

II. INTERDEPARTMENTAL COORDINATION AND PLANNING

The Department is benefitting from intensified and systematic communication resulting from interdepartmental activities.

Many of the planning and coordinating activities are led by the Office of Science and Technology (OST), often in connection with the Federal Council for Science and Technology (FCST). Others function under different charters, sometimes at the instigation of the several Departments or agencies involved.

The FCST Committees on (1) Environmental Quality, (2) Water Resources Research, and (3) Atmospheric Sciences are examples of interdepartmental activities in which USDA participates. Through these efforts and others such as the Water Resources Council the Department is gaining assistance in developing and operating its programs.

The Federal Committee on Pest Control (FCPC) is an example of agency initiated coordinating activities. All pest control programs involving Federal monies are subjected to review and evaluation. The FCPC is comprised of members from the Departments of Agriculture, Defense, Health, Education and Welfare, and The Interior.

President Johnson, on March 8, 1968, in his message titled "To Renew a Nation", instructed the Secretary of Agriculture to conduct a review of agricultural pollution. OST is providing the government-wide leadership needed to respond to these instructions. A study group is comprised of representatives from the Departments of Agriculture, Commerce, Defense, Health, Education and Welfare, Housing and Urban Development, The Interior, and Transportation. This group is identifying pollution problems, establishing priorities among them, and recommending action and research programs needed to deal with these problems of environmental management.

III. USDA—STATE AGRICULTURAL EXPERIMENT STATION COORDINATION AND PLANNING

State Agricultural Experiment Stations (SAES) and Forestry Schools participated with the Department in conducting a long range study of agricultural research needs. On-going State and Federal Research was inventoried. This information, together with additional material from other Federal agencies and industries was taken into account in projecting research needs for a ten year period.

The SAES-USDA study led to the preparation and distribution in October 1966 of "A National Program of Research for Agriculture." In keeping with a recommendation of this long range report, a number of SAES-USDA research task forces are addressing themselves to specific subject areas in the study in order to project the needs in greater detail. Specialists are developing guidelines for projected research programs. Some of the research task forces which deal with managing the environment are :

Forestry.
 Soil and land use.
 Water and watersheds.

Pollution in relation to agriculture and forestry.
 Weather modification.
 Remote sensing.
 Natural beauty and ornamental horticulture.
 Forage, range and pasture.
 Food safety.
 Rural development and family living.

IV. PUBLIC ADVISORY COMMITTEES—COORDINATION AND PLANNING

The Department obtains valuable help in program planning and coordination from a Public Advisory Committee system. Members on these committees are qualified and experienced people representing various segments of agriculture and consumer interests. From these committees comes a continual inflow of problems and suggestions which are thoroughly discussed in relation to program development needs. Based on these, each committee makes recommendations to the Department with respect to research and action program development and operation.

Some of the Research Advisory Committees authorized by the Research and Marketing Act deal especially with managing the environment. They are:

- (1) National Agricultural;
- (2) Farm Resources and Facilities (Soil and Water Conservation and Agricultural Engineering);
- (3) Forestry; and
- (4) Plant Science and Entomology.

Among other public advisory groups created by statute or administrative action which directly or indirectly deal with managing the environment are:

- (1) Advisory Committee on Multiple Use of the National Forests,
- (2) Public Advisory Committee on Soil and Water Conservation,
- (3) National Advisory Committee on Rural Areas Development,
- (4) Committee on Agricultural Science,
- (5) The Advisory Board on Wildlife,
- (6) Cooperative Forestry Advisory Committee,
- (7) The National Arboretum Advisory Council.

V. USDA CHANNELS FOR LOCAL ACTION

Improving the quality of the environment has now become a major aspect of the Department's missions as indicated in the attached Secretary's Memorandum No. 1631.

The Department has offices in almost every county of the Nation. Its field staff is trained in knowledge about natural resources and is adapting that knowledge to improving the environment.

The Department works directly with local action groups and organizations such as Soil and Water Conservation Districts, Rural Cooperatives, Extension Education Organizations, Community and County organizations and officials and educational institutions in carrying out its missions through research, education, and technical and financial assistance.

Through these channels of action the Department—

1. Projects its goals such as indicated in the previously mentioned guidelines titled "Resources In Action" and "Communities Of Tomorrow."
2. Receives from local people their views about problems pertaining to agriculture and related natural resources protection, development, and wise use. These views are considered by the Department in further program improvement.

Moreover, through the Department's outreach approach numerous problems arising from local areas are channeled into the efforts of other appropriate agencies of the Federal establishment.

Technical Action Panels organized with USDA assistance at State, Area and County levels provide coordination of the Department's action programs with those of other Federal, State and local groups. These Panels operate in response to local initiative of the citizenry whose leadership is always involved in the decision-making process.

SELECTED U.S. DEPARTMENT OF AGRICULTURE PUBLICATIONS DEALING WITH
MANAGING THE ENVIRONMENT

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- Resources in Action*, Agriculture/2000.
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- Our American Land. Soil Conservation Service, Agriculture Information Bulletin 321.
- The American Outdoors, Management for Beauty and Use. Forest Service, Miscellaneous Publication No. 1000.
- Soil, Water and Suburbia. (Jointly published with U.S. Department of Housing and Urban Development.)
- The District's Role in Water Quality. Talk by Kenneth E. Grant, Associate Admin., SCS, at NACD Southeastern Area Mtg., Charleston, S.C. 7/29/68.
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- Winds Over Wildlands—A Guide for Forest Management. Agriculture Handbook No. 272, U.S. Department of Agriculture, November 1964.

PART 2—CONFERENCES AND SYMPOSIUMS

- Agriculture and the Quality of our Environment, A Symposium Presented at the 133rd Meeting of AAAS, December 1966, Nyle C. Brady, Editor. AAAS Publication No. 85, 1967.
- Air Pollution. Proceedings of the U.S. Technical Conference on Air Pollution, sponsored by the Interdepartmental Committee on Air Pollution. L. C. McCabe, Chairman, 1962.
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RESOURCES FOR THE FUTURE, INC.,
Washington, D.C., August 26, 1968.

HON. EMILIO Q. DADDARIO,
House Office Building,
Washington, D.C.

DEAR CONGRESSMAN DADDARIO: As the primary organizer of the recent "colloquium" on environmental quality, I thought you might be interested in the enclosed reports. These represent results of research on environmental quality undertaken and sponsored by Resources for the Future in recent years.

As an individual I would also like to express my commendation, both for your efforts to illuminate the issues regarding environmental quality and for your efforts to bring about more rational organization within the federal government to cope with environmental quality problems.

Sincerely,

BLAIR T. BOWER,
Acting Director, Quality of the Environment Program.

REGIONAL MANAGEMENT OF ENVIRONMENTAL QUALITY¹

(By Blair T. Bower)

INTRODUCTION

It is appropriate that the speaker who is to talk about society's leftovers be last on the program. Whether or not this ordering represents the relative priorities attached by the conference organizers to the problems under discussion, I do not know. However, it should be emphasized that no matter how much we are concerned with air quality, water quality, the birds and the bees, environmental quality remains only one component—albeit an important one—of the national bill of desired goods and services. The events of the past few months should make this abundantly clear.

A statement on regional environmental quality management must begin with a description of the sources and nature of the management problem and of the policy issues involved. Such a description comprises the focus of my remarks.

For a long time we have thought, if at all, of the wastes produced by society as unwanted garbage to be disposed of as quickly and as easily as possible, without considering the impacts on environmental quality. However, the increasing number of references to the effluent society,² rather than to the affluent society—although the two are directly and positively related—perhaps reflect a changing perception of the problem. Rather than being concerned with garbage, we should focus on residuals; instead of being called garbage men, I hope that I and my professional colleagues will become known as “residuals management experts.”

The term, residuals management expert, however pompous it may sound, accurately reflects the source of the environmental quality problem facing society. Man in his production and consumption activities—farm, forest, mine, factory, office, home—produces desired commodities and services and, at the same time, generates unwanted materials, most of which become residuals discharged into the environment—air, water, land—in one form or another—liquid, gaseous, solid.

What happens to the wastes which are generated in society's activities, in a factory for example? (The following order implies neither frequency of occurrence nor relative importance.) First, some may be directly recycled back into production as inputs to the same production process, e.g., the chemicals from black liquor recovery systems in sulphate pulp production. Second, some may be recycled as inputs into a production process at another plant in another location, e.g., the peach pits from peach canneries used to produce charcoal briquettes. “By-product production” may also occur at the same location where the original waste was generated. Third, some may be discharged directly into the environment. Fourth, some may be treated by one means or several, as in waste treatment plants, in which their form or weight may be changed. Before and/or after treatment the wastes may be temporarily stored before discharge as *residuals* into the environment, or after treatment some or all may be recycled back into production. For any one production or consumption activity, various combinations of the above occur.

The magnitude of the residuals problem can be suggested by various numbers. These are usually stated in terms of individual wastes discharged into the environment each year, such as the number of cans, bottles, jars, the total tons of sulfur dioxide, or the total pounds of biochemical oxygen demand.

A more useful way of looking at the residuals problem is to look at the difference in weight between the inputs to production and consumption activities—fuel, food, and raw materials—and the outputs from those activities. The latter include services such as heat and light, durable and nondurable consumer products and the liquid, solid, and gaseous residuals which are not yet recycled into production. Durables or final goods eventually become residuals—junk cars, dis-

¹ Remarks prepared for presentation at the Pennsylvania/New Jersey/Delaware Regional Conference, Swarthmore College, June 12, 1968. The author is Associate Director, Quality of the Environment Program, Resources for the Future, Washington, D.C. The views presented are his own, and do not necessarily represent those of RFF.

² For example, see the Time Essay, “The Age of Effluence,” in the May 10, 1968, issue of *Time*, pp. 52–53.

carded furniture, demolition materials from urban redevelopment. This weight equation must balance. That is, considering a region or a nation and ignoring exports, imports, and capital accumulation, the total weight of all inputs must be balanced by the weight of all outputs. In terms of this "materials balance", the weight of residuals being inserted into the air, water, and land environments is approximately equal to the weight of basic fuels, food, and raw materials entering processing and production plus the weight of oxygen from the atmosphere. Thus, the weight of residuals requiring disposal is larger than the weight of basic materials produced. Allowing for exports, imports, and capital or stock accumulation, the weight of residuals produced in the U.S. economy is about 10% less than the basic inputs.

There are other components of, or factors involved in, residuals-environmental quality management. Without attempting to enumerate them all, one important one should be mentioned—noise. This is an increasingly pervading residual in the urban environment with an increasing average intensity—although with the potential advent of supersonic aircraft even the depths of Grand Canyon will apparently not escape. Noise as a residual differs substantially from most other residuals in terms of the input-output relationship. In many production processes residuals comprise more than 25% by weight of the inputs, i.e., 250,000 parts per million (ppm). In contrast, noise as a residual often represents a very small portion of the input; in the case of an average car, in energy terms it represents about 1 ppm of the input.

"THE SYSTEM"

What are the components of the wastes generation/residuals disposition/environmental quality management system (and problem)? The major components are as follows:

1. The factors affecting the generation of wastes;
2. The interrelationships among the three forms of wastes—gaseous, liquid, and solid;
3. The assimilative capacity of the air, water, and land environments, in both the short-run and in the long-run, and hence the impacts of residuals discharge on environmental quality;
4. The impacts of the time pattern of environmental quality resulting from residuals discharge on the receptors—man, vegetation, buildings; and
5. The techniques and methods available for residuals and environmental quality management.

Factors affecting wastes generation

The major factors affecting the generation of wastes in productive activities are: the nature of the raw materials used, the technology of the production process, the product output mix, the operating level, the plant layout, and the environmental controls imposed on the production unit. Because of the number of variables involved, there is a wide range in the magnitude and character of wastes generated even in a single industry. For example, in the combustion of coal to produce electrical energy, the quantity of particulates generated ranges from about 20 to about 240 pounds per ton of coal burned, depending on the quality of the coal (ash and volatiles contents), type of boiler, firing conditions, and operating level. Note that these represent the quantities generated—not discharged. The quantities actually discharged to the environment are a function of the methods of handling after generation, which in turn are a function of the environmental controls imposed.

To illustrate the effect of type of raw material on wastes generation, using high sulfur crude in petroleum refining will result in larger and more complex wastes per barrel of crude throughout than using low sulfur crude, for the same product mix. In fruit canning, genetic research over the past two decades has yielded raw products more amenable to the canning process. This improved raw product quality (in conjunction with improved processing equipment, has reduced the wastes generated per ton of raw product processed.

Product mix is a particularly important factor. In some cases the changing product mix over time has increased, in others decreased, wastes generation per unit of output or per unit of raw product processed. For example, in the paper industry the proliferation of paper products, the development of new coatings and sizings, higher quality specifications, more colored products—all have increased the wastes generated per unit of product. Here is where the affluent society has its impact. As long as madame wants pink, red, blue, green,

and flowered tissue paper—in (increasing) preference to white, and to the extent that Madison Avenue convinces madame that the old brown kraft paper bag is no longer “in”, and that colored bags are “better”, the result will be a trend toward more wastes generated per unit.

In the canning of peaches the changing product mix has had the reverse effect. Two decades or so ago, the peach canner packed only peach halves and peach slices. Now he is likely to can halves, slices, pie pieces, irregular bits, nectar, and concentrate. In so doing more of the raw peach gets into the can, and less goes to waste per ton of raw product input.

We can summarize the effect of production process technology and product mix as follows. To produce a specified set of production and consumption goods, the total materials throughout necessary and hence the quantity of residuals generated decrease as the efficiency of utilization, including recycling, and the useful lifetime of goods increase. The longer machinery, cars, buildings, and other durables last, the less new materials are required to compensate for depreciation and/or to sustain a given rate of capital accumulation, and less wastes are generated in total. The same is true for energy production—the more efficient are the combustion processes, the fewer wastes will be generated for a given level of energy production desired.

Interrelationships among solid, liquid, and gaseous wastes

The typical approach to wastes and to wastes management in the past has been to look at each of the forms of waste separately. In attempting to cope with the problems “created” by one form of waste, the effects on the other forms have often been overlooked. Thus, in the not so distant past paper mills often discharged their white water—waste water containing paper particles and lignin—directly into streams. Imposing strict controls on such discharges, i.e., water pollution, often stimulated the incineration of the white water, with a resulting gaseous waste problem, i.e., air pollution. Strict controls on both liquid and gaseous waste discharges result inevitably in transforming the waste problem into one of handling solid residuals.

For example, in the case of municipal incinerators for mixed refuse, the imposition of air quality controls on particulate emissions has stimulated the use of wet scrubbers. This may result in a water pollution problem, or if controls on suspended solids in waste water discharges are strict, the ultimate result is more solid wastes to be handled.

Thus, solids comprise the ultimate form of residuals. By application of appropriate equipment and energy, essentially all of the undesirable substances can be removed from liquid and air waste streams, except for carbon dioxide. (Whether or not it is economically desirable to do so is another question.) This “fact of life” emphasizes the fundamental interrelationships among the three forms of wastes.

Assimilative capacity of the environment

There is a finite capacity of air, water, and land to absorb the residuals discharged into them without significant impacts on quality. When this capacity is exceeded, quality deteriorates.

It is important to note that there are both short-run and long-run aspects of assimilative capacity. The short-run aspect involves the time variability of assimilative capacity in relation to the frequency of adverse meteorological conditions—inversions for example, and adverse hydrologic events—low flow periods. Assimilative capacity may change from hour to hour, day to night, day to day, season to season and so on. It is during these periods that the discharge of residuals into the environment has major impacts on quality. When assimilative capacity is large, the discharge of residuals may well have little or no measurable impact on environmental quality. Only for certain toxic materials, i.e., those dangerous in even minute concentrations, is it essential to preclude any discharge at all. The varying assimilative capacity in the short-run is important for environmental quality management decisions. Significant cost savings—in terms of both capital and operating expenses for facilities to reduce, modify, or otherwise handle wastes—are likely to be possible in achieving the given desired quality level by environmental controls which are imposed non-continuously (over time) and selectively (over different dischargers), rather than continuously on all dischargers.

The long-run aspects of assimilative capacity are much less well known. Discharge of carbon dioxide into the atmosphere can be considered harmless in the short-run, because natural vegetation and oceans provide major “sinks” for its

assimilation. Yet there is some evidence that a net accumulation of CO₂ is occurring in the atmosphere. If this accumulation were to continue, some experts have suggested that it may give rise to significant and probably adverse weather changes by the end of this, or early in the next, century. Similarly, although the ocean has long been considered a "bottomless pit," we are not yet sure what the long-run effects of dumping presumably leak-proof containers of radioactive wastes will be; or if the basic food chain in the ocean will be significantly altered in the long-run by the discharge of waste materials such as baled solid wastes.

Our knowledge of the long-run potentially irreversible impacts on ecosystems is limited. In fact, if sufficient "virgin" ecosystems are not maintained, we will not even have the base lines from which to measure changes in environmental quality. In some areas this has already become a problem, in that background levels of radioactivity, seismicity, and so on were not measured prior to human activities which affected these environmental parameters.

Impacts of environmental quality on receptors

Even if we could specify for each type of residual the time pattern of environmental quality resulting from a specified time pattern of its discharge³—which we cannot—the next problem is that of delineating the effect of the resulting time pattern of quality on humans, animals, vegetation, and so on. The unknowns in this area are much larger than the knowns, particularly in the long-run. To cite one example, the evidence of the impact on human health of exposure to sulfur dioxide is inconclusive. Experiments in England which have continued for over ten years have shown no measurable impacts on health. Yet there is still a "residual" belief that such exposure may be harmful. It may be that the impacts are a function not of exposure to SO₂ itself, but rather to a combination of SO₂, particulates, and atmospheric moisture.

We can define, reasonably well, the impacts of exposure of some plants to different levels and durations of concentration of sulfur dioxide. Thus, short-run damage functions (or loss functions), for leafy plants such as spinach, lettuce, and tobacco have been developed. The long-run damages are essentially unknown. Yet it is the long-run impact which may be most critical or some residuals, such as pesticides, where the cumulative effect throughout the food chain over time is the central problem.

Environmental quality management

The integration of the four components discussed above should be accomplished by the application of the various available techniques and methods for environmental quality management. Developing an environmental quality management program for a specific region involves three basic questions.

1. What level(s) of environmental quality are desired what portion(s) of the time? That is, should the dissolved oxygen level in the river be 3 parts per million (3 ppm), 4 ppm, or 5 ppm—and must it be at the given level 100% of the time, or only 98% or 95% of the time?
2. What is the least cost means of achieving any desired level of quality with a specified degree of certainty?
3. What kinds of management institutions can be devised which will enable achieving the desired quality levels most efficiently?

The first question cannot be answered in isolation from the second question, i.e., how much does it cost. This is because there are other demands, particularly in an urban society, on the scarce resources available—demands for schools, transportation, social welfare. Nor can it be answered without considering the third question as well, because the nature of the management institutions and the instruments used by them affect the costs.⁴

Because all of the benefits of improved environmental quality cannot be measured in dollar terms, we must resort, at a minimum, to defining how much it will cost to achieve different levels of quality.⁵ Then the decision must be made regarding how much increased quality is worth—in relation to the benefits foregone by devoting that amount of resources to improving environmental quality rather than to other needs. In a recent public opinion survey, about three-quarters of the respondents felt that more should be done to reduce

³ The residual discharge itself may be a stochastic variable, i.e., one whose characteristics can be specified only in terms of a probability distribution.

⁴ An empirical example relating to these questions is given in the Appendix.

⁵ The problem is not only the magnitude of the benefits but the distribution of the benefits among segments of the population. The distribution of costs of environmental quality management is also very relevant.

water and air pollution in the United States, but only a few percent were willing to pay \$15 per capita per year toward that end.

Two aspects of the costs of environmental quality merit mention. One, the incremental costs of achieving higher levels of quality with increasing certainty rise rapidly. That is, the unit cost of removing a pound of organic waste from a liquid effluent at the 95% removal level is much higher than the unit cost at the 50% removal level.

Two, a multiplicity of ways exists for improving environmental quality, ranging from activities undertaken in the individual production units—process change, materials recovery, by-product production, treatment—to activities under collectively—reservoirs to provide water in low flow periods, collective waste treatment facilities, imposition of effluent charges or standards. Research and practice have shown sizeable economies of scale in residuals-environmental quality management, and significant efficiencies to be derived from looking at the problem in a systems context.

The importance of policy decisions with respect to the techniques used for environmental quality management merits emphasis. This can be illustrated in the following manner. A region which depends heavily on electric space heating and electrically-powered mass transit, utilizes efficient wet scrubbing of stack gases from industries and power plants, and disposes of its garbage by grinding, transporting in sewers, and discharging untreated to watercourses, would have a high degree of air quality. But there would be a heavy residuals load imposed on the watercourses of the region, with likely severely adverse consequences on water quality. Alternatively, suppose the region treats its municipal and industrial liquid waste streams to a high degree, and relies almost exclusively on incineration of sludges and solid wastes to handle the residuals from these treatments. Protection of the water and land environments would result, but at the expense of a heavy residuals load discharged to the air. If the region were to practice high-level recovery of waste materials, recycling, and by-product production, combined with the stimulation of production processes which resulted in the generation of small quantities of waste per unit, very few residuals might well be discharged into any of the environments.

Finally, knowing what the technological possibilities and economic consequences are, management institutions are needed which can utilize the range of possibilities available. The management agency needs to have authority to undertake the entire range of activities comprising environmental quality management—planning, research, data collection, construction and operation of facilities, regulation of emissions, levying withdrawal and effluent charges. The designing of governmental institutions which would perform the task of environmental quality management effectively, efficiently, and equitably, and which would be politically viable, is the toughest problem facing us. While there are gaps in our technological knowledge requiring research, pilot projects, and demonstration operations—for example, methods of analyzing management systems, technology for reducing wastes generation per unit of product, and the short-run and long-run impacts of residuals discharge—the institutional problem is the most difficult and most important.⁶

APPENDIX

The following data relating to the questions posed on page 10 are taken from a study of the Potomac estuary by Davis.*

Table 1 shows the costs of the least cost system—some combination of reservoirs for low flow augmentation, in-stream aeration, effluent redistribution, advanced waste treatment—to achieve different levels of water quality as measured by dissolved oxygen (D.O.) concentration. The incremental costs of going to the next higher level of quality are also shown.

⁶ Institutional experimentation would appear to be the order of the day. The performance of the following agencies having some degree of responsibility for environmental quality management should be observed and evaluated—the interstate-federal Delaware River Basin Commission, Ohio Development Authority, New York State Pure Water Authority, New York City Environmental Protection Service, Miami Conservancy District (whose responsibility has recently been expanded to include water quality management), Ontario Water Resources Commission, Los Angeles County Sanitation District, Metropolitan Sanitary District of Greater Chicago. Likewise, consideration should be given to agencies which have been proposed but are not yet in operation—such as Maryland's Waste Acceptance Service—and of agencies not yet proposed but hopefully are being conceived in some fertile imaginations.

*Robert K. Davis, 1968. *The range of choice in water management: a study of dissolved oxygen in the Potomac estuary*, Johns Hopkins Press, Baltimore.

TABLE 1.—LEVELS OF WATER QUALITY AND RELATED COSTS¹

Quality level D.O., parts per million	Least cost system, 10 ⁶ \$	Incremental cost, 10 ⁶ \$
2.....	8	—
3.....	18	10
4.....	21	3
5.....	27	6
6.....	(²)	(³)

¹ Costs are present worth of 50-year time stream of capital and operation, maintenance, and normal replacement (OMR) costs discounted at 4 percent.

² Very large.

³ Large.

Table 2 compares the cost of the least cost system to achieve a specified level of water quality (D.O.) with the cost of a reservoir only system to accomplish the same end by increasing low flows for the dilution of wastes. These data illustrate one effect of policy decisions—in the planning process as well as in the decision process—concerning the types of quality management techniques which are included for consideration.

TABLE 2.—COMPARATIVE SYSTEM COSTS¹ AND LEVELS OF WATER QUALITY

Quality level D.O., parts per million	Least cost system, 10 ⁶ \$	Cost of reservoir system, 10 ⁶ \$
2.....	8	8
3.....	18	27
4.....	21	115
5.....	27	—

¹ Costs are present worth of 50-year time stream of capital and OMR costs discounted at 4 percent.

Table 3 shows the impact of another type of policy decision on the cost of environmental quality management—the cost-sharing policy of the federal government. The area directly benefited by the environmental quality management system pays more or less of the direct costs, depending on the particular facilities included in the system. All systems provide the same level of water quality, i.e., 4 ppm D.O.

COST SHARING IN ALTERNATIVE WATER QUALITY MANAGEMENT SYSTEMS

System designation	System cost, ¹ 10 ⁶ \$	Cost ¹ to area, 10 ⁶ \$
A.....	22	14
C.....	29	29
D.....	38	26
H.....	115	0

¹ Costs are present worth of 50-year time stream of capital and OMR costs discounted at 4 percent.

POLLUTION AND A BETTER ENVIRONMENT

(By Allen V. Kneese, Resources for the Future, Inc., Washington, D.C.)

I.

Introduction

In many ways, the performance of our economy has been impressive in this decade. The sixties have seen the United States emerge from a period of relatively slow economic growth and soul-searching about its inability to keep up with the growth rates of the Western European countries. The economy's annual growth

in GNP of about 4% per year has become one of the highest in the developed world, and man-hour productivity growth of about 6% per year is well above the post-war trend. Productivity gain has been particularly impressive in the manufacturing and agricultural sectors, and prices of goods have been falling relative to services, thus making food, energy, and material goods more and more copiously available to the population. These developments would seem to be good reasons for euphoria and in many ways they certainly are.

There is a dark lining on this silver cloud, however. The vast increase in manufacturing activity and output and the rapidly rising conversion of fossil fuels to energy has imposed an ever-increasing burden of waste residuals on the environment. In fact, the total weight of residuals discharged to the environment tends to rise *pari passu* with the increase in manufacturing activity and energy conversion unless there are gains in the technical efficiency of converting inputs to useful outputs or the recycle of used goods is increased.

Throughout most of our history, the discharge of residuals to air, water, and the land was of concern only in particular and unusual instances, if at all. Granted some of these instances were spectacular, such as the smoke in Pittsburgh early in this century. But overall, we were endowed with immense space and vast flows of water which could dilute and assimilate residuals with little damage to the natural environment. This was fortunate because the air and water are "common property" resources with respect to which the private market, on which we have relied so heavily to allocate resources to their most valuable uses, cannot function. In recent years, the naturally available assimilative capacity of the natural environment has been rapidly used up and it is becoming more difficult to protect one environment medium, such as water, without damaging another, such as air. In the past, when pollution control efforts were undertaken, it was often assumed that if a liquid or gaseous waste stream was treated, or solid wastes were burned or hauled off the premises, the pollution problem was solved. In recent years we have gradually come to appreciate that air, water, and solid waste problems are closely interdependent and their analysis and control is best viewed as a systems problem relating to the whole process of residuals generation and control.

The overall residuals problem

To clarify and illustrate these points, it is useful to view the residuals problem initially as a materials balance problem for the entire economy. A highly simplified schematic of how the goods and residuals production process works is shown in Chart I (p. 144). The inputs to the system are fuels, foods, and raw materials which are partly converted into final goods and partly become waste residuals. Except for increases in inventory, final goods also ultimately enter the waste stream. Thus, goods which are "consumed" really only render certain services. Their material substance remains in existence and must either be reused or discharged to the ambient environment.

In an economy which is closed (no imports or exports) and where there is no net accumulation of stocks (plant, equipment, inventories, consumer durables, or residential buildings), the amount of residuals which is inserted into the natural environment must be approximately equal to the weight of basic fuels, food, and raw materials entering the processing and production system, plus oxygen taken from the atmosphere. This result, while obvious upon reflection, leads to the, at first rather surprising, corollary that residuals disposal—in terms of sheer tonnage—is an even larger operation than basic materials production.

In an open (regional or national) economy it would be necessary to add flows representing imports and exports. Similarly, in an economy undergoing stock or capital accumulation the production of residuals in any given year would be less by that amount than the basic inputs. In the entire United States, economy accumulation accounts for about 10-15 per cent of basic annual inputs,¹ and there is some net importation of raw and partially processed materials amounting to 4 or 5 per cent of domestic production. Table 1 shows estimates of the weight of raw material produced in the United States in several recent years, plus net imports of raw and partially processed materials.

¹ Mostly in the form of construction materials.

Chart I.--Materials Flow

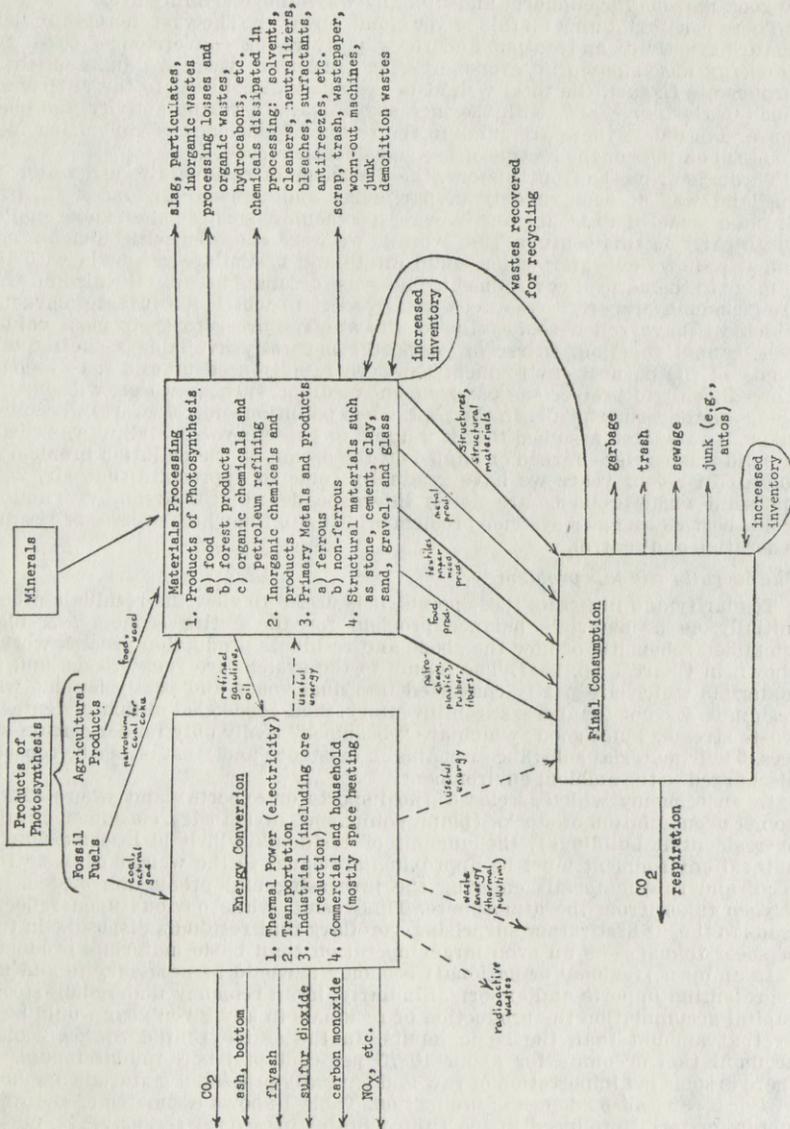


TABLE 1.—WEIGHT OF BASIC MATERIALS PRODUCTION IN THE UNITED STATES PLUS NET IMPORTS, 1963

[10⁶ tons]

	1963	1964	1965
Agricultural (including fishery and wildlife and forest) products:			
Food:			
Crops (excluding livestock feed).....	125	128	130
Livestock.....	100	103	102
Other products.....	5	6	6
Fishery.....	3	3	3
Forestry products (85 percent dry weight basis):			
Saw logs.....	53	55	56
Pulpwood.....	107	116	120
Other.....	41	41	42
Total.....	434	452	459
Mineral fuels.....	1,337	1,399	1,448
Other minerals:			
Iron and ferroalloys.....	204	237	245
Other metals.....	161	171	191
Construction materials.....	1,579	1,668	1,763
Other nonmetals.....	125	133	149
Total.....	2,069	2,209	2,348
Grand total.....	3,840	4,060	4,255
Total "active" materials ¹	2,261	2,392	2,492

Excluding minerals used for structural purposes, ballasts, fillers, etc.

Source: Compiled and inferred from official statistics.

Of the "active" inputs,² perhaps three-quarter of the overall weight is eventually discharged to the atmosphere as carbon (combined with atmospheric oxygen in the form of CO or CO₂) and hydrogen (combined with atmospheric oxygen as H₂O) under current conditions. This results from combustion of fossil fuels and from animal respiration. Discharge of carbon dioxide can be considered harmless in the short run. There are large "sinks" (in the form of vegetation and large water bodies, mainly the oceans) which re-absorb this gas although there is evidence of net accumulation of CO₂ in the atmosphere. Some experts believe that the latter is likely to show a large relative increase—as much as 50 percent—by the end of the century possibly giving rise to significant—and probably, on balance, adverse—weather changes.³ Thus continued combustion of fossil fuels at a high rate could produce externalities affecting the entire world. The effects associated with most residuals will normally be more confined—usually limited to regional air and water sheds.

The remaining residuals are either gases (like carbon monoxide, nitrogen dioxide, and sulfur dioxide—all potentially harmful even in the short run), or dry solids (like rubbish and scrap) and wet solids (like garbage, sewage, and industrial wastes suspended or dissolved in water). In a sense, the solids are the irreducible limiting form of waste. By the application of appropriate equipment and energy, all undesirable substances can in principle be removed from water and air streams⁴—but what is left must obviously be solid. Looking at the matter in this way, clearly reveals a primary interdependence between the various waste streams which, as previously noted, casts into doubt the traditional classification of air, water, and land pollution as individual categories for planning and control policy.

But solid residuals, or for that matter those that remain in a liquid or gaseous state, do not necessarily have to be discharged to the environment. In many instances, it is possible to recycle them back into the productive system. The materials balance view underlines the fact that the total materials throughput necessary to maintain a given level of production and consumption decreases as the technical efficiency of utilization (i.e., recycle of materials) increases. Similarly,

² Excluding stone, sand, gravel, and other minerals used for structural purposes, ballast, fillers, insulation, etc. We also disregard gangue and mine tailings in this tally.

³ See *Implications of Rising Carbon Dioxide Content of the Atmosphere* (New York: Conservation Foundation, 1963). There is strong evidence already that discharge of residuals has already affected the climate of individual cities. See William P. Lowry, "The Climate of Cities," *Scientific American*, August 1967.

⁴ Except CO₂ which may be harmful in the long run, as noted.

the useful lifetime of goods is closely related to the net throughput of the system. The longer cars, buildings, machinery, and other durables last, the fewer new materials are required to compensate for depreciation or sustain a given rate of capital accumulation.

Finally, the more efficient energy conversion processes can be made (in the strict energy conversion or Carnot cycle sense), the fewer waste products there will be for the environment to receive, for a given total energy production. Perfect utilization of carbonaceous fossil fuels would leave only water and carbon dioxide as residuals, while nuclear energy conversion need leave no chemical residuals at all (although thermal pollution and radiation hazards cannot be dismissed).

Table 2 presents estimates of the amounts of emissions to the atmosphere by type and sources. The estimates are based on a materials balance calculation. The roles of transportation—mostly automobiles—and utilities power in the overall emissions picture are striking.

TABLE 2.—SUMMARY OF RESIDUALS FROM ENERGY CONVERSION, 1965

	[X10 ⁶ tons]				
	Carbon monoxide, CO	Hydrocarbons, HC	Sulfur dioxide, SO ₂	Oxides of nitrogen, NO _x	Particulates
Utility power.....	1.0	(¹)	13.6	3.7	2.4
Industry and households.....	5.0	(¹)	8.4	7.0	7.0
Transportation.....	135.0	27	.4	5.7	.2
Total.....	141.0	27	22.4	16.4	9.6

¹ Negligible.

Source: Based on calculations in Robert U. Ayres and Allen V. Kneese, "Environmental Pollution," paper prepared at the request of the Joint Economic Committee of the Congress of the United States.

Another illustrative calculation is presented in Table 3. This shows estimates of materials flow in human nutrition under U.S. conditions. Chart II (p. 147) puts the residuals from food on a per capita basis and adds flows from household use of other non-durable and durable goods. This chart shows clearly some major interdependencies between liquid, solid, and gaseous residuals streams. In the household and as in other sections they can be traded off for one another to a far-reaching extent.

TABLE 3.—MATERIALS BALANCE FOR HUMANS (1963)

	[Dry weight X 10 ⁶ tons]					
	Carbon	Oxygen	Hydrogen	Nitrogen	Sulfur	Total
Food inputs:						
Carbohydrate.....	24.10	26.80	3.25	-----	-----	54.15
Fat.....	12.04	1.81	1.89	-----	-----	15.74
Protein.....	6.28	2.73	.83	1.90	0.12	11.86
Total.....	42.42	31.34	5.97	1.90	.12	81.75
Outputs:						
Garbage.....	~9.8	~5.1	~1.3	~.15	-----	~16.5
Respiration ¹	~21	~16	~3.0	-----	-----	~40
Sewage (solids) ²	~9.1	~8.4	~1.2	.7±0.1	.1	19.4
Sewage (soluble) ²	~1.3	~1.5	~.3	~.9		
Losses due to death ³75	.2	.1	.1	-----	1.15
Added biomass ³ (population growth).....	.45	.12	.06	.06	-----	.7

Note: All figures prefaced by ~ are estimates based on plausible allocations of protein, carbohydrate, and fat.

¹ Not including oxygen from the air; proportions based on combustion of sugar (C₆H₁₂O₆) yielding CO₂ and H₂O.

² Sewage solids estimated at 0.55 lb. per capita per day; nitrogen content of sewage sludge (3 percent to 4.3 percent) taken from O. E. Albertson, "Low Cost Combustion of Sewage Sludges," Water Pollution Control Federation Meeting (1963).

³ Assuming the population increase is 3.2 percent (of the biomass) per year, and the death rate is 2 percent (of the biomass), leaving a net increase of 1.2 percent.

Source: Based on calculations in Robert U. Ayres and Allen V. Kneese, "Environmental Pollution," a paper prepared for inclusion in "Federal Programs for the Development of Human Resources," a compendium assembled by the Joint Economic Committee of the U.S. Congress (forthcoming).

on the incineration of sludges and solid wastes, would protect its water and land resources but at the expense of discharging waste residuals predominantly to the air. Finally, a region which practiced high-level recovery and recycle of waste materials and fostered low-residual production processes to a far-reaching extent in each of the economic sectors might discharge very little residual waste to any of the environmental media.

In the transportation sector—which is the greatest single source of gaseous residuals and also a very significant source of solid wastes—a variety of residuals and cost tradeoffs are also possible. For example, powering automobiles electrically and supplying energy for them from conventional steam plants would tend to greatly reduce carbon monoxide and hydrocarbon emissions to the atmosphere but at the same time would increase SO_2 unless the waste gases from the power plant were treated. If treatment took the form of wet scrubbing, discharges to the water environment would be increased. If dry sulfur recovery processes were used, overall discharges to the environment would be reduced but NO_x emissions less so than the others. Mass transit substitutes for individual cars would greatly reduce emissions as would the substitution of steam (external combustion) engines for conventional internal combustion engines. If electric vehicles were, as has been suggested, longer lived than conventional automobiles, another major residuals problem would be significantly reduced in intensity.

Further complexities are added by the fact that sometimes it is possible to modify an environmental medium through investment in control facilities so as to improve its assimilative capacity. The clearest, but far from only, example is with respect to watercourses where reservoir storage can be used to augment low river flows which ordinarily are associated with critical pollution situations.

Approach to planning and policy

In light of the intricate and interdependent nature of the problem, the piecemeal and ad hoc approach we have taken to environmental protection in the past seems clearly unsuited to the present situation. A more systematic approach to the forecasting and management of residuals is needed if we are to achieve not only a better environment but achieve it at an acceptable cost. The appropriate area for such management is the "problem shed"—the region impacted by waste residual discharges and in which effective systems of controls can be exercised. Such a region will be difficult to define and clearly may differ in extent as the focus shifts from the air to the water and to the land environment. Research progress is being made on the question of the appropriate regions for analysis and control; on providing more accurate and detailed forecasts of economic development and the residuals associated with it; on mathematically modelling the meteorological and hydrological systems which, given a rate of emissions, determine the concentrations of foreign substances and their probabilities and duration; and finally, on the measurement of damages caused by these substances in the environment.

All these tools must be brought together to plan more rational and effective environmental management strategies in our regions. But a reasonably careful review of the level of work in these areas suggests it is not nearly commensurate with the urgency of the problems we confront in creating a better environment.

STATEMENT OF DR. DOUGLAS L. BROOKS, PRESIDENT, THE TRAVELERS RESEARCH CENTER, INC., HARTFORD, CONN.

These hearings have illustrated most effectively that better management of our environment is, or ought to be, everybody's business. For most of us, however, it would involve complexities which are orders of magnitude beyond what we have come to think of as "business as usual." In fact, after listening to these most instructive proceedings, I will make a prediction about one probable consequence of establishing environmental quality control as a national objective. It is almost certain to produce a nation-wide identity crisis!

Scientists are going to have to become humanists, harnessing their methods and knowledge to the yoke of human service.

Humanists must become, if not scientists, at least connoisseurs and critics of systems and societies as well as of individuals, the objective "out there" as well as the subjective "in here."

Politicians must transform the art of the possible—which someone has defined as “steering a course of least resistance among competing special interests”—into the art of the impossible; that is, how to bring all special interests, no matter how powerful, to jointly secure the long run collective interest, even when the latter has no ready advocate.

We must all become ecologists—and ecologists must transcend their tradition of being primarily naturalists and become “hard” scientists, and so I come full circle.

A tall order, but the alternative is an accelerating plunge of the human spirit into perhaps eternal shadow where the correspondingly dizzy rise of the GNP to unprecedented heights will never even be perceived.

What, in less poetic terms, must be done? The last five years has produced a large body of literature on the subject, to some of which I have contributed. It, like these hearings, boils down to this. In simplest terms, we need two things: information, and people who will act on that information.

This means, first, government people, and at the Federal level, most importantly Congress, since in domestic affairs, at least, even when the Executive proposes it is Congress that disposes. I leave it to those who know whether Congress is organized properly to receive, recognize, and act on information diagnostic and prognostic of our environmental ills.

Is that information available? In great part, yes. The Departments of Interior, Commerce, Agriculture, HEW, Transportation, HUD, aided by programs supported under an impressive array of legislation, have produced great amounts. So has the scientific community. It needs to be properly packaged, however, and communicated in timely and appropriate fashion to a Congressional body committed to its wise and far-seeing use. The institutional means for doing so is lacking, however, as I have said elsewhere.¹

The greatest and potentially most serious lack, however, is fundamental information concerning future consequences of present action. For this we need a genuine working theory of the environment and of man/environment interactions. To get one, we will need—

Not fewer physicists, chemists, biologists and economists, but more environmentalists, cross-disciplinary generalists who will pioneer the development of the new field of environmental management;

Not fewer university departments built around well-established fields, but more environmental institutes or centers—not necessarily university based—concerned with a whole new realm of phenomena, environment, and man interactions;

Not less attention to theories of the cosmos or of the cell, but more effort devoted to the development of a theory which portrays how the environment reacts to pressures put upon it by man and in turn produces pressures on man and his communities.

I have elsewhere¹ described the kind of institute or, preferably, institutes I feel are needed. A short-hand term for them might be “Environmental Management Laboratories.” They will require money and imagination, and even then will be a long time in staffing, training, observing, modeling, and experimenting before acceptable holistic designs for “Spaceship Earth” begin to appear. But since we badly need today these fruits of what may be decades of work, I suggest its high time we begin.

NATIONAL ACADEMY OF SCIENCES,
COMMITTEE ON SCIENCE AND PUBLIC POLICY,
Washington, D.C., August 22, 1968.

HON. EMILIO Q. DADDARIO,
House of Representatives,
Washington, D.C.

DEAR CONGRESSMAN DADDARIO: I am responding to your invitation to submit additional comments in connection with the Joint House-Senate Colloquium of July 17. I would like to emphasize several points which came out in the discussion, but which I feel require special emphasis. These comments relate to the following points: (1) the setting of standards for the environment, (2) the degree

¹ Reference: *Social Sciences and the Environment*, Garnsey and Hibbs, eds., University of Colorado Press, 1967.

of presumption for and against new technology, (3) the relation between understanding of a technology and estimating its environmental impact, and (4) the preservation of future options for use of the environment as an important criterion for investment decisions that affect the environment.

1. Standards. There is an implication in some of the discussion of environmental quality that it is possible and desirable to set absolute standards of environmental quality that are independent of circumstances or of alternative uses of the environment. I do not believe that this is a proper approach, and I am afraid that its widespread adoption in legislation or regulation would result in increasingly serious misallocation of resources. A given standard can be met only at a certain cost both in terms of direct investment and in terms of foregone opportunities for other social benefits that might otherwise have been realized. Standards are often a substitute for thought. What is needed rather is a decision-making process for environmental quality that gives consideration to the environment and man's works as a total system, and takes into account all the costs and benefits in this system.

In most cases, investment in environmental improvement yields great benefits for relatively little cost up to a point, and then reaches a point of diminishing returns where the cost of further improvement accelerates rapidly while the benefits of additional quality improvement become more and more marginal. Ideally investment in environmental improvement should stop near the point where the difference between costs and benefits reaches a maximum, provided that all environmental effects, including the more intangible ones, are taken into account. Such a decision process, however, may lead in some cases to standards that are more stringent than any arbitrarily selected standard, and much more stringent in other cases. If standards were set to meet the needs of the most demanding use of the environment, there would be many cases in which they are unreasonably high and costly to maintain.

If standards are built into law, they are hard to revise in the light of new knowledge of environmental effects. Since man is part of the environment he cannot exist without some degradation of parts of the environment. Thus the problem is one of trade-offs between environmental deterioration and the social benefit of the activities that pollute. Obviously we should tolerate more pollution caused by activities that have large social benefits or that benefit many people than we tolerate from activities that produce little benefit. Just as we do in the field of drug regulation in which we now require a demonstration of positive benefit of new drugs as well as a demonstration of no damage, so also in regulating pollution we should demand a demonstration of the benefits resulting from the polluting activity weighed against the degree of environmental deterioration caused or the costs of reducing it.

This type of decision-making will probably require a much more formalized decision process than we have at present, but it seems to me that legislation should be directed primarily at establishing the process rather than at setting the standards. Similarly, regulation should aim at requiring various sorts of measurements and evidence rather than specific standards. The decision process will involve formal representation of a wider variety of interests than at present.

2. Presumption for and against new technology. In the past the presumption has usually been in favor of the introduction of new activities or the application of new technology until a demonstration of positive damage to the environment was forthcoming. A recent current example is the decision to proceed with the development of an SST relegating to later research study of the question of the environmental effects of the sonic boom. The presumption is that the new technology will be introduced one way or another, and that the environmental effects will be managed somehow. The costs of these environmental effects was not very directly considered in the over-all economic analysis of the SST program. Similarly giant oil tankers were introduced into international shipping without much consideration of the possible environmental effects of massive leakage of oil into the sea near coastlines or harbors. Certainly the social and environmental costs of such accidents were not considered in evaluating the over-all economics of large tankers.

In the future it seems clear that we shall increasingly have to require a demonstration of acceptably low damage to the environment before a new activity is permitted to be introduced. As indicated under (1), the term "acceptably low" cannot be an absolute standard, but must be evaluated in relation to the benefits of the new activity. The point is, however, that the environmental

effects cannot be considered as an afterthought, but must be considered from the start in the over-all economic analysis of the activity. We have already adopted such a position with respect to nuclear energy and nuclear power. We are also in the course of adopting such a posture with respect to food additives and with respect to drugs and therapeutic agents. If we do not adopt an approximately uniform posture with respect to all activities, especially new activities, there is danger of misallocation of resources, because investment will tend to be shifted toward activities that do not have to bear their full share of the costs of the environmental deterioration that they may produce. Thus, to take a purely hypothetical example, if we do not adopt safety standards with respect to oil pipelines and oil storage that are in some way comparable with our standards of reactor containment for nuclear power plants, we might bias investment away from nuclear power. An analogous situation occurs with respect to atmospheric pollution caused by coal-fired power stations in comparison with that caused by nuclear-powered stations.

The point is that in considering the desirability of any new economic activity we must be in a position to evaluate its environmental effects, and estimate their social cost, before rather than after the decision to invest in the activity. This may considerably increase the cost of introduction of new technology, as is already true in the case of drugs, but it is probably an extra cost that society will be increasingly willing to pay, provided it is assessed reasonably fairly against all activities with a potential for environmental deterioration. It may be that in many cases it will prove desirable to cover a part of this cost by public investment, as is the case with nuclear power reactors at present, where the AEC has a large program in reactor safety research. But again the method of assessing costs should be carefully considered for its effects on the relative attractiveness of technologies that compete for the same objective. In many cases the ultimate benefits of a new technology or activity may be considered sufficiently high, so that a large public investment in minimizing its environmental effects, which are often diffuse, may be desirable.

3. The need for understanding. Dealing with the secondary and tertiary effects of technology is much more demanding of fundamental scientific knowledge than the introduction or invention of new technology, which can often be carried out on a partially empirical basis with relatively little theoretical understanding. Understanding is important not only from the standpoint of predicting environmental effects, but also from the standpoint of demonstrating environmental effects to the degree necessary to convince the public and policy-makers. When a causal relation can be established between certain activities and environmental pollution, it is much easier to obtain public action than when the evidence for pollution is based merely on statistical correlations. One possible reason for the small public response to the demonstrated relation between smoking and health is the lack of a clearly described causal chain between smoking and the incidence of disease. The relation is thus far purely statistical, and each individual thinks he can escape the average.

Unforeseen environmental deterioration may be regarded as a form of "technological surprise" resulting from lack of basic knowledge, and from lack of theoretical understanding of the interaction between the polluting activity and the rest of the environment. The understanding of the environmental interactions of technology is one of the most important objectives of basic research, perhaps even more important than its role in the generation of technology. For example, there is a great deal to be learned about how pollutants disperse in the environment, the degree to which they are decomposed, diluted, or concentrated by natural processes, and the time scale of all these effects. As another example, the physical chemistry of natural and polluted waters involves extremely complicated and interacting equilibria. We know the general outlines of the biochemical and chemical processes by which receiving waters accept and dispose of pollutants, but much of the detail is not understood. Trace metallic elements occurring in discharges can often dramatically upset natural processes, and inhibit nature's disposal methods. The complexity of all these phenomena is such that we cannot rely on empirical testing to predict all the effects that may occur; we need a thorough theoretical understanding of both the biology and the chemistry involved. We cannot wait to solve specific problems by means of research when they appear. We must have sufficient basic understanding to anticipate problems in the environment, and to guide us in narrowing down on the most promising potential remedial measures. Without adequate fundamental theory, the possibilities for applied research are too numerous for all to be pursued simultaneously. It is fundamental research only that can provide us with the

wisdom to select the proper path through the maze of possibilities, and important ideas may come from areas apparently distant from the problem area at hand.

4. The preservation of options. In calculating the costs and benefits of a project or policy that affects the environment, better methods must be found for factoring in the preservation of future options for the use of the environment as a relevant consideration. This does not mean that all choices for environmental use can be preserved, but only that, other things being equal, those projects or policies should be favored that offer the greatest room for maneuver in the future, including the possibility of reversing or modifying the decision. Less costly actions that are irreversible with regard to their effect on the environment should be penalized in evaluation, as compared with more costly projects that are more easily reversible. Thus pollution of a lake is worse than pollution of a river, and disposal of municipal wastes on land may be favored over disposal in streams and rivers. In the past, use of rivers and lakes for the disposal of wastes seemed cheap and efficient because it took advantage of natural processes for the degradation of waste materials, but it failed to take into account the constantly increasing load because of population concentrations, and the simultaneous increased demand for the use of streams and lakes for recreation. Thus an important alternative use of an environmental resource was foreclosed by the choice of a method of waste disposal based largely on short-term economic efficiency.

The general tendency of human use of the environment is to decrease its diversity. Food crops are monocultures in which the natural equilibrium among many organisms is disturbed. In a sense, all other aspects of the natural environment are sacrificed for intensity of cultivation of one species. This is necessary in most cases, but it should be recognized that the reduction of diversity in the environment may irreversibly destroy the option of establishing a new equilibrium in the future. A species, once extinct, can never be recreated.

Dams and reservoirs have a finite life because they eventually fill up with silt. Hence the construction of such dams forecloses the later possible use of the site for a reservoir, possibly at a time when it would be more urgently needed. In this sense, many water works are irreversible, and imply a cost in the future. This is not to say they should not be built, but only that the cutting off of options in the future must be considered.

Sincerely yours,

HARVEY BROOKS.

MICHIGAN STATE UNIVERSITY,
DEPARTMENT OF BOTANY AND PLANT PATHOLOGY,
East Lansing, Mich., August 28, 1968.

Hon. EMILIO Q. DADDARIO,
Chairman, Subcommittee on Science, Research, and Development, House of Representatives, Washington, D.C.

DEAR CONGRESSMAN DADDARIO: Speaking for myself as well as the Ecological Society of America, I wish to thank you for the opportunity to appear and comment briefly at the recent Congressional Colloquium on Environmental Quality. It was a stimulating and encouraging event. The development of continuing dialogue between the Congress and scientists experienced in environmental problems is one that should be maintained, indeed, even expanded. We deeply appreciate your precedent establishing efforts in this most important new step forward.

The Public Affairs Committee of the Ecological Society has prepared a statement on the importance of ecology and the ecosystem concept which we think is pertinent to this general problem area. I am transmitting it in the hope that it, or extracts therefrom, can be included in the record of this special session.

Also, I am including a copy of an address I delivered to my colleagues in the humanities wherein I attempted to convey some of the reasons ecologists are uneasy about the present unplanned drift in the nature of our planet's living skin. It will be published this winter in a journal called "*Centennial Review*". If you think any parts are pertinent feel free to include them in the record or make whatever other use might enhance your important work.

Finally, I'm including some specific recommendations that reflect my personal views rather than my official position as President of the Ecological Society of America. Again, these can be included in the record if you think it appropriate, or use them in any manner you think will speed us toward a more rational course relative to retrieving and maintaining quality environments.

Again, let me thank you for the privilege of bringing before the colloquium some of the views of the ecologist. We trust you will continue these very important efforts of yours in bringing before Congress a truly balanced assessment of where we are and where we're heading.

Sincerely yours,

JOHN E. CANTLON,
President, Ecological Society of America.

Enclosures.

FURTHER RECOMMENDATIONS FOR THE RECORD OF THE JOINT SENATE-HOUSE
COLLOQUIUM ON ENVIRONMENTAL QUALITY

(By Dr. John E. Cantlon, professor of botany and plant pathology, Michigan State University)

In reviewing what transpired at the Colloquium I find that the general state of the situation was presented rather well—especially for the narrowly oriented human health aspects of environmental quality. However, in addition to the need for more active and meaningful environmental quality monitoring and more research on how ecosystems operate, I should like to sketch a few more straightforward recommendations.

1. The Congress needs to clearly state some specific constraints beyond which environmental degradation is clearly inimical to the long term well-being of the country; e.g., (a) It is to be the policy of the government of the United States that no man-induced alteration of the environment shall be permitted to continue which stresses over a broad area the natural purification processes that maintain the healthful balances among the gases of the atmosphere and among the essential inorganic nutrients of land and water environments. In any case wherein damage is alleged by a panel of experts the burden of proof of absence of stress shall lodge with the agency, corporation or individuals responsible for the continuing alteration. It shall further be the policy of The Government of the United States to attempt by all peaceful means to obtain international agreements on this essential constraint upon Man's capability of altering this planet's natural life support systems.

2. As custodians of a heritage not only from previous generations of men, but a heritage of millions of years of evolutionary development, the Congress should clearly establish constraints against further inadvertent extinctions of species and ecosystem types in the U.S. and lands under its administration; e.g., (a) It is to be the policy of the government of the United States that no species or ecosystem types will be permitted to be placed in jeopardy of extinction without an unbiased review that clearly establishes both the non-essentiality of the species or ecosystem type and the absence of reasonable alternatives to the operations producing stress upon the species or ecosystem type. It shall further be the policy of the United States to attempt by all peaceful means to obtain similar international agreements on protecting marine and migratory terrestrial organisms in non-U.S. regions.

3. The Congress should undertake to expedite eliminating the serious lack of environmental understanding in the public educated citizenry of the country. The need to preserve the essential exclusion of federal government from interference in public school curricula narrows the alternatives of action. They are not absent, however. The objective should be to have each high school graduate attain voting age possessed of some minimal understanding of how the ecosystems that sustain and inspire him operate and what maintains their continuing good health. Since our fundamental knowledge about ecological systems will rapidly increase in the years immediately ahead, it is essential that this new knowledge be expeditiously translated to elementary terms for continuously updating this crucial facet of public education.

One example of a place to start would be to encourage the home economics curricula in the United States to adopt as a curricular focal point "the home as an ecosystem." Learning to think of each household as a system of inputs and losses of energy and materials would provide a means of relating to the larger urban and rural ecosystems. It would be rather simple to quantify the coupling of each individual in a systems way to his requirements from air, water, and food sheds, from fuel and other resources; as well as coupling his waste outputs to these regional sheds and man's larger ecosystems. Learning how these systems operate and where he fits in the picture may help alleviate some feelings of alienation between the individual and various components of his environment.

Learning what affects the health of the ecosystems that sustain and inspire him may make him a better informed voting citizen.

The education divisions in HEW, NSF, USDA, USDI and The Smithsonian Institution could, if encouraged by Congress to work imaginatively in this field, find many ways of improving the present state of primitive environmental education in our public schools.

4. To my knowledge, Congress has not attempted e.g., through the offering of prizes, to elicit from the nation's talent pools a feeling of participation in the solving of national problems. One could imagine something akin to the Nobel prizes administered by the pertinent Joint Senate-House Committees on the very highest ethical and intellectual level.

A. Such prizes to go to:

1. The individual making the most significant:

(a) research or engineering contribution to solving an environmental problem

(b) contribution to translating recent research and development into a broad educational presentation

2. The private enterprise company

Ditto.

3. The Federal Laboratory

Ditto.

B. The prizes would have to be real distinctions, akin to the Congressional medal of honor for military contributions of individuals or Unit Citations for groups.

C. The administration of the prizes should be by Congress, but they should obtain the services of panel of experts for judgment and circulate the public widely for nominations.

THE IMPORTANCE OF ECOLOGY AND THE STUDY OF ECOSYSTEMS

(By the Public Affairs Committee of the Ecological Society of America)

This essay on the status and importance of ecology was developed in response to a challenge made to ecologists by the Subcommittee on Science, Research, and Development, Committee on Science and Astronautics, House of Representatives (*Environmental Pollution, A Challenge to Science and Technology*, Report of the Subcommittee on Science, Research, and Development to Committee on Science and Astronautics, Eighty-Ninth Congress, 1966). The Ecological Society of America welcomes this challenge and wishes to thank the Subcommittee for the opportunity it has provided for ecologists to bring to the American public the growing and pervasive environmental quality problems which are facing all of us. These remarks therefore are offered as part of our response to that challenge with the respectful quest that they be made a part of the record of these hearings.

Before discussing the importance of ecology, it is essential to consider how ecology relates to other fields especially in regard to the status and need for research in ecology. It is not difficult for the practitioners of a discipline to arrive at the rather obvious conclusion that their particular field of study is not only important but that it merits support, in this case financial support from society, of a greater proportion than it has heretofore received and a relatively greater proportion than is allocated to other disciplines.

"Criteria for scientific choice" have been suggested by Alvin M. Weinberg,¹ a physicist and director of the Oak Ridge National Laboratory. His criteria apply to any field of science, and we would like to present the case for ecology within the framework of his suggestions. Weinberg's basic thesis is that the time has come when we must make choices among various fields of science as a matter of public policy. While the scientist may argue that all of science is of importance to man, in fact certain areas of science are more nearly ripe for rapid expansion and exploitation and some areas of science are far more important to mankind than are others. We believe that ecology is ready for rapid growth and development and also that the subject matter of ecology is of vital importance to mankind.

Weinberg believes, first of all, that there are two kinds of valid criteria for scientific choice: internal and external. Internal criteria are generated within the scientific field itself and answer the question "How well is the

¹ *Physics Today*, March 1964.

science done?" External criteria are generated outside the scientific field and answer the question "Why pursue this particular science?"

Two internal criteria can be identified easily: (1) Is the field ready for a significant advance? (2) Are the scientists in the field really competent? These are important questions. Their weakness as criteria is that the judgments derived from such questions are likely to be parochial since such questions can best be answered only by the scientists working in the field.

Answers to these two questions are somewhat complicated because ecology is a highly diverse field of endeavor. The subject matter ranges from the behavior of single species to interactions between all of the organisms forming part of an ecosystem, from study of movements of a particular kind of chemical ion to the movements of populations. The approaches to these topics may be descriptive, analytical, or theoretical and mathematical. All of these approaches and topics and the numerous combinations of them are essential to the development of ecology, and the people interested in the various parts of the spectrum are quite different in their approach and in their degree of sophistication.

Ecosystem analysis is the most complicated of these topics, and it is in this area that great advances can be expected in the near future. Theoretical, mathematical models have been constructed for various aspects of the ecosystem, but the combination of these mathematical models into a comprehensive whole has necessarily depended upon the development of computer techniques for its success. Preliminary efforts in this direction have already been made, but the ecosystem is the most complex entity which scientists have considered. More than computer technology is required, however. To have genuine significance, theoretical models must be shown to have some relationship to the real world. The demonstration of their relevance calls for more factual information than we now possess. Much more effort must be directed to this general type of analysis before we can achieve the goal, which is to be able to predict the effects of modifications of the environment, whether man-made or natural, upon the total balance of organisms and physical environment which make up the ecosystem.

The wide spectrum of problems which ecologists tackle makes it difficult to be dogmatic about the competence of scientists in the field. A scientist interested in the description of the biota in a given environment may be completely inept in the application of mathematical models in an ecosystem analysis, and he may be viewed as less perspicacious and hence less competent than those who are using the more sophisticated techniques. On the other hand, the person who has a talent for mathematical theorizing may lack the gift for seeing relationships in the field, in the real world, where confirmation of theory must be sought. In each of the areas which are essential for the further rapid development of ecology, there are highly competent people, though naturally, as in any field, there are also dabblers, amateurs, and incompetents who like to call themselves ecologists. There are also people who, because they have acknowledged competence in a distant area of biology or environmental sciences, mistakenly assume they must have equal competence in ecology.

In regard to these two internal criteria, therefore, we are of the opinion that the field of ecology and, particularly of ecosystem analysis, is ready for a major and significant advance. Many of the personnel engaged in all aspects of ecology are competent, and with the present personnel these significant advances may be expected. The future development of the field will, however, certainly require the training of additional ecologists, and centers of excellence are available where this training can be obtained.

Three external criteria can be recognized: technological, social, and scientific merit. These criteria can be applied to choices between broad fields of science—say, high-energy physics versus molecular chemistry, or ecology versus space exploration.

Technological merit, in Weinberg's sense of the term, denotes a major technological end point such as a breeder reactor or a means to desalt sea water. The goal of ecology is less specific, but no less vital. As mentioned above, the goal of ecology is to develop an understanding of the major ecosystems of the world. Once achieved, that understanding would enable one to predict the changes which might be expected as a result of planned or natural modification of the various environments. There are many examples of potential man-made changes in the environment which could have widespread effects. These are generally recognized by ecologists as major problems even though the effects may be in the distant future. But many are not yet recognized as problems by the general public. As one example, we are, today, burning fossil fuel at a rate greatly in excess of the

rate at which new organic matter is being stored on earth. This has inevitably increased the carbon dioxide content of the atmosphere and this may ultimately lead to a major climatic change. The so-called "greenhouse effect" results because an increased carbon dioxide content of the atmosphere will absorb and retain on earth a higher proportion of the long wave length reflected radiation which has for millenia been lost to space. This retention of heat could warm the earth as a whole, and only a small average warming effect may cause tremendous changes, some good, some bad. For example, a change of only 1°F in the average annual temperature would melt large amounts of the polar ice caps and perhaps inundate our coastal cities. The level of carbon dioxide in the atmosphere and the level of oxygen are closely interrelated since plants utilize carbon dioxide and release oxygen in forming organic matter. Some of the carbon dioxide added to the atmosphere will enter the oceans and may modify their productivity.

Some will enter the store of living organic matter, mostly in the forests which form the major reservoir of living organic matter on earth. Ecologists must be able to evaluate the long-range effects of these processes which will require an understanding of such diverse ecosystems as the ocean and the tropical rain forests.

The above example cites a problem which will not become acute in our lifetime but may be of vital importance to future generations. The social merit of a field of science may be judged on more immediate and practical applications. Weinberg states that social merits of a science depend upon relevance to human welfare and the values of man. Ecology has a strong claim for support based upon this criterion since herein lie the problems of pollution, over-population, environmental degradation, conservation, natural beauty, all areas which are highly significant in terms of human welfare. In each of these areas, ecology already has contributed and can continue to make significant contributions. Pollution is one form of environmental modification at which man has become enormously proficient because of his technological developments. Nature has a tremendous ability to recover from such abuses, but man has unfortunately proceeded on the assumption that this ability to recover is infinite, or at least is far greater than it is in reality. Society will obviously continue to have waste materials and as populations and technologies expand the most of waste to be disposed of will increase. We can, however, no longer disregard the effects that waste disposal has upon natural environments and populations since ultimately the loss of part of our environment is a direct loss to man. The cost-benefit ratios of our activities must include environmental effects in addition to the more obvious and immediate dollar values which can be assigned to different types of treatment and disposal. We must avoid, in Senator Jackson's words,² the dilemma that "much of the thrif of yesterday turns out today to be prodigality because the price tag did not include all of the social and economic costs."

Our rapidly burgeoning populations produce, in addition to the social urban problems (which might be termed human ecology), many problems of natural ecology. We must evaluate the basic productivity of the earth in order to insure adequate food supplies for future generations. What, for example, can the oceans contribute to feed the expanding human population? Can we understand the ocean ecosystem well enough so that we can cease to be hunters in the sea and become producers of new and presently not available resources? Can the tropical areas contribute greatly to the increased food needs? Certainly the ecosystem in the oceans and the tropics is vastly different from conditions in the temperate zones where most of our agricultural technology has been developed. We are already sure that the same technology is not applicable to these vastly different ecosystems. We must understand them much more thoroughly before we know the ways in which their resources can be increased and utilized to the greatest benefit of mankind.

As Weinberg suggests, the scientific merit of a given field can best be judged from the vantage point of the fields in which it is embedded. When the practitioners of a given field judge its scientific merit, the results generally tend toward a parochial view and an emphasis upon a disorganized mass of details and complexities. We feel that, on the basis of this criterion, ecology is a stripling, rapidly growing but not yet come of age. Ecology has not yet produced any fundamental concepts or discoveries which have become cornerstones for the development of other fields of science in which ecology is embedded.

² *BioScience*, December 1967.

In evaluating such a statement, however, we must consider the general structure of science as a whole. Certainly mathematics lies at the center of the scientific complex and has contributed fundamental and useful tools for every branch of science. Physics and chemistry occupy the next orbit of science, both drawing heavily upon mathematics and both contributing greatly to the study of the greater complexity of the life sciences. The great advances in the life sciences in the last few decades are related to the discovery of DNA and the interpretation of the genetic code which holds great promise for the control of disease and ultimately, perhaps, for the control of the genetic characteristics of different species of organisms, including man. Ecology by its very nature envelops all of these fields and its contribution to the development of science is the synthesis of information from many sources into concepts of increasing generality. Ecology is obliged to use information and concepts from all other biological fields, from chemistry, physics, and mathematics, in order to bring us to an understanding of the relationships of organisms to each other and to the nonliving characteristics of their environments. For example, in order to understand the development and operation of ecosystems, ideas and data from such diverse fields as physiology and computer technology, information theory and population genetics, taxonomy and biochemistry must be brought together. When a theory of ecosystem emerges, it will be one of the major synthesizing ideas in science, perhaps rivaled only by the theory of evolution through natural selection in this respect.

Considering scientific merit, now, in terms of capacity for generalization, we can only conclude that ecology satisfies this criterion for public support.

Where is ecology going? What direction should it take? By and large nature has been described in sufficient detail to give us a broad outline of what exists on this planet. Certainly some parts of the earth and some types of environments are poorly known. Certainly many species remain to be discovered and the composition of some communities, even in our own country, have not been described. In every field of science, there are areas requiring further consolidation and deeper understanding. And so it is with ecology. But the problem area that beckons ecology in the future, the area we know the least about and that represents a quantum jump, is the ecosystem.

Conceptually the ecosystem lends itself to analytical and empirical research as well as the cell, the organ, and other lower levels of biological organization. It includes the processes of circulation, transformation, and accumulation of energy, matter, and nutrient elements through the medium of living things and their activities. Some specific functional processes include photosynthesis, decomposition, herbivory, predation, parasitism and symbiotic activities. Because it involves process, interaction, transfer, the ecosystem is at least conceptually amenable to experimental study under field conditions. However, much experimentation requires more sophisticated research and analysis and greater array of research tools than heretofore was deemed essential by ecologists.

Earlier we mentioned several major national problems—pollution, population spread, resource management, and large-scale climate control, among others. All of these involve information about ecosystems. All of these have an urgency that is recognized by both the lay and scientific public. If ecologists succeed in attacking the ecosystem in a way that yields testable hypotheses and predictive information, the theories so generated are certain to bear directly on these national "practical" problems.

The same kind of logical inference that is successfully used in laboratory research must be applied to this higher level of organization, but in the field. To reach this goal, it will be necessary to develop new breeds of ecologists equipped with new tools and with a different outlook on research.

What about the new tools? To study ecosystems effectively, we will need both new physical and mathematical tools including digital and analog electronic computers, electrical and mechanical simulation devices. The act of expressing and testing biological problems with numerical, electrical, or hydraulic analogs often reveals unsuspected relationships and leads to new concepts or methods of investigation. More refined chemical analytical equipment will be needed such as gas chromatographs, infrared gas analyzers, and recording spectrophotometers, and new physical analytical equipment such as microbomb calorimeters, biotelemetric equipment, and other electronic equipment useful for rapid, non-destructive sampling of plant and animal populations and parameters.

As to outlook, ecologists will have to learn to curb some of their traditional individuality, to learn how to work in large teams harmoniously and effectively,

and to develop ways of sharing data. What is needed is nothing less than a new psychology or a new sociology for ecologists. The usual inertia attendant on changes in tradition will be overcome because the intellectual goals require change. Ecology is not different from any other scientific field in this regard: the intellectual values exceed all others.

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AN ECOLOGIST LOOKS AT HIS ENVIRONMENT

Review Lecture (By J. E. Cantlon, Michigan State University)

Like all images conceived by human beings an ecologist's view of the world in which we live reflects his particular biases and ignorances; but it also should contain any unique insights his background gives to him. This afternoon I'd like to convey both—hopefully more insights than biases, but I don't believe this is essential.

If ecologists of today were doing what they now do, say in the time of Charles Darwin, they would have considered themselves students of natural history, or just naturalists. Somewhat earlier physicists and chemists would also have been considered just students of natural history; but unlike physicists and chemists the ecologists have more nearly continued to study nature whole. That is, they have continued to study complex systems consisting of living organisms and non-living resources. Such systems we call ecosystems and they can be visualized as arrays of plants and animals together with inputs of energy—normally sunlight—and circulating resources like water, oxygen, carbon, phosphorus and nitrogen.

The living populations in such systems are coupled to each other and to the non-living resource pools by various pathways or webs of interrelationships along which energy, materials and information move. The fraction of sunlight that is fixed into usable chemical energy by the green plants is partly used up by the plants themselves. It also is the only source of energy for the plant eaters, who in turn are eaten by flesh eaters, who themselves may be eaten by other carnivores or parasites. "All flesh is grass" is the way the ancient Hebrew phrased this energy dependency upon the green plant. Ultimately all dead bodies and excreta are decomposed by such critters as maggots, bacteria and fungi. Thus, the energy originally fixed by green plants is dissipated a step at a time, and in most natural systems none is left over. All of our ecosystems are ultimately dependent upon the sun continuing to shine.

The materials, unlike the energy, can be used over and over again. The carbon, oxygen and nitrogen atoms that make up our bodies could have been part of the bodies of soaring redwoods, stupid dinosaurs, graceful antelopes and lowly sea slimes. Reincarnation in this sense is a fact of life and death.

In such a system where materials are continuously recycled pollution does not exist as a system characteristic. As Edward Deevey of Yale University has succinctly put it, for these natural systems today's production was yesterday's garbage. These complex, beautifully balanced ecosystems are the products of more than two billion years of evolution. Some individual plants or animals enter life with mistakes in their genetic codes, and some mistakes have resulted in more efficient cycling—i.e., smaller leaks of scarce materials from the system. Over the millenia this kind of genetic information has tended to accumulate and to form more effective recombinations as ecosystems have endured.

In addition to the strict sum of the genetic information of the constituent species, the ecosystems have additional information contained in the organization of the plants, animals and resource pools into functional arrays, with the parts tending to have particular spatial, numerical, temporal and interactive relationships. In a modern city the multitude of interrelationships among the different human occupations is an analogy that may help to convey this ecological information content of natural systems.

Each of the species in an ecosystem appears to be genetically programmed in one way or other to accommodate for the presence of most other common species in the system. This demands a sizeable amount of genetic information and to

make this information operational, energy and material must be expended. The octopus squirts ink when attacked by some predators. The bat sends out a sonar pulse to locate its prey, which (if it happens to be one particular type of moths) jams the bat's sonar with a sound signal of its own. The flower sends out a signal perfume, the pollinating animal detects it, automatically scans his memory bank for the response required and whether he changes his flight path depends on the genetic fit between the two very different kinds of organisms. It has been suggested by Dr. H. T. Odum, of the University of North Carolina, that the high cost in information, energy and materials required to add additional species to already complex communities places a limit to species diversity in natural ecosystems.

Another marvelous characteristic of natural ecosystems is their capacity for self-maintenance, self-replication and self-repair. It will not take the time here to illustrate these, but they are both intrinsically interesting and of considerable importance to man.

The ecologist's training and research nurtures within him a deep and profound respect for the elegance and complexity of these natural ecosystems. They represent a truly vast amount of information as yet virtually untranslated for any single whole system, although we know bits and pieces for particular species, particular interactions between species and particular attributes of systems. The complete extermination from the earth of any ecosystem type is viewed by the ecologist in the same light as scholars in the humanities might view the obliteration of any human culture's language, literature, art and other cultural components. Where total extermination is deliberate and made in the name of "improvement", both groups of scholars have the right, indeed the duty, to demand rigorous and wide prior review of such a decision.

For the ecologist, permitting the extinction of falcons or any other creature from any ecosystem type by the accumulation of long-lived pesticides is little different from tolerating the expunging of every profane word from the works of Shakespeare or de Maupassant. The analogy is similar for tolerating the extinction of whales from the seas or passenger pigeons and pumas from the entire eastern deciduous forest ecosystems by hunting. If it can be proven that these tragedies are essential and totally unavoidable it might ease our sense of guilt; but where, when and by whom were the decisions made? By whom were they reviewed?

Need I point out that preserving a few miserable survivors in a zoo or an arboretum, or in a remote corner of their former range, is equivalent to justifying the expunging of all the world's copies of Aristophanes' Five Comedies because dictionaries and other works harbor all of its words? Surely, it must be appreciated that functional wholes have to be the units of preservation. Further, these units must be large enough, near enough to the range center and protected from any general environmental degradation so as to retain intact the system's powers of self-regeneration and self-maintenance.

It may be true that the above position of the ecologist can be dismissed as a case of special pleading. However, he also has very hard-minded reasons for insisting that earth-wide environmental degradation and decline in ecological diversity must be reversed.

For developing this point I would like to make the barest sketch of the last 10,000 years of man's culture history giving an ecological perspective to events leading to the development of our present industrial ecosystems. Recall that in natural ecosystems the energy comes from the sun and the resources are used over and over, many very locally. The internal genetic and ecological information content of these systems is very high and they can maintain, repair and duplicate themselves. In most cases the output of these systems is completely utilized in self-maintenance or is lost in sediments—there is no net yield left over.

In man's primitive beginnings he was just another critter in the ecosystems making up his habitat. He was brighter than most, but for long millennia he created no more impact than browsing elephants or a town of prairie dogs locally do in their natural ranges. Man's discovery of fire making made early changes, and the self-repair capabilities of ecosystems in regions with pronounced dry season began long ago to adjust to man-caused increases in fire frequency.

Domestication of agricultural ecosystems brought further, though at first more local, changes. Domestication, from an ecological perspective, is akin to brainwashing the population being domesticated. That is, as individual plants or animals are removed from their original setting they are free to lose certain formerly essential genetic information with impunity. For example, certain

abundant insects in a domesticated plant's original home would quickly eliminate any individual plant whose genetic code did not direct the making of the correct repellent terpene compound; i.e., this mutation would be ecologically lethal. If the insect cannot occur out of its normal habitat the mutation would not be lethal for individual plants growing where the insects are absent.

What are the habitat characteristics of early domestication sites? Ignorance far outweighs evidence on this, but Dr. Edgar Anderson of the Missouri Botanical Garden has proposed an interesting hypothesis for our discussion. He called it his garbage dump hypothesis of plant domestication. He notes that the most ancient evidences of domestication are associated with areas where locally abundant hunting and gathering permitted at least a semi-sedentary human existence. At these sites dumps of refuse, the middens of the archeologists, accumulated. Most wild species do poorly on such highly concentrated garbage, which by the way would include seeds and roots of the wild-gathered species that were overlooked by the food preparer. Some of these plants could grow, and here at the dump many former lethal mutations could occur without damage to the plant. The energy and materials formerly used to convert the genetic information to ecological action could now be used for greater growth. The incipient domesticant became huskier. Since more inorganic nutrients and water were present at the dump, both through man's input and the reduction in competition from other plants, these huskier plants soon provided a favorite collecting ground. Man's agile mind grasped the idea of expanding the suitable habitat and plant domestication arose, surely quite independently, in a number of places on the earth's surface. Animal domestication also resulted in the loss of particular kinds of genetic information, e.g., that useful in eluding predators such as man, or some aspects of the species' normal migrational wanderings. Non-essential genetic loci are free both to mutate and to participate in various new combinations. From these man has tended partly inadvertently to select for such qualities as ease of harvest, storage properties, size, docility and more rapid growth rates.

Viewed ecologically, domestication has for the most part yielded individuals that are big, fat and stupid, in a word "vegetables". Man replaced parts of the species' intrinsic self-maintenance, which was either coded on its genes or contained in the ecological information of its native ecosystem, with cultural information and in the process extracted a yield of energy and materials. After these keystone discoveries additional improvements were rapidly added. He very early noted that water as well as garbage was good for plants. From ancient days he knew that gathering and hunting of preferred plants and animals were favored by occasional fires and soon was burning areas specifically for his domesticants. He now had the essentials of a domesticated ecosystem.

Grains, legumes with their associated nitrogen-fixing bacteria and a few other plants could be sown directly on the ashes after burning natural systems. The self-repair processes of the fire-damaged natural system yielded a formidable array of weeds, and abandonment was easier than weed-fighting. Later the digging stick and plow permitted man to stay and fight. When he did his persistence led to losses of nutrient elements because the living pools were now too transient. Retreat to flood plains with their periodic import of nutrients in flood waters, import of wood ashes and leaf litter from non-farmed areas, use of animal manures, use of particular sequences of crops, and systematic use of fallow (now a semi-natural repair system) all emerged over a few thousand years.

Rome was able to conquer a vast region using primarily the surplus energy harvested from such domesticated systems. Plant and animal agriculture was the main energy fountain of Rome. It was augmented by hunting and gathering from the forests and the seas. The former also yielded charcoal to smelt their ores as well as wood to heat their homes and supply their building needs. Except for the wind that sometimes assisted their ships, their domestic agricultural ecosystems, together with gathering from the vast surrounding quasi-natural ones supplied their energy needs.

Even at this stage, however, imbalance was clearly a problem. Dr. O. Arrhenius of Sweden has shown that ancient culture sites remain areas of high phosphorous in the surface soils long after the culture center has ceased to exist. The areas surrounding this "high" tend to be lower in phosphorous than equivalent areas not near enough to have been stripped by cropping, grazing, hunting, leaf harvest and wood cutting. Materials that had formerly cycled locally were now tending

to accumulate in sumps. This process goes on even where conspicuous soil erosion is absent. Dr. David Frey, of the University of Indiana, has described long sequences of changes in the chemistry and biology of European lake sediments and correlated them with displacement of natural ecosystems of those of man.

Modern industrial ecosystems came into being partly as the result of challenges and stresses appearing in these pre-industrial systems. This audience need not be reminded of the early role of agricultural questions in giving birth to large segments of our present technology. In part, in attempting to solve the problems of early imbalances and perturbations we have set in motion new imbalances that dwarf the former ones. Man now uses nearly all the known chemical elements and has set up wondrous pathways along which they move. However, for this very brief early stage in the evolution of these new systems he has not had to cycle many of these materials. Largely these resources move as energy does in natural systems, it flows through them, partly dispersed along the way but most of the residue ending up in a sump, whether it be in a body of water, its underlying sediments, the local garbage dump or the atmosphere. Recall that energy continues to flow because the sun continues to shine. High grade bodies of some materials are clearly exhaustible, so ultimately we will be obliged to recycle or find substitutes for many of our materials. In the meantime their dispersal touches us as our growing pollution problems. The Report of the U.S. National Academy on Waste Management and Control, and the Whitehouse Report on Restoring the Quality of Our Environment present many rather impressive figures, I need not do so here.

Breaking free of green plants as the energy base of his system gave industrial man a massive energy surplus. Fossil fuels, which of course are sedimented plant energy from earlier natural ecosystems, have formed the energy base of present industrial cultures. Where Rome conquered a large piece of the world largely using agriculture as its energy fountain, modern agriculture has become an energy sump. Industrial agriculture consumes many times more energy than it produces. Fossil fuels are used to run the agricultural machinery, to manufacture this machinery as well as to make fertilizers and pesticides, to move water and to harvest, store, process, package and transport the agricultural commodities. One sometimes reads that modern industrial food production is more efficient than food production has ever been. However, by what measures? Not by energy or materials inputs, and one wonders whether it would be in terms of manpower if all the urban people necessary to bring the yearly ration to a man's table were entered into the calculation.

We have, of course, been able to increase the yield per unit of land area in a very sizeable way. We do this by importing to these agricultural sub-systems large amounts of fossil energy and other materials as well as utilizing a truly massive amount of non-genetic and non-ecological information which we call technology. These new sub-systems have very much attenuated self-repair and self-maintenance capabilities of the earlier type. For example, picture the disastrous repercussions to industrial agriculture of the total destruction of the fossil fuel industry for a three year period.

I have sketched this somewhat biased description of man's new industrial ecosystems not to disparage them—but rather to help convey a feeling for the ecologist's perspective. Since ecologists like to eat and enjoy the rewards of our highly productive industrial culture as well as the next man, they cannot seriously or honestly propose a return to the pre-industrial state. Contrary to some misunderstanding, ecologists aren't misguided romantics lusting after a raw virginal world without men, nor are they modern Thoreaus, recommending the abandonment of chemical fuels, fertilizers, pesticides and flush toilets. As long as the effects of these technological marvels remain confined to the sites of their use, or provisions are made to keep them from becoming widely dispersing degrading pollutants, any bad effects they produce will tend to be self-corrective in time.

However, it is the ecologist's duty to make the point that these new industrial ecosystems can scarcely be called time-tested. Really, their present state is not older than an average human life span; e.g., the persistent pesticides, atomic energy, modern herbicides, the jet aircraft, many plastic industry wastes, leaded gasoline are very recent additions. Further, only a fraction of the earth's population has yet been able to fully adopt these new systems; and decision makers throughout the world have recommended accelerated programs to bring this

about. Meanwhile, in the ecologists' view danger signals are already being registered in declining populations of some sensitive species and in flickers of change in atmospheric and water chemistry.

Homo sapiens evolved in a biosphere the nature of which was determined by the operation of the ecosystems that pre-dated his emergence. He continues to be totally dependent upon a life support system that requires functional ecosystems. This means that large numbers of plants and animals are required to keep the gas mixtures in balance and some of the essential nutrients circulating. It is true that we can do these same things without the help of other living things; e.g., in a closed space capsule. However, Dr. H. T. Odum has pointed out that this requires massive amounts of energy, materials and outside regulation; further, these systems do not maintain, repair or duplicate themselves.

I think every ecologist I know, and probably most scientists who have examined the facts, would agree that man is very likely always to be dependent upon the continued operation of ecological systems containing many species of plants and animals. At the present time it simply is not known by any man, or any group of men, which of the earth's organisms are absolutely essential to the continued good health of the ecosystems that sustain us.

Ecologists have great respect for the resilience of ecosystems but degradation in lands surrounding smelters and of bodies of water like Lake Erie convince us that a ceiling does exist beyond which the damage is greater than we should tolerate.

The very fine *Time Magazine* Essay of May 10, 1968 details some ecological assessments of changes in our modern industrial biosphere. The apt phrase "The effluents of affluence" from that article conveys part of the message. Dr. La Mont Cole of Cornell University in the *New York Times* of March 31, 1968 conveys other aspects of the ecologists' uneasiness. What neither of these articles stresses, in my opinion, is the need to maintain a wide safety margin in these matters of our life support systems. No architect or engineer could long survive professionally who did not carefully calculate the failure point of his design under expected conditions, and then add a large safety factor, both in the interest of common sense and humility in the face of our proven massive ignorance. Let us note again how very young our industrial ecosystems are and recall that there are major natural perturbations against which these systems have yet to be tested. What happens at the next massive volcanic explosion such as Krakatau produced near the end of the last century? Remember it was not the first in historic time. When the next one occurs additional loads of several things will be injected high into the atmosphere which is already showing the effects of our new ecosystems. If one wishes to play Cassandra there are other fine perturbations to play with. My main point here is that a safety margin in the design of a life support system ought to be as great as in any other design.

A stressed life support system for man is surely bound to be a lethal state for some of the earth's more defenseless and delicate species. This returns us to the first point, degradation by wide-moving pollutants and direct inroads by massive replacement of natural ecosystems by these new man-made ones both threaten not only certain species, but whole ecosystem types. The latter may be in far greater and more immediate danger. The whole can be lost while the parts persist each in different corners of other ecosystems. The ecologist doesn't want to lose any ecosystem before we've had a chance to examine it. From a more hard-minded view, however, might not potential solutions to some present and future problems exist in the information contained in these systems? Ecosystems with a long selective history favoring retention of nutrients in the system are apt to harbor some useful avenues to explore in scrubbing polluting materials from water, and finding more effective ways to use fertilizers. If all countries wish to utilize the same amount of fossil fuel energy per calorie of food yield that we now do, might not this increased drain on the world's limited fuel supply make the present high energy requirements of our systems disadvantageous? If so, we will have to come up with new designs in the future and the nontechnological information pools will reside in the ecosystems extant at the time. It seems foolish in the extreme to jettison totally any of this information, unless it is done systematically and carefully. My own inclination would be to mimic the cautious military security officer who was directed to dispose of classified documents—he made seven copies of each one before he destroyed it.

Our past tendency to allow environmental degradation to erode not only the biological diversity of the managed lands themselves, but to poison systems far from the areas where effects were intended, is little short of criminal. The

established preserves should guarantee preservation. If wide-ranging, long lived pesticides, radioactive fallout, hard detergents and other atmospheric and water pollutants jeopardize even the most sensitive of the species in these islands left in the new sea of low information domesticated ecosystems, we simply haven't insisted on high enough minima. If attempts at weather modification seriously stresses a species or an ecosystem type, we had better make very certain of all aspects of the cost-benefit calculation, and then err in the direction of easing the stress.

Although my remarks may suggest that I am, like Cassandra, foretelling doom that will indeed overtake us, I really do not believe this to be true. By nature I am an optimist—although thoroughly convinced that even optimists had better be activists. Events and changes in policy in the last decade lead me to believe we are waking up. This week I received a report from the U.S. Office of Science and Technology which summarized Federal expenditures in the area of environmental quality. From it one can estimate that in FY '69 a sum of approximately one-quarter billion dollars was encumbered for research, development and demonstrations related to environmental quality. Such computations are very difficult to make, but I feel certain that most ecologists would reject as much as one-third of the included items as not being pertinent to, or not motivated by environmental quality considerations. With more than \$30 billion being spent annually on Vietnam, and \$12 billion on Federal aid to education, my assessment is that we haven't assigned a high enough priority to this task as yet, but the point is, we are moving. There are far more encouraging signs. The world's major atomic nations have stopped atmospheric testing of fallout-producing weapons; this came at great increases in cost by moving the tests underground. The detergent industry has stopped marketing massive amounts of hard detergents. The Atomic Energy Commission and the National Science Foundation are supporting fundamental research into complex natural systems. The U.S. part of the International Biological Programs does include the examination of relationships between food production and pollution (or materials cycles) and it is proposed that natural and man-made systems be compared.

However, we need much more activity in all of these areas. Perhaps as important as any is the need to perfect methods for distant early warning and evaluation of environmental degradation trends. It should not be necessary to permit a body of water like Lake Erie to reach the cesspool stage, or have almost worldwide mortality in sensitive species from chlorinated hydrocarbons before something is done. The scale of our environmental modification capabilities today is so great that serious damage can easily be incurred before we even suspect we've made a major blunder. Catastrophes have always been considered acts of God. When international maritime law permits gigantic tankers to ply the seas, we can be quite certain that periodically one will founder and spew its load over the waters and shores. The actuaries in the maritime insurance field could give us the probabilities rather easily. The massive size of such a pollution event will guarantee that the endemic shore life of some oceanic islands will live in a world of increasing probability of extinction.

Through the deeply entrenched American principle of jurisprudence that a party is innocent until proven guilty, sources of pollution have found more refuge than we may ultimately consider prudent. Thus, where environmental degradation causes major perturbations in the species mix in a protected natural area, establishment of proof of the pollutant's causal role is a very difficult task, indeed. One needs only to recall the years of controversy in the tobacco-human cancer relationship to appreciate the problem. We obviously need to do some pioneering in environmental protection law. It is possible that fundamental human rights will need to be expanded to guarantee the right to a healthful—and some would maintain even an inspiring—environment. Senator Clifford Case of New Jersey in recently introducing a bill that would ban non-military supersonic flights over the United States for an indefinite period stated: "As a nation I believe we are moving from blind idolization of technology to recognition that we must also be concerned with its effects on the quality of life and the livability of the environment". Ecologists hope he is correct.

Present inequities in the way we calculate costs interfere with developing a clear economic picture of environmental alternatives. Certainly cheap electric power isn't really cheap to society if wastes from its production increase the number of hospitalizations for respiratory ailments in a significant way—especially at today's costs for medical care. Perhaps one of the unforeseen fallouts of

socialized medicine will be much tougher laws on pollution that degrades human health.

However, I close by returning to the bias of the ecologist. There are plenty of feedback links that will operate in the interests of human health. Ecologists generally agree that long before man himself is seriously endangered by primary effects of environmental pollution, many of the other creatures with whom we share this planet will be in serious jeopardy. We cannot take the advice of an advisor on a federal committee discussing pollution who recommended less attention to natural purification phenomena, and more effort directed toward increasing the tolerance to pollution in the living things. All one needs in order to see the patent absurdity of this advice is to ask: on which of the millions of species? Even before whole species are rendered extinct some ecosystem types will have been vastly modified. Thus, if we continue to proceed the way we are going, we stand to lose important pieces of both our genetic and ecological information. No scholarly person can sit idly by and tolerate this high-handed act of information censorship. We ecologists feel certain that once others understand both the questionable moral position of the decision to continue as in the past, and the possibility of ultimate serious threat to man's life support systems, you'll all join us at the barricades.

COMMENT FOR THE JOINT SENATE-HOUSE COLLOQUIUM TO DISCUSS NATIONAL POLICY
FOR THE ENVIRONMENT

(By Jack W. Carlson, Director, Program Evaluation Staff, Bureau of the Budget)

In response to your request for comments, I would like to review a conceptual approach for evaluating problems affecting the quality of the environment and consider some of the problems in using the approach. Primarily my comments are aimed at pollution control but have application for other aspects of environmental quality.

THE NEED FOR GOVERNMENT ACTION

As was recognized by most participants in the Colloquium, there are good and sufficient reasons for a forum on environmental quality to have been organized by Representatives Daddario and Miller and Senator Jackson because to alleviate environmental problems governmental action is necessary. First, those who pollute air, water, and landscapes or create noise do not bear the full costs of the resulting decline in the quality of the environment; and second, no individual acting alone can usually withhold benefits resulting from his efforts to improve environmental quality and thus receive compensation for his investment. Therefore, if polluters are neither penalized for the damage they create nor rewarded for their expenditure for pollution abatement, one can hardly expect polluters to automatically control pollution to a desirable or optimal level. Consequently, the public must devise adjustments to a purely marketplace solution.

For such an adjustment there are basically two approaches: first, polluters can be required by law or encouraged by a set of financial charges to pay for the damage resulting from the release of their waste; second, those who benefit by environmental quality improvements can be required to pay. So far, in meeting the challenges of pollution abatement the Federal Government has chosen the first alternative and has chosen to require that polluters reduce wasteloads to meet a minimum environmental quality standard. The enforcement of such standards is through the police power of the state. No use of economic incentives has been employed.

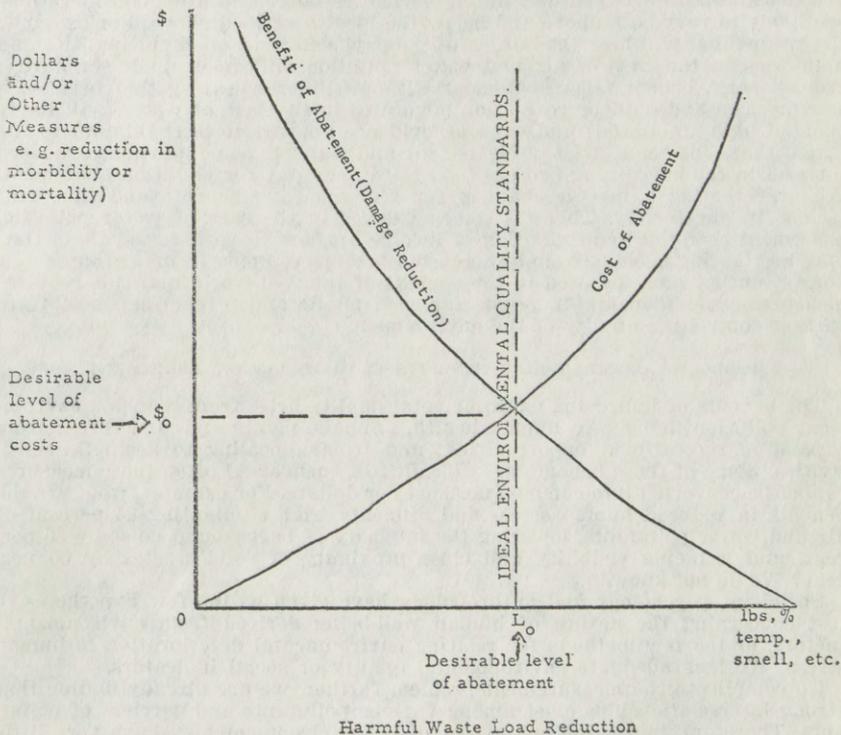
This general approach in principle assures that the real costs of producing goods and operating households are borne by those who consume the products and enjoy the homes. Moreover, placing the burden on polluters will likely result in their using the least costly way for cleaning the environment. Assuming, of course, that arbitrary choices are not imposed on polluters by governmental action, such an approach assures consumer sovereignty and the careful identity of costs and benefits in an essentially private enterprise economy. Also, the comparative advantages of pollution-free locations are more obvious and thus can be more properly valued.

IDEAL ENVIRONMENT QUALITY GOALS

Some of the participants in the Symposium indicated that they favored an environmental quality level similar to that which must have existed when Columbus set foot in the Americas. In contrast, other participants more timidly hinted that pollution may not be much of a problem. The answer, I believe, is between these two extreme positions. But it would be helpful to identify what an ideal abatement level or environmental quality standard should be. Simply stated, it is one in which society should control environmental quality to a greater extent if the damage from further environmental quality degradation is obviously greater than the cost of additional control. Society should resist further expenditures for environmental quality when the cost of environmental quality control is obviously higher than the damage otherwise inflicted. Therefore, an ideal standard occurs when the cost of control just equals the benefits [or damage reduction] from such control. I have attempted to illustrate this in Chart 1.

CHART I

Appropriate Conceptual Relationship
Between the Benefits of Pollution
Abatement and the Costs



It is important to have this concept in mind before taking steps to actually determine desirable levels of environmental quality. If it is accepted, maintaining the existing ecology is not necessarily good or bad. It depends. Some change may be acceptable if the costs to prevent it are greater than the deleterious effects of environmental degradation. In some cases, the change in the ecology may be desirable, such as additional heat in water bodies in Maine during the winter

season. To state categorically that changes in the environment should be prevented at all costs is to fail to recognize the value of resources invested for other purposes or to fail to recognize the multitude of adjustments that can be and are made when some resources are over-used. Moreover, there is no justification to place a higher value on the degree risk or uncertainty found in estimating ecological changes than in any other similarly risky or uncertain investment. There undoubtedly will be times when degradation in the environment is worth the benefits that accrue from the new technology or other conditions that caused it. Moreover, there have been very few times in history where adjustments to environmental degradation could not be accommodated. My reason for raising this point is to encourage Symposium participants to fully reflect on this concept and recognize the losses sustained by those who pay for improved environmental quality as well as the benefits gained by those who experience environmental quality improvements.

We may be seeing the results of inadequate recognition of this concept in our first attempts to improve environmental quality. There are, however, good reasons for this shortcoming: First, we do not have very good estimates of the extent of damage from pollution, although rough measures indicate that it is high enough to justify considerably more abatement of pollutants. Second, because the existing standards and those contemplated are appropriately set or will be set in the political process where relative bargaining strengths of beneficiaries and those who will pay differ, efficient resource allocation considerations are likely to vary both above and below the ideal described above. For example, the groups that will bear the burden of the payments, such as municipalities and industries in the case of air and water pollution will resist high standards; groups which benefit from abatement without directly bearing the costs, such as fishermen and outdoor recreation advocates in the case of water, will likely demand high standards; and existing evidence appears to bear this out to the extent that the beneficiaries of cleaner air and water in some locations are more forceful in the bargaining process than those who pay for pollution abatement. We are creating a new mechanism for redistributing benefits and thus real income in our society. There is some evidence in the case of water pollution abatement that this redistribution of income appears to be regressive and thus is redistributing benefits from lower income groups to upper income groups.

Any concept must be used in the context of the real world and this requires measurement of benefits and costs for each public and private expenditure to further control the quality of the environment.

PROBLEMS OF MEASURING BENEFITS FROM POLLUTION ABATEMENT

The benefits of improving environmental quality arise from reducing environmental pollution damage to human health, animals, plants and structures; from expanding recreational opportunities; and from appealing to aesthetic sensitivities. Some of these benefits are difficult to measure and often these measures cannot be converted into common measures or dollars. For example, what are the benefits in reduced human stress and ailments from eliminating 85 percent of air and water pollutants, lowering the intensity of background noise by 50 percent, and reducing visibility and close proximity of solid wastes by 60 percent? We do not know.

Sociology, psychology and anthropology have given us too few hypotheses to test concerning the nature of human well-being derived from environmental factors, or too few methods for relating environmental deterioration to human stress. We lack adequate environmental quality or social indicators.

To complicate the measurement problem further, we are already finding that strong interrelationships exist among various pollutants and carriers of pollutants. Therefore, improving one aspect of the environment may have very little effect on human stress until other environmental problems are simultaneously treated.

However, all hope for rational decision-making is not lost; some benefits are capable of being estimated. For example, some of the benefits from water pollution abatement can be estimated by calculating gains in recreational uses, greater yields from shell and other fisheries, and greater quantities of usable water for agriculture; many of these measures are expressible in dollars. The more difficult areas are measuring aesthetic enjoyment and improvement in human health. Given the inability to measure some benefits in dollars, an analyst can still com-

pare alternative dollar investments to achieve a given health objective, for example.

Another complicating factor is that benefits once measured do not hold for long. People's aesthetic preferences are continually changing. People are much more sensitive today, for example, to air pollution in Pittsburgh, Pennsylvania, than they were at the turn of the century. Undoubtedly, people will become increasingly sensitive to visible or invisible dirt in the atmosphere and will demand higher levels of abatement in the future.

For the measurement of physical health alone, scientists have had difficulty in identifying damages attributable to pollutants. Although lung cancer is highly correlated with both air pollutants and cigarette smoking, it is far less frequent if smoking is missing. What portion of this damage should be attributable to air pollutants and what portion to smoking? And should we as a society stress the less damaging air pollutant without investing heavily in reducing smoking?

Damage to physical objects and non-human life is easier to estimate and is susceptible to measurement in terms of dollars. The damage of certain airborne pollutants to crops, equipment and buildings has been crudely estimated. Trout and shad are adversely affected if water quality falls below a certain threshold and their economic cost can be estimated. Hearing to people and animals is impaired by various combinations of intensity, frequency and duration of noise and some of the economic impact can be estimated.

Currently, these admittedly crude measurements coupled with intuition as to health and stress damage to people are, in my judgment, sufficient to justify action to improve the quality of the environment or, at least, to resist further deterioration. However, we should obviously stress development of better estimates of the damage to people and things from environmental degradation if we are to identify the magnitude of the problem and resolve it.

There are those people who stress the importance of who the beneficiaries are. Beside consideration of redistribution of benefits to target groups such as the poor, the aged, the young, there is the question of investment for future generations. Should society invest more or less now for our children and children's children? The answer is: It depends on the additional benefits to be realized by future generations for investment by the current generation and upon how much redistribution of wealth through additional investment for future generations the present generation wishes to make; the level of redistribution is a personnel preference, but the productivity of investment is an objective measurement problem. The extended time period from initial investment to a return for our children becomes important. The benefits and costs should be discounted to the present, using a discount rate that properly reflects rates of return foregone in other investments because of an environmental quality investment and a discount rate that reflects the riskiness of the environmental quality investment (Risk can also be treated in the calculation of costs and benefits.). The minimum discount rate for such calculations should be the current yield on Government bonds. More appropriately, the rate should be higher.

If the present value of both the benefits to present and future generations does not exceed the present value of the cost of present and future generations, then the investment should not be made. If the benefits for the present generation are not greater than the cost, then one has to see how much to give to future generations. Per capita Gross National Product is now \$4,250 and will likely be about \$10,000 in the year 2000. Why redistribute more income into the future. It is the current generation that is poorest.

PROBLEMS OF MEASURING LIKELY ABATEMENT COSTS

Measurement of the cost to achieve environmental improvements is somewhat easier than measurement of the benefits from additional investment in improvements, however, estimates of the investment in environmental quality are often biased and overestimate the needed expenditure. This quite naturally occurs because only a limited number or in some cases only one alternative is considered when estimating likely costs.

For example, in the case of waterborne pollutants, costs are frequently calculated by assuming that abatement will or should occur by using waste treatment plants only. But, in fact, it is often cheaper to control pollutants through a combination of changes in pollution creating processes, modification of inputs, development of in-stream aeration and other techniques.

In the case of airborne pollutants from stationary sources, costs are frequently estimated by fuel substitution alone. Other options available are treatment of inputs and waste outputs. Disposal costs for solid wastes are now estimated by calculating the cost of using old processing methods and urban sites for disposition of solid wastes. But changes in commercial packaging practices and transportation to more suitable sites outside urban areas are also feasible.

Moreover, simultaneous reduction of airborne and waterborne pollutants and solid wastes may be practical. For example, New York City has investigated the use of a facility for incinerating sewage sludge and solid wastes which, in addition, can provide steam for electric power and in the process reduce air pollution. Such imaginative approaches may be the wave of the future.

Today, analysts need not be satisfied with simple methods of calculation. Data is now available to do more. And it is obvious that better estimates are changing our perception of the problem and how to handle it. Several Symposium participants indicated this to be so and the Executive Branch has made some studies towards developing and using better data.

For example, in the case of air pollution, we now know far better than this time last year that the following factors have a significant impact on both the choice of abatement methods and the cost to achieve specified levels of abatement: (1) variations in meteorological conditions, such as wind direction and speed, frequency of calm and windy days and temperature inversions; (2) location of emitters, such as upwind of the central city; (3) location of potential receptors, such as dense population centers; (4) prospects for technological change, such as desulphurization of coal.

With optimal choice depending upon these factors, some of the alternative methods for abatement are identified as: (a) pretreatment of inputs, such as desulphurization of oil; (b) improvements in the processes that create harmful wastes, such as improved combustion; (c) treatment of waste once generated, such as scrubbing and bagging; and (d) further dilution of wastes, such as higher smoke stacks.

Failure to consider all or any of these factors or methods can cause cost estimates to be excessively high and may cause the Government to provide incentives for more costly abatement methods. For example, failure to consider the location of those who discharge waterborne wastes in the Delaware River Basin could increase abatement costs by 50 percent for the same level of water quality. This additional cost can easily arise by requiring abatement of all wasteloads whether harmful or not.

Failure to consider the location of emitters and receptors in an airshed can cause costs to double. Failure to consider the fact that harmful levels of air pollutants accumulate during less than 5 percent of the days in a year can cause costs to quadruple or more.

Cost of any investment must also consider the undesirable impact that the particular investment might have in areas seemingly far removed from the site of the investment. These effects are often very important. Society may wish to provide assistance to reduce the costs to certain target groups in a society even though the dollar cost appears to be low. For example, insisting that air pollution abatement occurs through the exclusive use of very low sulphur fuels, especially coal, may cause unemployment of 25,000-43,000 Pennsylvania, Ohio, Illinois and Indiana high-sulphur coal miners.¹ The resulting loss in employment could be permanent for those older miners who are not mobile. And this would be in a geographical part of the United States which already suffers from high unemployment and underemployment. Therefore, the total dollar cost of air pollution control could appropriately be adjusted upward to account for unusually harsh results to a target group that society wishes to assist.

CRUDE COST ESTIMATES

Recently a staff study within the Federal Government² made a first rough estimate of the likely cost of pollution abatement. It would be helpful for Symposium participants to know of this study and the information it provided and also to realize that even crude analyses can help determine new directions for

¹ *Secondary Impact of Air Pollution Control*, Summary Report of the Working Committee on Secondary Effects of the Federal Coordinating Committee on the Economic Impact of Pollution Control, December 15, 1967.

² *Cost Sharing With Industry*, Summary Report of the Working Committee on Economic Incentives (Revised) of the Federal Coordinating Committee on the Economic Impact of Pollution Control, November 20, 1967. (Committee Chairman: Jack W. Carlson with the Council of Economic Advisers.)

society to consider in order to deal with the complex problems of environmental quality.

The study started with most participants feeling that pollution abatement costs would likely be several billions of dollars for water and air to achieve "desirable" quality levels, but the estimates developed by the study surprised the experts and showed that costs might not be nearly so high.

For example, the additional annual cost of reducing human exposure to sulphur oxides and particulates by 60 to 75 percent in all metropolitan areas (containing 70 percent of the population) was estimated to be about \$ $\frac{3}{4}$ billion. Of this total, manufacturing and electric power companies would likely bear about one-half the cost or \$350 million—or the equivalent of one-sixth of one percent of the value added by industry to the production of goods and services in the United States in 1967. In contrast, another production cost, labor costs, rose by 5 percent or 30 times as much during 1967. The remaining cost would likely be borne by service and distributive firms and households and would average about \$3.00 per person in cities.

The additional net cost for pollution-inhibiting devices for 1968 model cars was estimated to be nearly nil because fuel savings should offset the \$11 annual cost per car for installation and maintenance.

The additional annual cost for providing the equivalent of 85 percent treatment of biochemical oxygen demanding material (BOD) and suspended solids was estimated to be about \$925 million. Industry's burden will likely be about \$275 million or one-eighth of one percent of value-added by manufacturing firms in 1967. This is rather a small cost compared again to labor cost increases of 40 times this amount in 1967. The remaining burden of about \$650 million could fall primarily on municipalities and the per capita cost for city dwellers may be about \$5. Some of this burden is being shifted to Federal taxpayers through subsidies for construction of municipal waste treatment facilities.

For both water and air pollution, abatement costs for manufacturing firms and electric power plants (except for thermal pollution abatement) were estimated to be about \$ $\frac{2}{3}$ billion or about 0.3 percent of value-added by industry to the Nation's output of goods and services in 1967. Although obviously significant, it is still small compared to changes in the cost of other inputs; labor costs were 17 times as much in 1967.

However, not all industries will likely bear the costs of abatement equally. For example, Chemicals and Allied Products will likely bear water pollution abatement costs nearly four times greater than all other manufacturing industries. In contrast, the Electrical Machinery Industry will bear only about one-tenth of the average cost. Moreover, costs for particular plants will vary even more and could impose a temporary problem of inadequate access to financial markets. It was for this reason that the President recommended short-run assistance through the Small Business Administration and the Economic Development Administration for "hardship plants" if their short-run commercial viability were threatened by pollution abatement actions.

The study also showed that in the case of industry, the proportion of annual cost solely for the amortization of necessary plant and equipment expenditures was found to be small. In the case of water pollution abatement, the capital cost estimates were only one-third of the total annual costs while operating costs were two-thirds. For air pollution abatement, capital costs were even a smaller proportion, as low as 15 percent. However this did not include capital expenditures of other sectors of the economy secondarily affected by abatement expenditures in each airshed. For example, abatement in the New York-New Jersey area will undoubtedly require capital expenditures for desulphurization of oil in Venezuela and for opening new low-sulphur mines in the United States. Fuel substitution was found to be by far a cheaper alternative at lower levels of abatement, but it became less advantageous at higher levels.

This information, I am sure, was in part the reason that tax writeoffs on capital expenditures were viewed by some members of industry to be less attractive. From society's viewpoint, a capital subsidy which undoubtedly would encourage over-use of capital and would offer assistance for only a small proportion of the abatement costs is undesirable. For example, an increase in tax credits from 7 percent to 20 percent or an additional subsidy of 13 percent on capital expenditures would be only a 4 percent subsidy on cost for water pollution abatement and 2 percent for air pollution abatement. Yet the likely cost to the other taxpayers could be \$302 million per year, \$241 million for water and \$61 million for air.

If one assumes that all abatement costs are passed on to consumers without a change in the quantities of goods sold, the per capita cost if borne by city dwellers alone could be about \$12 or one-fifth of one percent of the average income of Americans (per capita personal income).

In the future, however, this cost will undoubtedly rise. People are clustering more closely together and industry is locating closer to urban centers than before or urban centers are growing to surround industry which was originally rural. With this trend, more wasteloads will have to be controlled to achieve the same level of environmental cleanliness. By 1985 when population in metropolitan areas could rise from 140 million to 195 million and the national population grows from 200 million to 265 million, the additional cost could more than double to about \$30 per person or about one-third of one percent of per capita income at that time. Therefore, the moderate cost of environmental quality control is likely to become more burdensome and not less in the years ahead.

The cost to control pollution of landscapes has not been estimated, even crudely. Nor has society determined what relative cleanliness really means in this area. However, we do know that sanitary disposal of solid wastes alone could require about \$1 billion more in urban areas. This is about \$7 per city dweller per year. But even this amount does not include the rapidly increasing costs of solid waste collection. We do know that the removal of unsightly junk autos will be similarly costly; however, there are encouraging signs that declining junk processing costs and increasing prices of junk metals will help to automatically alleviate this problem.

The cost of noise control is even more unknown, even though current knowledge of the physical damage to ear drums, the reduction in work efficiency, and deterioration of home environments are enough to encourage additional abatement.

MANAGEMENT OF ENVIRONMENTAL QUALITY

Management of the quality of the environment is extremely important. Poor management can result in excessively high costs of control for each level of environmental quality improvement. And this is not merely an increase of 20 to 40 percent, but rather 200 or 400 percent.

The economies of environmental pollution control are greatly affected by the institutions created for such control. In my judgment, this is now the most critical question. It requires more than just the disciplines of the physical and biological sciences. Economists, sociologists and political scientists are required.

Environmental problems should be managed so as to encompass the location where the problems originate and where it causes damage—or in the context of problem sheds. In the case of waterborne pollutants, river basins or river basin segments and larger lakes provide a convenient starting point; however, feasible methods for controlling water may be more important between water basins than between upstream and downstream portions of the same river. Or existing political institutions may so compromise embryonic basin organizations so as to make them an undesirable organization with only half enough muscle to manage water quality.

In the United States, we have, in part, rejected entire basin management in preferences for segmented basin management through the 50 States. This occurred understandably because Congress is composed of State representatives who are unlikely to encourage competing power centers in interstate organizations. Also, planning and management of water quality at the national level has the disadvantage of being too extensive. Some planning, however, is occurring by regions and river basins which may improve the decisions of States in their management of river basin segments. Perhaps this might be the beginning of a slow evolution towards region or basin management, or, more importantly, enough planning will occur by basins to gain many of the benefits that flow from basin management.

In the case of airborne pollutants, meteorological conditions and the topography of urban and affected rural areas appear to be the major determinants of the dimensions for management. Hopefully, recent legislation creating airsheds will provide adequate incentive to assure that proper institutions will be created. Currently, city governments are often too small and State governments either too large or unable to encompass the problems shed which may overlap two or more States.

In the case of noise, land and air transportation corridors and metropolitan areas are the key to control. This is obviously virgin territory for public policy and is just now being explored.

The problem shed for solid wastes is necessarily tied to urban centers and an area surrounding them where, based upon the limits of transportation costs, disposal is economically feasible. Cost-reducing technology in the transportation field is making it possible to transport waste 100 miles instead of the more expensive alternative of disposing it within city limits.

If the quality of the environment is more broadly defined, provision for open spaces, parks and other recreational resources, and congestion-less streets and highways should also be urban related since overcrowding is related to population density.

In the future, preventive measures can be taken as opposed to relying on curing environmental degradation problems as they arise. For example, new techniques that are developed primarily for other purposes but which may have environmental quality effects can be identified early and modified before the new technology is widely adopted. This is already occurring in the case of new drugs where the side-effects are explored before they are released for public use. I would imagine preventive controls on new technologies will increase in the future.

ENVIRONMENTAL MANAGEMENT IN URBAN AREAS

Because the cause of many pollutants and the benefits of their removal are often related to urban development, analysis and management of the quality of the environment can be, in part, urban related. Population size and the geographical dimension of metropolitan areas can be planned to preserve the quality of the environment. Much can be done with advanced metropolitan planning of land and air uses. In fact, three dimensional city planning and analysis should be the trend of the future. The location of freeways and airways not only affects travel time and congestion, but also the concentration of airborne pollutants, noise levels, and access to tranquil open spaces and parks. Obviously, better city planning should and can satisfy a multitude of social objectives simultaneously.

Perhaps combining heating, electric power generation, and solid waste incinerators all together can be one way of controlling our burgeoning problem, efficiently and effectively.

Cities, however, are often unable to plan for environmental quality both because of fragmented political jurisdictions and because of the acceptance of the traditional separation of social responsibility among industry, utilities, and municipal governments. Potentially, actions by the central government through planning and other forms of assistance and through requirements for environmental quality standards are helping in a small way to resolve these problems. A major limitation on the usefulness of analysis and efficiency of environmental quality management is the lack of appropriate institutional focus. Unfortunately, there is too little scholarly effort in this area. The Symposium tended to give inadequate recognition to this major shortcoming of current analytical efforts.

In the future, new towns could be justified by environmental quality factors. It may be less expensive to maintain environmental quality by encouraging the growth of population in new or small cities rather than packing more people into existing large cities, especially since the per capita cost of pollution abatement likely increases with each additional city dweller. Also, the current tendency for cities to spread out because of the automobile as opposed to packing tighter should help to provide some dilution of additional pollutants. But the increase in total population and industry to serve them will more than offset dilution gains. Therefore, additional abatement from existing sources will likely be required in the future.

SUMMARY

Maintaining the quality of the environment is primarily a problem for society because those who benefit are not necessarily those who pay and environmental quality is a public good. Although public policy in the United States is helping to internalize this problem, existing institutions are not meeting the challenge of managing environmental quality, efficiently and effectively. We need to focus existing institutions on problem areas, or if this fails, develop new institutions that will.

The situation is aggravated by the difficulty of measuring benefits. However, crude cost estimates indicate that only moderate expenditures are required to treat some dimensions of environmental quality, such as pollution abatement. And it is obvious to me that the damage from degradation of environmental quality merits more control.

The per capita cost of controlling environmental quality is forecast to rise with increasing concentration of people and industry. Therefore, the maintenance of the quality of the environment should be an integral part of three-dimensional metropolitan planning even though particular pollutants can best be simultaneously managed by problem shed institutions which should overlap cities and rural areas.

Perhaps the dialogue developed by the Symposium will help to move the United States towards more effective management of the quality of the environment. I hope my comments are useful for this purpose.

CORNELL UNIVERSITY,
DIVISION OF BIOLOGICAL SCIENCES,
Ithaca, N.Y., July 19, 1968.

Representative EMILIO Q. DADDARIO,
House Office Building,
Washington, D.C.

DEAR REPRESENTATIVE DADDARIO: The following are the remarks I would have made at the colloquium July 17 if there had been time to get to me:

Dr. Ripley has emphasized the long developmental process ahead for ecology. This is correct but ecologists already have a great deal of knowledge that should play a role in planning but which is not being so used today. I am glad that Dr. Gates and Dr. Cain mentioned some specific such areas. I am particularly sensitive right now on the subject of thermal pollution because we are threatened with a nuclear reactor to be built on the shore of Cayuga Lake. The plan is to heat 10 percent of the volume of the lake each year by some 25 degrees F. Leaving aside the questions of safety and radioactive contamination of the lake and atmosphere, we are not certain that the lake can survive this thermal insult. But I recently discussed the matter with an exponent of "progress" who said: "oh this is only the beginning, you'll have 10 or a dozen reactors on that lake eventually; we have to keep generating capacity growing by 10 percent per year."

I think the fact that this colloquium has been organized indicates a growing awareness on the part of Congress that they do need competent advice on ecological questions. I have read most, if not all, of the bills calling for the establishment of some sort of "council of ecological advisors." I think the need for such a council is urgent but I am disturbed by the present bills which fail to specify the range of competencies that should be represented. I shall mention here only two areas that are not well represented in the places that Congress traditionally turns to for scientific advice.

First, underlying all of the problems of environmental deterioration is the problem of population growth. If the population is going to continue to grow indefinitely the environment is going to continue to deteriorate and its ability to support life will eventually be destroyed. If the capacity to generate electricity by means that are feasible today continues to grow we shall find ourselves writing off one body of water after another until none remains and we shall change our climates through thermal pollution of the atmosphere. Without population regulation disaster is inevitable. Therefore, I think it should be spelled out that any council of advisors on environmental problems must include demographic competence of the highest order.

The second area I wish to mention is ecology itself. We ecologists have become fairly accustomed to seeing one committee after another set up to deal with ecological problems without including a single competent ecologist. Many of the traditional scientific organizations are so ignorant of the field that it never occurs to them that ecologists might know something that would not be immediately apparent to a chemist or engineer. (I know of one recent case of an engineering dean who announced that it was now necessary to invent a new interdisciplinary field to be known as "environmental biology.") So I consider it very important to assure by specifying that any council of ecological advisors shall include ecologists of the highest competence.

Any such council will also need competence in chemistry, engineering, geology, meteorology, sociology, and economics. While a few rare individuals can be found who are competent in two or three of the areas mentioned, it seems to me certain that the three-man council envisioned by at least one of the bills is too small.

Respectfully,

LAMONT C. COLE, *Professor of Ecology.*

UNIVERSITY OF OKLAHOMA,
DEPARTMENT OF METEOROLOGY,
Norman, Okla., July 29, 1968.

Senator H. M. JACKSON,
Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR SIR: The enclosed contribution for the record of the "Symposium on Environmental Quality" is submitted at the suggestion of Dr. Walter Orr Roberts, President of the University Corporation for Atmospheric Research. He suggested that a statement might be appropriate in connection with the environmental quality symposium at the Capitol Wednesday, July 17th, since I was not at the Symposium.

As is the case with many of the members of my profession, I am vitally interested in the impact of the atmospheric and hydrologic environment on man, and vice versa.

I would be happy to supply further elaboration or specific documentation of the enclosed material should you wish it.

Yours truly,

AMOS EDDY,
Professor; Chairman, Department of Meteorology.

ON THE NEED FOR EDUCATION OF ENVIRONMENTAL APPLIED SCIENTISTS

The interaction between man and his environment is quite clearly a problem of survival. In the specific use of our Urban Environment, the problem has taken on alarming aspects. A descent by plane into the major cities in our country can present a person with a startling view of the pall of health-destroying pollutants hanging in the very air with which he will shortly be trying to sustain his own life. The many hours of inaction forced on countless people every winter as they sit in snowbound traffic jams in our northern cities imposes time for thought on problems of the cost of snow removal, work loss, property deterioration and even health hazards stemming from such frustrating experiences. In many states floods and heavy rains create hazards, stall traffic and destroy property: does this stem from ignorance of the impact of the atmosphere on urban problems? Can these losses be reduced through education in the field of applied meteorology? Then, what are the implications of a drought? This particular type of weather-produced disaster was recently inflicted on the northeastern part of the United States. New York City faced a succession of crises, some in quite unforeseen directions, because of this water shortage. Droughts in other areas threaten the food supply of the country.

Many pages would be required to give even a cursory treatment of the various facets of the problem. Strategies for the deployment of water, gas, and electricity are required and one of the inputs affecting such decision making is the atmosphere with its role in the hydrologic cycle and in the redistribution of the sun's energy.

We need well trained applied scientists and engineers to provide answers to these problems and especially to contribute to logical and efficacious decision making processes.

My specific proposal for a positive course of action is to establish a center of excellence in Environmental Applied Science which would train people to tackle these critical problems, to produce and test engineering solutions, and then to aid in *implementing* these solutions in an *effective manner*.

We have now the scientific maturity and technological skill to effect tremendous improvements in our environmental living conditions. In order to bring about these improvements we have only to bring home to our future engineers the importance and even the drama of work in this field. And they must be provided with a first class educational institution where they can meet the problems and train to design their solutions.

MISSOURI BOTANICAL GARDEN,
St. Louis, Mo., July 19, 1968.

HON. EMILIO Q. DADDARIO,
House of Representatives,
Washington, D.C.

DEAR MR. DADDARIO: I received your letter of 12 July upon my return from Washington. I shall take your suggestions and continue to see congressmen concerning the status of science in general.

I do not expect to get to Washington again this summer. However, when next I do get there if you are there as well I will see if we can meet for a good discussion of what to do about ecology and environmental science.

There were several other things I might have said during the colloquium the other day. It was kind of you to suggest that Representative Miller call on me to make a few remarks. I am sending to your office within a few days a paper I am just now completing for the MII alumni magazine *Technology Review*. I believe you and your staff will find it of interest. It contains a number of ideas which I might have expressed the other afternoon.

Sincerely yours,

DAVID M. GATES, *Director.*

EXPLOITATION, EVOLUTION, AND ECOLOGY

Mankind has lit the fuse of the environmental bomb. It is not a question of whether or not it will explode, but only a matter of how fast. Man is the product of a long evolutionary web of life and the consequence of a billion years or more of development. Man stands at the pinnacle of the food chain pyramid and at the summit of resource utilization. Man is distinguished from all other animals by the intensity of his impact on the landscape, by the irreversible character of his actions, and by the suddenness with which he produces changes in the habitat. Man is capable of rational decision and has the capacity to control his own destiny. Man can visualize a better way of life, a higher quality of health and happiness, while at the same time having a realization that he is backsliding to a lower level of existence.

It is clear that all segments of the world—all soils, waters, woods, mountains, plains, oceans and ice covered continents—will be occupied and used by man. Not a single solitary piece of the landscape will go untouched in the future and, in fact, not be used repeatedly for as long as man survives. Everything between soil and sky will be moved about, redistributed and degraded as man continues to exploit the surface of the planet. There is no question as to the fact that man will be around for thousands of years in the future. The only question concerns the quality of his mental, social and physical well-being. A thermonuclear war will be devastating and might leave man a grotesque shadow of his former self, temporarily reduced in population, with multitudes of badly mutated and inept forms, yet with vast numbers of normal human beings who will strive to maintain the species against the aberrant millions. Yet the Earth will be populated by people and the population will grow until it reaches some equilibrium level. The thermonuclear holocaust would be only a temporary setback in numbers but a permanent reduction of the quality of human life. An alternate ultimate destiny is for an earth of half-starved, depressed billions gasping for air, depleted of oxygen and laden with pollutants, thirsting for thickened eutrophic water, struggling to avoid the constant presence of one another and in essence continuing life at a degraded subsistence level limited in numbers not by conscience but by consequence. A third possibility exists for mankind which is to maintain a reasonable quality for life by means of population control, rational management of the Earth's ecosystems and conservative exploitation of resources while at the same time avoiding involvement in major wars, either nuclear or non-nuclear. If this is not achieved soon, we will go down in history known as elegant technological

society which underwent biological disintegration for lack of ecological understanding.

Congressman Emilio Daddario of Connecticut, Chairman of the House Subcommittee on Science, Research and Development, delivered an eloquent plea to the House of Representatives for stronger Federal funding of research, in which he said, "The most competent testimony which our Science Committee has been able to elicit from the forecasters indicates that we have not less than 30 years nor more than 70 years to reverse the destructive trends which a sprawling, acquisitive humanity has created for itself. After that it will be too late. Too late to stem the human tide. Too late to control the eradication of resources. Too late to halt the pollution of Earth. Too late for anything except to witness the gradual sinking of our standard of living and the erosion of personal liberty."

Man must consume the resources of the Earth—there is no denying this. There is no point in setting oneself against the utilization and exploitation of resources, for such action is irrelevant. Man must use in some way all parts of the landscape—either for industry, for shelter, for food, for recreation, for transportation and communication or for the preservation of species within reserved plant and animal communities, such as national parks and wilderness areas. But man must learn conservative exploitation and careful, rational ecosystem management. If the basic human rights are life, liberty and the pursuit of happiness and if we have any conscience whatsoever towards the well-being of our children and our children's children, then we must take urgent measures soon towards a more responsible viewpoint. It is unlikely that the quality of life, liberty and happiness—each of transcendent character—will continue for future generations in the form we consider appropriate today.

It is easy to be disillusioned or blinded by the abundance of our own manner of living. It is easy to live in opulence and believe that everything will continue well forever. It is easy to live in good health and believe that all peoples can do likewise. But our high quality of living—of fine homes, fast cars, abundant food, rapid transportation and leisure time—is achieved at a frightful toll of careless exploitation and reckless living. The toll is paid in resources that will deny future generations an opportunity for even a reasonable quality of life. The cost is evidenced by polluted air and contaminated water, cut forests and depleted soils, a changing climate and a noisier environment. There are fewer species of plants and animals to give form, beauty and diversity to the world. Man today repudiates his evolutionary heritage of natural history and denies all subsequent generations even the opportunity to see, enjoy and use the rare exotic species of the world. Yet man has and will depend on plants and animals for food, medicine, fiber, enjoyment and culture.

Man must have industry, transportation and communication as well as time and space for recreation. Man must burn the fossil fuels, convert nuclear energy, harness the sunshine, mine the metals of the world, dam the rivers, pave great highways, expand urban areas and develop new cities. This is progress and a part of our way of life. But man need not pollute with reckless abandon, contaminate, litter and destroy the balanced character of the ecosystems upon which he so critically depends.

PRINCIPLES OF ECOLOGY

Modern man is faced with the urgent necessity for his own fitness to understand and live by basic ecological principles. He must apply these principles to the management of all ecosystems. Some of the basic ecological principles are well known by ecologists and many others may not yet have been discovered. Modern science has not unraveled the intricate, complex interactions and underlying mechanisms of most ecosystems. The attempts to do so have been pitifully few and analytically weak. The number of ecologists available for such work are tragically scarce. Modern science and modern technology are capable of far greater achievement towards understanding and managing ecosystems than ever attempted. Man's persistence in living contrary to ecological principles is dangerous and will tend to attenuate his longevity and to make the stability of life uncertain. The following are examples of ecological principles or generalities which are violated and the consequences of doing so. It is not that man must strictly abide by the slow, persistent methods of natural history, but wherever possible man must understand the consequences of running contrary to the laws of nature and attempt to use ecological rationale for his own well-being.

A natural ecosystem recycles its mineral resources. The minerals are taken up into the biomass and on death and decay are returned to the soil. One of man's ugliest habits is his refusal to recycle his resources. All plants and animals of the world except man are a part of an intricate recycling system of the natural habitat which will continue to function well when supplied by energy from the sun. Man leaves his debris of automobiles, cans, bottles, plastics, chemicals and pavement scattered about the landscape and lets his organic refuse of garbage and sewage be funneled into the rivers and streams to be washed to the sea. He does not return the used minerals to the factory for reprocessing or the nutrients to the soil, but draws on new concentrated supplies available in nature. Clearly, such a way of life cannot continue indefinitely. The sooner major achievement to recycle is made, the better off will be future generations and the greater will be their gratitude to the present generation. Recycling will never achieve 100 percent efficiency; but if it can reach much greater efficiencies than at the present time, man's life span on Earth as an industrial organization will last much longer. It is not even clear that man can find a way to recycle the products of society, but he must make a monstrous attempt to do so. It is likely that garbage and sewage will need to be processed and the enriched sludge returned to the fields. It is likely that all metals be recovered when used and reprocessed again and again. Man may need to dredge the river deltas in order to recover the wastes so recklessly abandoned. It is inconceivable that man will continue to exploit the non-renewable mineral resources unless he is willing to substitute organic products for them. Metals are essential for applications requiring high thermal and electrical conductivity, strength and sometimes low density. Even the use of organic substitutes permanently removes resources from the ecosystem cycle, since these polymerized products refuse to break down by bacterial decay. There must be severe penalties for throwing away anything.

Natural ecosystems of forest and stream, grassland or pond, mountain meadow or estuary have a diversity of plant and animal species which is the consequence of long, gradual evolution. The natural diversity of species within the community gives the community stability and makes it resistant to change by climate or disease. Man replaces natural communities with monobiotic communities of plants or animals with high productivity, but with vulnerability to climate and infestation. When a hot, dry summer occurs, the native grasslands and woodlands suffer and some species may reduce in population; but the community of plants and animals continues to function and survive. However, during extended heat and drought, the corn and wheat crops die off and leave a scorched earth beneath. A disease infestation can devastate mercilessly a standing crop or single species; but with the diverse natural community, only a part of it will be struck down and the soil not left exposed. The potato blight and devastating Irish famine in 1845-1847, the Dutch elm disease currently rampant in the elms of the Midwest, the Japanese beetle which destroyed many crop varieties, the Colorado potato beetle and many others are examples of the threat to simple ecosystems by insects. The continuity of crops across the countryside and of a few varieties of shade trees, village by village and town by town makes the spread of insects relatively easy. The balance of simple communities of plants and animals is upset more easily than that of richer species diversity when anything goes wrong.

Man has cocked the trigger for widespread disaster by planting vast contiguous areas with one crop. A rust fungus hits a wheat crop and man works desperately to breed a rust resistant variety of wheat which he then plants over a vast piece of the landscape. But a new rust fungus strikes this crop when the fungus evolves a new strain. It would be far better to plant many varieties of wheat in alternate rows and thereby discourage any single fungus from attacking the whole crop. How much nicer it would have been if, instead of losing entire avenues of elm trees in some of our towns, we might have had a few elms mixed with sycamores, oaks, maples, gingkoes and other species. Even the appearance along the thoroughfare might have been less monotonous.

Another example of the need for diversity by man is found with the use of hedgerows and shelterbelts. An enormous spread of undulating golden grain may please the eye and suppress the pangs of hunger during good years; but during dry and windy periods, the full treachery of such practice becomes apparent. Man's clean monoculture of a single crop without interruption is potentially very dangerous. Nothing, absolutely nothing today tells us that once again we may not have great clouds of dust eroding the landscape if the climate goes hot and

dry for several years. As long as man has agricultural surpluses, he can withstand such shock to his food supply; but now that population density is crowding closer and closer to the limit of production, man can no longer afford to live so dangerously. Clearly man must plant crops in order to produce food, but perhaps just as productive and far more secure would be a practice of farming mixed monocultures, alternating one with another in space and time. Careful study is being given to this concept at the present time by some agronomists.

When man destroyed the softwood forests of Eastern Canada, replanting with pure stands of balsam fir, the spruce budworm responded with delight and invaded the region in near epidemic proportions. Ecology teaches us the importance of diversity for landscape practice. A mixed forest of native species may be far more productive and safer over the centuries ahead than pure stands of timber. A single species of plant or animal has unique tolerance limits and whenever climate, mineral or chemical ingredient exceeds this tolerance limit, then disaster within a monoculture ensues.

The natural world is arranged in a complex web of production known as a food chain. Plants are primary producers and convert water and carbon dioxide to carbohydrates and proteins by use of sunlight in photosynthesis. Herbivores of many kinds feed on the plants and convert a small fraction of the plant tissue to animal tissue, but with the loss of much of the stored energy. Carnivores feed off of the herbivores and extend the predator-prey food chain to a higher level of organization. Usually, in such a food chain, the animals at higher trophic levels are larger and of fewer numbers. On the other hand, the parasitic food chain always proceeds from larger organisms to smaller, since the host must be capable of supporting the parasite within itself. The saphrophytic or decomposer food chain proceeds from dead organic matter to microorganisms. Whenever energy is passed through the food chain from one trophic level to another, the second law of thermodynamics levies a huge tax against the stored energy.

At the primary level, efficiencies are one to three percent. Herbivores may convert energy from the primary level with an efficiency between 9 and 16 percent and carnivores may convert energy stored in the biomass of herbivores with an efficiency anywhere between 10 and 20 percent. The complexities of food chains are not well understood in quantitative terms; yet it is essential to do so, since the whole matter of population dynamics and ecosystem stability relates to it. All of the fish in the world harvested for food are the end product of a complex aquatic food chain. If any part of the chain is removed or disturbed, the food supply for man is immediately affected. Man strives to shorten the food chain by replacing the intricate web of natural communities by a simplified crop production. He sprays with insecticides to eliminate predators, but often upsets the ecological balance of the neighboring region to such a degree that other problems arise. The pesticides get passed through the food chain to other animals and concentrated at higher trophic levels. Man has taken precautions to isolate himself from the cycles of pesticides in the food chain, yet the accumulation of these within ecosystems is leading to profound changes of the biota. The argument here is not that the use of pesticides should be stopped entirely, for they have served important purposes; but rather intensive evaluation is needed of the consequences of their use to the animal populations of the world. It is not unlikely that, from the long-range benefit to man, selective restrictive use of pesticides is mandatory, if man is to derive other benefits from the natural communities.

Sometimes man extends a food chain in order to destroy a particular species. So it was in Australia when the prickly pear cactus invaded the continent and nearly destroyed cattle production. Then the moth, *Cactoblastic castorum*, whose larvae consume the cactus, was introduced from South America. The moth consumed the prickly pear and saved the cattle industry. If the natural enemies of the moth had been there, the experiment would have failed.

Rapid transportation and mass movement of peoples accelerate the dispersal of plant pests despite rigid controls by Department of Agriculture inspectors. Man must, of course, have crops. We are not suggesting that he not plant more crops nor continue current production. What we are saying is that we must understand in much more detail the delicate balances of animal populations within food chains in order that we can cope intelligently with the problems of man-made ecosystems.

A basic ecological principle is the law of limiting factors, which states that an organism has certain basic requirements for essential materials and environmental factors. An organism may require a certain amount of mineral and yet

not be able to tolerate too much. It may require certain temperatures for growth or activity and temperatures too high or low may kill it. A major challenge in ecology is to discover just what these limits are for a given plant or animal. However, the limit for one factor only has meaning in the context of all the other factors and materials which are essential to the organism. This is an extremely complex problem which ecology has not yet solved except in a general conceptual way. However, the consequences of the law are seen on every hand as man disturbs the habitat.

Before discussing the consequences of the law of limiting factors, we should consider another important ecological generalization. All available ecological niches, or positions in the economy of nature, tend to be filled with organisms. During the long course of evolution, plants and animals developed unique characteristics and physiological requirements in order to fill the entire complex of physical, behavioral and psychological factors at any given time and place. The ecologist cannot be certain that all possible niches are filled in nature, but they certainly appear to be so. When one organism is removed, another organism usually adapts to fill the vacant niche. But if several organisms are taken out of the food chain, far reaching consequences may result. Kill off the insects with pesticides and the bird population may decrease catastrophically. Remove a parasite from an animal which feeds on vegetation and the animal population may explode catastrophically.

The law of limiting factors is seen in the observation that even though food supply is abundant, some single factor of the environment is limiting the number of species. Hence, in the arctic and antarctic oceans, the number of species is few, but the number of individuals of each species is enormous. In the polar regions the low temperatures may be the limiting factor for most species. The species of the desert are few where the limiting factor is water. The number of plant species beneath the dense forest canopy are few where the limiting factor is light. On the other hand, in the tropical lagoon the number of species is large and the abundance of each is less. In the tropical forest the number of species is enormous, but the population of each is low. Every species of the tropical forest is a part of an intricate food web where each plant or animal is about to be pounced upon by a predator and each in turn is consuming another neighbor. If one species increases suddenly then others will consume it and keep it in check. The natural ecosystem rarely has the great population explosions so characteristic of the epidemics within man-made communities. Where the numbers of species are naturally fewer and the population density of each is greater, to remove one species can have dire consequences.

If man poisons the habitat or in some way concentrates one factor—such as salt in the soil—the number of species tolerant to this limiting factor become very few. But there is a population explosion of these few, since their predators and competitors do not survive. This is precisely the fate which befell Lake Erie, once clean and clear, now a sick body of water choking with pollution. The fine game fish of Lake Erie are gone for lack of oxygen. A few species of algae thicken the shallow waters of the shore line. Great masses of pollutants from the bordering industries, fertilizers from the farms, and garbage and sewage from the towns and cities enrich the waters with sulfates, nitrates and many other chemicals. A few species of plants grow abundantly and great masses of organic detritus accumulate in the lake bottom to tie up the oxygen in oxidation. Lake Erie is eutrophic and will always remain eutrophic. It is unlikely that ever again will anyone see it clean, clear and productive of game fish. A lake accumulates the minerals and contaminants which flow into it and it is nearly impossible to ever remove them from the bottom sediments.

Recently, while visiting on Lake Kegonsa near Madison, Wisconsin, I watched a young girl start to water ski; but she couldn't get pulled free of the aquatic plants growing in the shallow water. She spent the next few minutes pulling great masses of algae and weeds from her skis and then gave the signal to the boatman to put on the power and take off. Lake Kegonsa, Mendota, Monona and others near Madison have become classical examples of eutrophication—lakes rich in nutrients, poor in species, rich in algal growth and poor in game fish and higher members of the food chain. The summer visitor to Lake Michigan, repulsed by the stench of rotting tens of thousands of alewives on the beaches, is witnessing the first danger signals of eutrophication.

CHANGING CLIMATES

Much has been written concerning man's impact on climate and the apparent warming trend of the first half of the 20th century as the possible consequence of atmospheric carbon dioxide increase. It seems likely that the jet age has brought with it increased cloud cover from jet contrails and a concurrent increase of the Earth's albedo. This, along with the increased dust and pollution haze of the great metropolitan areas, may be producing a significant cooling trend of the Earth's atmosphere. We do not really know what is happening and, even more seriously, we do not know the consequence to climate of the growth of man's activities during the next century. Climatic changes of incident sunlight, temperature and moisture will produce monstrous shifts of plant and animal communities in ways which are now only partially predictable. No one has assessed the changes to productivity of the great agronomic regions of the world nor the costs expected in heating, air conditioning or other creature comforts. The supply of oxygen in the Earth's atmosphere is distinctly finite. Lamont Cole, a prominent ecologist, has estimated as well as numbers available will permit, that growth of fuel consumption at the present rate may generate an oxygen depleted atmosphere within a few generations, particularly if industrial development is rapid in all countries of the world. If there is the slightest likelihood of this occurring, then a very thorough study of the situation should be made as soon as possible and a rationale developed for coping with the problem.

ECOSYSTEM MANAGEMENT

It seems to me that an entirely new profession is required by modern man—the ecological management of the world in which we live. I have sometimes referred to this as landscape management, but it seems to me that "landscape" has the wrong connotation. What I am suggesting here is ecosystem management. The entire Earth is one giant ecosystem which we can subdivide into as many lesser ecosystems as we wish. An ecosystem is a division of the landscape which encompasses the biota and environment as a unit. A lake is an ecosystem encompassing water, soil, rock, plants, animals and atmosphere, including incident sunlight. A bog, grassland or forest is an ecosystem as well as a city, village or farm. An ecosystem is a dynamic unit which is usually undergoing change and within which all objects, organisms and factors are interacting in various ways. To understand the various ecosystems of the world is an enormous challenge to man; indeed it is one of the ultimate necessary challenges to man.

The challenge of ecosystem understanding and management is an open invitation to all intelligent men. It is a challenge in particular to industry as well as to academia. It is a challenge to city, state and national governments. To meet the challenge requires the evolution of ecological engineers and ecosystem managers. These professionals will require engineering training in physics, mathematics, chemistry, heat transfer, fluid dynamics and other things as well as thorough grounding in the fundamentals of ecology, including plant and animal systematics. A profession of ecological engineers or ecosystem managers is intellectually exciting, technologically challenging, and in addition, satisfying for its humanitarian prospects.

If industry would join in the effort to evolve a profession of ecological management, they might find it enormously profitable to themselves. There could be better understanding of resource use. There may be vast numbers of new products required for intelligent ecosystem management. There could result a healthier, happier way of life for many industrial communities. To pioneer is a privilege presented to few, but an incredible opportunity exists now because of the exigencies of our age for industries and universities to pioneer a new profession.

ECOSYSTEM MANAGEMENT INSTITUTES

The Federal Government, to cope with the problems of defense and war, has found it advantageous to establish the Rand Corporation and the Brookings Institute. These research groups have been enormously effective in their efforts to establish a theoretical understanding of the complex problems of war, defense and economics. Surely, if "think tanks" or operations research groups of this

nature are needed, then man needs ever-so-much a similar type of institute to attack the incredibly complex problems of ecosystem management. It is here within the institute, as well as in industry and government that the coupling must be made between the ecologist and the problems of man with the landscape.

Ecology and ecosystem management has not yet come into the modern age as a mature flourishing discipline utilizing all the techniques and tools of science and engineering. It can and it will do so. But the leadership for doing so must come from those who recognize that irrespective of war, poverty and urban ills, man's ultimate confrontation is with nature. No matter how friendly we are with one another, how well we live together, how rich and abundant our life, how healthy we may be, unless we achieve an understanding of the ecosystems of the world and manage the landscape with all the rationale we can bring to bear on the environmental problems we face, we will lose the whole ball game. Then, and sooner than we think, if ecological understanding and ecosystem management are not achieved, mankind will indeed sink to a lower and lower subsistence level and the loss of life, liberty and happiness will be beyond all comprehension. A word to the wise is sufficient.

STATEMENT OF DR. HAROLD GERSHINOWITZ, CHAIRMAN, ENVIRONMENTAL STUDIES BOARD, NATIONAL ACADEMY OF SCIENCES—NATIONAL ACADEMY OF ENGINEERING

The formal statements presented at this meeting and the discussions of the morning and the afternoon have shown that there is a general awareness of both the technical and organizational complexity of activities which affect the quality of our environment. These discussions have also demonstrated that we are still far from agreement on what constitutes a good or desirable environment. I hope that from these discussions will come some mechanism for the examination of the fragmented elements of the problem in a way which will permit a synthesis of the factual data and a resolution of conflicting views and interests. Such a mechanism, call it a commission, committee or agency as you will, is lacking in both the legislative and the executive branches of the Federal Government.

A national policy on the environment is needed not only to determine our immediate course of action but also to indicate the most useful directions for research on the quality of the environment. It is on that latter point that I wish to comment in this contribution to your deliberations.

An ideal program for determining a national policy on the quality of the environment would proceed through the following three steps:

1. Measurement of what is there and determination of the rate at which it is changing.
2. Measurement of the effect of what is there and of any anticipated increased or decreased concentrations of constituents of the environment on both the physical characteristics of the environment (e.g., erosion, deforestation, haze in air, scum on water) and the physiological effects on living organisms, human and other.
3. Determination of standards, criteria and tolerances, based not only on the factual data from 1 and 2 but also on the economic, sociological, political and aesthetic consequences of adopting or not adopting such standards, criteria or tolerances. These determinations or decisions should be made not by the technical experts or by specialists but by those who represent the whole of society.

Anyone who has knowledge of or experience in administration realizes that decisions must be made all the time. They cannot be postponed until a complete and unambiguous analysis of the consequences of alternative decisions is available. We cannot wait for stages one and two to be completed before stage three is begun. But the important thing that should be recognized when working on stage three is that stages one and two are still incomplete and that one should make the kinds of decisions and regulations which would automatically or easily be modified as more knowledge is accumulated from stages one and two.

Non-scientists sometimes misunderstand and are puzzled by the nature of scientific data. There are very few immutable facts in science. Improved methods of measurement, better theoretical understanding of relationships among the things which are measured, discovery of unexpected interactions between things previously thought to be independent of each other, all of these result in a continuing change, not only in the theories of how nature behaves, but in the actual

numerical values of data. Despite the dogmatic statements of some scientists, no scientific fact is beyond criticism and possible change. However, the more complete our understanding becomes, the smaller is the magnitude of the changes, so that in many branches of science and technology we can act as though we were dealing with certainties. In matters dealing with the environment we are still very far from that desirable condition.

A national policy on the environment should be framed in such a way as to encourage and stimulate the two stages I have described above, first, the measurement of the composition of and rate of change of the environment, second, the determination of the effects of these constituents of the environment on inanimate nature and on man and other living organisms. Our knowledge is still too imperfect for us to choose correctly the nature of an ideal environment for man. It was said during the discussion that interest must be stimulated in the scientific community in the kinds of research and engineering which would lead to a better understanding of the processes which make and change our environment. In my opinion, one of the best ways to stimulate such interest would be to frame a national policy for the environment in terms which would make it clear that part of that policy is to increase our knowledge of the physical and biological nature of that environment.

THE NEWS-JOURNAL Co.,
Wilmington Del., August 7, 1968.

Representative EMILIO Q. DADDARIO,
Committee on Science and Astronautics,
House of Representatives,
Washington, D.C.

DEAR MR. DADDARIO: This is to thank you and the co-chairmen of the House-Senate Colloquium on a National Policy for the Environment which I had the great pleasure of attending July 17 at the invitation of Sen. Jackson and Rep. Miller. I wish I had had a chance to meet you that day and express my satisfaction in this lively kind of discussion. I hope it presages a good, foresighted policy that the people can look to the Congress to implement. Your letter is appreciated.

I promoted my own invitation via my good friend and pollution-control supporter, Senator J. Caleb Boggs, and have thanked him too.

Enclosed is an editorial written after that most interesting experience that day. My thanks also to Sen. Jackson and Rep. Miller.

Very sincerely,

ANTHONY HIGGINS,
Associate Editor.

[From the Wilmington, Del., Morning News, July 23, 1968]

(LOOK TO TOMORROW NOW)

"Man, an Endangered Species?" is the title of the current yearbook of the U.S. Department of the Interior. But that title, one finds, does not imply the extinction of man like the extinction of the passenger pigeon or the dodo. The report contents itself with spotlighting some of the modern problems that stand to impair the livability of the land we live in.

Much has been done, especially in the 1960s, to set in motion the scientific, industrial, and governmental safeguards that will have to be invoked—or discovered by research—if the quality of the American environment is to be protected, let alone enhanced. The most recent example of the new awareness was an all-day "colloquium" of U.S. senators and representatives last week to discuss national policy for the environment.

No pronouncements or resolutions came out of that meeting. But when Secretary of Housing and Urban Development Robert C. Weaver declared, as he did that "there must be decent urban growth with green spaces, and brand-new communities" of the best possible planning, he was pointing to a prime consideration for the future. That is simply people, sheer numbers of people, concentrations of people.

When Secretary of the Interior Stewart L. Udall called for an "early warning system" to monitor or prevent the manufacture of dangerous products, he was talking in the context of environmental damage that can be avoided. Nor was

he kidding when he called the aluminum beer can a "national disaster" because of its durability. Such cans must somehow be reclaimed. But how?

There was sense in the talk among the congressmen and others when it came down to consumer costs. There was no rebuttal when Sen. Muskie of Maine asked, "When does enhancement begin to take precedence over the degradation of the environment?" There was no audible objection when he observed that sometimes a product's cost will have to be higher "so that the cost of environmental damage will be lower in the long run."

That get-together in the Capitol didn't settle anything, to be sure. But it showed that Congress, like the people is waking up to the absolute necessity for long-range action as well as study and thought if America is to be fit for many more millions of people to live in a very few decades from now.

STANDARD OIL CO.,
New York, N.Y., August 12, 1968.

HON. EMILIO Q. DADDARIO,
*Chairman, Subcommittee on Science, Research and Development,
Rayburn House Office Building,
Washington, D.C.*

DEAR MR. DADDARIO: The Joint House-Senate Colloquium on a National Policy for the Environment held July 17 was a very worthwhile event in my opinion and I appreciated the invitation to attend.

I had prepared certain remarks in case I was asked to speak, and I am attaching these for the record in accordance with your letter of July 26.

At the time of the Colloquium I was associated with the Esso Research and Engineering Company but have since transferred to the parent company, the Standard Oil Company (New Jersey), at 30 Rockefeller Plaza, New York City.

Best wishes for success in your efforts to improve the legislative process and the quality of our environment.

Sincerely yours,

F. A. L. HOLLOWAY.

STATEMENT TO JOINT HOUSE-SENATE COLLOQUIUM ON NATIONAL POLICY FOR
ENVIRONMENT

My name is Frederic Holloway. I am a member of the National Academy of Engineering and of the Academy's Committee on Public Engineering Policy. I am also a member of the Joint Board of the Academy of Engineering and Academy of Science on Environmental Studies. I am also President of Esso Research and Engineering Company, the principal scientific and engineering affiliate of the Standard Oil Company (N.J.).

I am speaking today as a representative of the Academy of Engineering, and wish to outline the Academy's interest and resources in contributing to national policy and strategy for improving the environment. The National Academy of Engineering is a relatively young organization. It was founded less than four years ago by 25 members. It was established under the charter of the National Academy of Science, which is over 100 years of age and is much larger in membership. The two Academies are available for advice to both the executive and legislative branches of the national government, and to local governments on broad areas of science and technology. The Academy of Engineering has committees and activities of its own, and in addition joins with the National Academy of Science in sponsoring work of the National Research Council. The membership of the National Academy of Engineering has grown over the last 3½ years from its original membership of 25 to a current membership of approximately 230. The Academy of Engineering is composed of people from industrial, academic, and government fields. Election is on the basis of important contributions to engineering theory and practice, or unusual accomplishments in pioneering new fields of technology.

The Academy of Engineering seeks to be of service to the governments by bringing together on a part time basis groups of members and others who can put together both specialized and broad judgment in problems related to technology in such a manner that individual biases are outweighed by the judgment of the group. Such groups can formulate new ideas and goals, can develop needs and plans for action, and can assess plans and results. Since they are

part time they cannot execute detailed studies personally, but they can overview and guide such studies.

It is important that government and the private sector learn to work directly together to develop policies for maintaining the quality of the environment. Where appropriate, the Academy can be useful in serving as a liaison force or to provide advice and counsel for objectivity in this interaction.

From the beginning of its organization the Academy of Engineering has recognized the importance of improvement of the environment. Within its first year it organized an ad hoc committee on Control of Wastes in Air, Water, and the Land. This led to joint activity with the National Academy of Science in forming a joint coordinating board on Environmental Studies somewhat over a year ago. The two Academies have a number of committees dealing with environmental subjects.

In addition the Academy of Engineering is also interested in environmental problems other than those of the physical environment. It has for example organized a Committee on Urban Technology in the Division of Engineering of the National Research Council, which is operating under a contract with the Department of Housing and Urban Development.

On the subject of a proper environmental quality policy, both government and the private sector have a role. In the case of government, time permits mention of only one example—the role of developing and implementing constructive regulations based on sound criteria. As to the private sector, it must be ready to devote its capabilities to developing the means for meeting regulations and to making necessary changes in operations or products. The end purpose of course is that under normal conditions neither operations or products will be harmful to human health or cause other undesirable changes to the environment.

To accomplish this, I favor regulations to the extent necessary to protect all of the public's legitimate interests. I believe regulation should provide the needed benefit at the least cost to the consumer, they should reflect anticipated needs and the time required to develop and implement technology, they should treat competitive products or equipment fairly, and they should place the prime responsibility for control with the appropriate government agency as close to the region concerned as possible. Care should be taken to avoid speculative or emotional bases that go beyond real needs, or to solve one problem at the expense of creating another. Regulations should be sufficiently flexible that clear incentives will exist for improvements in methods of control to provide lower costs in the future.

In establishing regulations the greatest area of uncertainty is the extent to which air and water quality should be improved for national welfare. As higher degrees of quality are approached the added benefits become less and the added costs to the public increase. Research and objective evaluation of research results are needed on the harmful effects of air and water contaminants and the amounts that can be absorbed by natural processes without significant harmful effects. I hope the government will address its primary research and assessment efforts to supplying this need as a basis for sound regulations.

As mentioned previously, I believe the private sector should have the primary role of developing and implementing means for meeting regulations.

I would like to speak briefly of the interest and resource of industry in solving problems of the environment, and as an example to speak of the Standard Oil Company (N.J.) and its affiliates. The Esso Research and Engineering Company has been developing means of improving air and water quality for many years, and has intensified these efforts in the last ten years as problems have become more acute. Within the last two years it has demonstrated the technical feasibility of a device to store gasoline vapors from automobile carburetors and fuel tanks and burn these vapors in the engine. It has entered into a cooperative research project with the Chrysler Corporation to study the combined effects of engines, fuels and lubricants on automobile emissions, and to develop new methods of reduction. With this and other industry research we believe that the goal of a practical, no-harmful-emission internal combustion engine car will be reached in the next few years.

Esso Research has also developed improved technology for desulfurizing fuel oils which has served as a basis for investment of over \$100 MM by an affiliated operating company in Venezuela for manufacture of low sulfur oils. It has developed a dispersant for oil slicks in ocean waters that has been demon-

strated to be highly effective and is not harmful to marine life. The Company is continuing in its research and development for new and more efficient methods of improving air and water quality to desirable standards, and believes that the private sector is best equipped to carry out this role.

Thank you for the opportunity to speak.

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF SCIENCE AND TECHNOLOGY,
Washington, D.C., July 31, 1968.

HON. EMILIO Q. DADDARIO,
*Chairman, Subcommittee on Science, Research and Development,
House of Representatives,
Washington, D.C.*

DEAR REPRESENTATIVE DADDARIO: Thank you for your letter of July 26, 1968 concerning the Joint House-Senate Colloquium on a National Policy for the Environment. I sincerely wish to congratulate you for your efforts in connection with it.

The Colloquium has been the subject of considerable discussion in the Office of Science and Technology. If additional information results from these deliberations, we will most assuredly forward it to you.

Sincerely,

DONALD R. KING,
Technical Assistant.

McGRAW-HILL, INC.,
New York, N.Y., July 22, 1968.

HON. HENRY M. JACKSON,
U.S. Senate.
HON. GEORGE MILLER,
U.S. House of Representatives.

DEAR SENATOR JACKSON AND CONGRESSMAN MILLER: I greatly appreciated the opportunity to attend the Colloquium on A National Policy for the Environment last week. There were many useful views expressed and considerable attention focussed on this most important concern.

Let me address the question of information, as it relates to a national policy for the environment. The Committee print entitled "A National Policy for the Environment," dated July 11, 1968, emphasized two major structural innovations: "(a) a high-level reviewing and reporting agency and (b) an information gathering and organizing system." Constructing an information gathering and organizing system should not be a difficult job, especially if the system design and implementation are entrusted to experienced contractors. This is the procedure employed by NASA to plan and operate its efficient and effective aerospace information system.

Like Dr. Hornig, I would prefer to emphasize the need for developing enough reliable information on environmental questions, and the necessity for adequate mechanisms to receive, evaluate, and take actions based on the information at hand. Already there is more information available on certain aspects of environmental management than we are taking advantage of; either we do not now have adequate mechanisms or our mechanisms are not adequately motivated to take advantage of this information. Additional effort placed on more effective information systems may be wasted unless there is concurrent effort to create more eager receivers for the information.

The amount of time it takes to properly evaluate information relating to such a complex situation as environmental control should also not be overlooked. It seems to me that the Defense Department "think tanks" provide a useful model for evaluation of environmental control information. Perhaps such an organization as this should be created and funded as an adjunct to the operations of one of the Federal departments or agencies. In my opinion, in order for such an organization to be efficient and productive it must have a reasonably focussed effort; it cannot effectively cover all of the manifold aspects of the environment. Already there are organizations such as this planned for consideration of the urban environment and education.

As a second point, let me suggest that the broad question of environmental control should not overlook the rapidly changing "information environment." Nearly all the testimony and published articles with respect to the environment have focussed on the physical, chemical, and biological changes which are taking place. They are concerned with air and water pollution, food and soil contamination, overcrowding and noise in cities, ecological systems in the natural environment, ect. I recall no statement about the rapidly changing information environment, except the insight offered by Professor Marshall McLuhan. In other words, the concerns so far articulated have focussed on man's requirement for a hospitable environment for his animal needs.

I am equally concerned about the hospitality of the environment for man's intellectual needs. Within the last twenty years there have been such remarkable changes in the information environment, almost unnoticed, and such revolutionary changes on the horizon, that mankind is faced with an equal challenge to understand and manage this part of his environment for his benefit. The changes in the information environment include a rapidly increasing volume of information doubling every eight to ten years, and much faster dissemination of this information over much more efficient and effective communications channels. It also includes the more and more diverse sources for information, whereby events in remote corners of the world are flashed instantaneously around the world. It also includes a far greater complexity of issues on which information is needed to understand and resolve, and a much greater diversity of the channels for communication of information and for manipulation and processing of information. Since the United States is presently coping, albeit under stress, with the physical, chemical, and biological environment of today, but has not yet examined nor understood the implications of the revolutionary changes in the information environment, one could argue that these latter environmental changes are deserving of a higher priority than the former, even though the former have so far received all the attention.

Cordially,

WILLIAM T. KNOX.

RESOURCES RESEARCH, INC.,
Reston, Va., August 5, 1968.

HON. EMILIO Q. DADDARIO,
House of Representatives,
Washington, D.C.

MY DEAR MR. DADDARIO: I appreciate your invitation of July 26 inviting me to submit comments on the joint House-Senate colloquium on A National Policy for the Environment. I anticipate that you will have my comments during the month of August. I appreciate this opportunity to participate in a very constructive and forward looking meeting.

Very truly yours,

JOHN S. LAGARIAS, *President.*

AIR POLLUTION CONTROL ASSOCIATION,
Pittsburgh, Pa., August 20, 1968.

HON. EMILIO Q. DADDARIO,
Chairman, Subcommittee on Science, Research, and Development,
Committee on Science and Astronautics, House of Representatives,
Rayburn House Office Building, Washington, D.C.

MY DEAR MR. DADDARIO: In response to your invitation to participate in the Joint House-Senate Colloquium on a National Policy for the Environment, July 17, I wish to add the enclosed comments to the record. The comments are in response to my invitation as President of the Air Pollution Control Association.

The Joint House-Senate Colloquium represents a unique approach to obtaining the most representative legislative process in expediting our efforts to obtain a useful and effective environment.

I appreciate the opportunity to have participated in this colloquium.

Very truly yours,

JOHN S. LAGARIAS, *President.*

STATEMENT OF JOHN S. LAGARIAS,* PRESIDENT, AIR POLLUTION CONTROL ASSOCIATION, PREPARED FOR THE JOINT SENATE-HOUSE COLLOQUIUM TO DISCUSS A NATIONAL POLICY FOR THE ENVIRONMENT

The desire for a national policy on control of our environment has been amply demonstrated in the outspoken concern of the able representatives of our federal agencies and the scientific community at the colloquium of July 17, 1968. Environment has been described in such broad terms, however, that it is difficult to determine the specific considerations to be included in such a policy.

In establishing a national policy, it is essential to identify and separate serious problems, existing or potential, which could conceivably overwhelm the human race, from temporary nuisances and inconveniences. The presence of an empty beer can and other litter along a road has frequently been described with the same concern as the world-wide increase of carbon dioxide or radioactivity, for example.

Many otherwise well informed people continue to speak of all environmental degradation with a single tone of concern. An initial consideration in the development of a viable national policy is that priorities and the relative magnitude of our environmental needs are established. The variability and complexity of tackling environmental problems cannot be overemphasized. Because the problems appear nebulous and all encompassing, however, does not justify inaction or procrastination.

CONGRESSIONAL CONCERN

Congress, through numerous actions and proposed bills, has voiced concern that insufficient attention has been given to environmental conditions and that they may even degrade beyond control. Congress fears that increases in national activity may or already have developed environmental situations that have become so out of control that they threaten to engulf and plunge the country into a series of crises.

To many, it seems we are moving toward a time where control of our environment, rather than having primarily economic and social values, must become a mission-oriented objective of our federal government. By identifying the control of our environment as a primary mission, it will be possible to allocate the proper resources and skills to the mission of enabling mankind to live and work safely and practically without abusing or misusing our environmental resources.

ROLE OF EXISTING AGENCIES

Agencies of the federal, state and municipal governments, and scientific and technical organizations must direct themselves to specific projects as authorized and directed by Congress, their legislatures or their membership. Such organizations have as individual charters the accomplishment of specific objectives, whether it be the navigation of streams, the evaluation of food and drugs for health and safety, the development of emergency flood control practices, or the control of air resources. In the case of federal agencies, Congress must authorize duties and allocate funds to enable them to achieve their specific goals.

The identification of the direction of the agencies and technical organizations to accomplish given objectives must, of necessity, preclude control of other ancillary but possibly equally important considerations. Each objective must, of necessity, be shaped to a size that is manageable and operational. The federal agencies, to achieve the charges given to them by Congress, must direct their major activities to their specific charges.

INTERAGENCY ACTIONS

Where a number of agencies have conflicting assignments, it is obviously necessary to coordinate their activities. In water, these may include navigation, stream pollution, water resource management, and conservation. Coordinating inter-agency committees have been established and are used extensively and effec-

*John S. Lagarias is President of Resources Research, Inc., a subsidiary of the Hazleton Life Sciences Center of TRW, Inc.

tively. Here, however, the primary purpose of coordinating agencies is to be sure that the primary charges of the various agencies are being carried out, compatible with each other.

This method of operation has generally worked well. It does not respond, however, to the unasked questions. Such questions, beyond the scope of most existing agencies, include: Is an imbalance in our environment occurring? Are there subtle degrading forces at work which will affect future generations? Are the environmental resources being misused? What are the limits of human and environmental tolerance? How effectively can we hope to control our environment and at what price? Such questions are of deep concern. They cannot be answered unilaterally. They cannot be legislated out of existence.

NEED FOR INCENTIVES

The question has been raised of what should be the justification for achieving environmental control. For example, should this be in the form of economic incentives? Should there be special tax relief to industries or more regulatory controls? What are the economic justifications, and should we consider the approach of having national regulatory environmental quality standards? National emission standards to achieve the environmental control have also been proposed.

It appears desirable and necessary that a mixture of every type of incentive and control will be required because of the very diversity, the magnitude, and the varying importance of our environmental problems. A single approach will not suffice. Typical requirements will include new and improved financial incentives, development of new economic goals, new technology, as well as new and meaningful regulations. The procedures with which we can hope to control our environment include regulation, persuasion, and incentive, not only to prevent further deterioration but also to enhance our environment. We must maintain a framework for which trade-offs can be established, as for example, the uses of our air resources by industry, and our urban communities.

USE OF EXISTING AUTHORITY

It is my belief that the major thrust today should still be in the enforcement of rules and regulations and the applications of existing technologies to our current problems. We have legislation and regulations available which, effectively applied, can materially improve many of our environmental needs. The application and proper funding of these tools is required.

The incentives that have attracted to this land people from all over the world, that have made our country great, include our natural resources, our enlightened government structure, and the opportunity to develop a person's capabilities and opportunities to the utmost of his talents. This has helped develop a great nation. Our resources are no greater than those existing in other parts of the planet. If this incentive—the combination of resources, thoughtful governmental structure, and rewarding of individual performance—has created an advanced civilization, surely this same approach should be applied to our environmental problems. The conflicting demands in the use of our environment require us to develop constraints which, while serving to protect our major civil requirements, nevertheless leave an atmosphere for performance and economic incentive in environmental control that will result in an improved environment.

NEED FOR A COMMISSION

A commission is desirable, possibly reporting through the National Academy of Sciences or the National Academy of Engineering, that will focus attention to the significance of our base line information and bring the *magnitude* of our environmental programs into focus. This commission should have as its primary purpose the advisement to Congress of the status of our environment and goals which should be established. There is always a tendency to regard our immediate problems as the most critical, which require immediate and thorough attention. There are other problems, however, that are at other times equally if not more pressing.

The recommendations of the 1966 report in "Our Environmental Pollution—A Challenge to Science and Technology" are certainly to be implemented. In addition to these recommendations, we continue to require base line information on the status of our plant and animal life. We need a continuing monitoring of the changes in the atmosphere and an ability to predict the consequences of man-made changes. We must expand our base line of knowledge of our entire environment.

An example of this is the centralized data bank which the National Air Pollution Control Administration of HEW has developed, SAROAD, involving the storage and retrieval of national air quality data. The significance of base line measurements now being accumulated can only be estimated today in terms of their value in the future. However, without good knowledge of our environmental quality, we can never successfully predict the changes that it will undergo.

While we must discuss our environment in absolute values, there are equally significant values that merely begin with physical parameters. The esthetic, the political and social factors also must be considered in evaluating our environment goals.

THE SYSTEMS APPROACH

In using our environmental assets, we must have a compromise between conflicting demands. We find the social, economic, esthetic, and regulatory requirements appear at times to be incompatible. We find it difficult to predict and analyze the important parameters. We find it difficult to even identify all the significant considerations required to control our environment and prevent its degradation or misuse. We cannot, however, afford to ignore the need for environmental control because it appears too difficult.

Analyses of many factors can be made through systems analysis but not unilaterally. Significant data are a primary requisite to a meaningful analysis. Information of this type can then be used to enable value judgments to be made. A systems analysis program does not give controls—it identifies alternate actions and permits decisions to be made with some idea of the consequences. As a tool, systems analysis can play a very significant role if properly developed and applied. For our future needs, it seems inevitable that this tool will be invaluable to help us understand, evaluate, and achieve the effective use of our environment.

APPROPRIATION OF FUNDS

The final judgement on the implementation of an environmental policy program must remain with Congress through the appropriation of the necessary resources to attack the problems. Congress has the ultimate responsibility in determining the course of action to the environmental problems. It does not make sense putting first priority to cleaning the air or water near a small town if the country is at war and survival is at stake, or the economy of an area is in such a state that it cannot produce enough food or shelter for its inhabitants.

The Solomon-type judgements to appropriate the resources necessary to solve environmental problems rest with the Congress and the state legislatures. An effective approach requires not only the proper legislation but also the appropriation of the necessary funds to carry out such a program. Obviously, during different periods in time, our urgent needs vary. It is this basic requirement—the placing of our environmental needs in perspective with our other problems of civilization—that must constantly be reevaluated. The implementation of a policy statement today will certainly change with the demands that are placed on us tomorrow. Policy and the required actions must be clear and justified to attract the necessary best efforts from the private sector. It can't be just an "ivory tower" effort.

When we discuss the deterioration of our environment, we have a tendency to be all inclusive with such a phrase. We are simultaneously describing litter in the streets, air pollution in the cities, and wholesale destruction of our land and life resources through air and water mismanagement. In some instances, the problems are trivial; in others, they may be catastrophic. It is incumbent, therefore, that a commission selected to advise the Congress on the direction of a national environmental policy be instructed to place our many problems in proper perspective. In this manner, we may and can place value judgements as to the courses of action which can be followed. A situation which may lead to the destruction of all mankind can have no dollar value placed on it. On the other hand, there are lesser problems which do have alternative actions; and these must be judged in terms of the impact on our total economy as well as give direction to technological changes which are required.

E. I. DU PONT DE NEMOURS & CO., INC.,
Wilmington, Del., July 24, 1968.

HON. EMILIO Q. DADDARIO,
*Chairman, Subcommittee on Science, Research and Development, Committee on
 Science and Astronautics, House of Representatives, Washington, D.C.*

DEAR MIM: This is a brief note to acknowledge your letter of July 22nd on the Joint House-Senate Colloquium on the Environment. I have comments, both on the substantive question of evolving a national policy for the environment, and the informal study seminar method. However, I am in the office for only a few hours today at an Executive Committee meeting and then I return to Martha's Vineyard and Woods Hole where I am aiding the National Academy of Sciences for two weeks; I am chairing an Economics Panel on the Application of Earth Satellites. Then I shall be on vacation until Labor Day.

I would like to send you my comments and best thoughts the first week of September, as I would like you to have them whether they are a part of the seminar record or not.

Yours sincerely,

Sam
 SAMUEL LENHER.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
Washington, D.C., August 3, 1968.

HON. GEORGE P. MILLER,
*House of Representatives,
 Washington, D.C.*

DEAR MR. MILLER: Secretary Cohen has asked me to thank you for your letter of July 24 regarding the Joint House-Senate Colloquium on the National Policy for the Environment.

I have asked Dr. William Stewart, the Surgeon General, to be in touch with your staff to make sure that, if there is any assistance we can provide, we will do so. In addition, he will be meeting with our staff to determine if there are any additional comments or suggestions that are appropriate for us to submit to you within the next several weeks.

Sincerely yours,

PHILIP R. LEE, M.D.,
Assistant Secretary for Health and Scientific Affairs.

Carbondale, Ill., July 18, 1968.

HON. HENRY M. JACKSON,
*U.S. Senate,
 Washington, D.C.*

SIR: I am sorry that my absence from my office and shortness of notice precluded my attendance to the important colloquium held on July 17, to develop the elements of a national policy for environment.

I urge you to include my thoughts in any documentation you may make as is presented in the enclosed transcript of my talk to the American Medical Association "What Quality of Environment Do We Want?", May 1968.

Thank you.

Very sincerely yours,

R. BUCKMINSTER FULLER.

Enclosure.

GENERAL ARTICLES—WHAT QUALITY OF ENVIRONMENT DO WE WANT?*

(R. Buckminster Fuller, DSc, Carbondale, Ill.)

Eddington defined science as "the earnest attempt to set in order the facts of experience." In attempting earnestly to think about our environment we realize gradually that it is not a static stage set. It is the continually changing sum of all our external experiences. It is omnidynamic. It is a complex of events. Environ-

* Submitted for publication May 25, 1967; accepted Sept. 27. From the Department of Design Science, Southern Illinois University, Carbondale, Ill. Read before the Fourth AMA Congress on Environmental Health Problems, New York, April 24, 1967. Reprint requests to Southern Illinois University, Box 909, Carbondale, Ill.

ment is all else of universe but self. Sometimes it feels superbly synchronous—at others, discordant; 99.999% of the events which constitute the physical and metaphysical universe are undetectable directly by our senses.

Considering and reconsidering clues which may permit our setting the complexly compounding facts of our environment in order requires (unfortunately not too obviously) that we first remind ourselves that many experiences have shown us the ease with which all our perceptual faculties can be deceived. We have also experienced the persistent and lightening-like contagion of misinformation. For instance, it is difficult to intercept and rationalize the two-year-old-to-two-year-old children's innocently relayed infusion of the artificial concept of "that is mine"—at first mimicked from adults but having such excitingly abrupt effect on other children as to induce attitude-forming repetition.

We are also reminded of the fact that our spontaneously developed shortsightedness and frequently deliberate exclusion from consideration of a large proportion of the environmental events have most often precluded discovery of the fundamental evolutionary trends implicit in the nonsimultaneous continuity of our total experiences. Our vision is limited to the tiny, red, orange, yellow, green, blue, violet bands of frequency tunabilities representing far less than one thousandth of 1% of the great electromagnetic spectrum of the thus far discovered vast range of the physical universe realities. Our *after-image overlapping* which results in our *sense of motion* is even more limited in its perceptual range. We cannot see the hands of the clock move. We cannot see life growing. We cannot see either the stars or the atomic components move though they move at fantastic speeds. We can only see the ultra-slow motions of the clouds, locally running waters, human beings, and other creatures and their parts. No wonder that little man who within his average lifetime has seen only about one millionth of the surface of his planet and has lived but a split second of the astronomical ages does not see and cope spontaneously with the larger evolutionary patternings and life abroad the planet earth. Only through memory plus thought—greatly aided by instruments does man discover the ultra- and infra-motion effects.

Sum totally, we discover that the many different and equally erroneous opinions of humanity regarding life and the world—and how to get along in it—gradually merge into often lethally divergent religions and ideologies—every one of them based on fundamental misconceptions and incomprehensions of the realities of universe—and the universally complex integrity of generalized principles, including for instance, the principles of *irreversibility* and *entropy* which together result in *inevorable evolution* and its myriad of constant local transformations.

The more we learn the more we realize how little we know. That little seems to say: We humans have been successful thus far in history only by virtue of the supreme intellectual capability manifest in the harmoniously scientific design of the *minimum perpetual motion machine*, the infinitely regenerative universe.

But humanity now everywhere around earth is intuitively aware of the increasing threat to human survival—around our planet—that is bound to follow the further promulgation of our egotistically ignorant and illogically opposed individual and group viewpoints.

Let us therefore be as scientifically orderly as is at present feasible in dealing intellectually and practically with that complex scenario of transformations called "environment." To do so, let us first examine our *subjective* macrocosmic and microcosmic experience apprehending processes and then our deliberate experimental explorations toward comprehending the macro- and micro-environmental event complex. Finally let us scientifically reconsider our intuitively objective formulations for the objective employment of the generalized principles which we seem to have winnowed from our experiences with the environment which in turn may permit us to make life-favoring alterations of the environment scenario.

For a microcosmic example of our spontaneous and superficial misapprehending and miscomprehending the environmental events we must concede that both theoretically and experimentally we have now learned and "know" that there are no "solids," no continuous surfaces, only "milky way-like" aggregations of remotely interdistanced atomic events. There are no "things"—no particles—only energetic events. Nonetheless society keeps right on "seeing," dealing, and superficially cerebrating in respect to "things" called "solid."

There are over a quadrillion times a quadrillion atoms dynamically intercoordinating in each of our brains, of whose successful local intercourings within microcosmic dimensions, at 700,000,000 miles an hour, we have no conscious awareness. Nor may we claim any conscious design responsibility for their fan-

tastically successful electromagnetic performances which altogether result in our consciously celebrating the sensations and thoughts which integrate as our seemingly simple *awareness of just being alive*—here and right now—and evolving and considering these self-emergent “thoughts.” It is not surprising that so exquisitely designed an apparatus can be carelessly and imperfectly tuned in by us, with superficially misleading results.

And as an example of the inadequacy of our *macrocosmic* apprehending I think of students who say to me, “I wonder what it would be like to be on a spaceship.” (Oldsters have for so long assumed that such events were impossible they no longer tend spontaneously to think of participating personally in space travel.)

I always answer the students by saying, what does it feel like? That’s all you have ever been experiencing. You are all astronauts, for you live aboard a very little spaceship, illogically called ‘Earth.’ I say illogically because of the relative meagerness of its exquisitely superficial stardust and radiation supplied, biologically photosynthesised, and chemically composed ‘top soil’—ie, the very complex variety of fine particle aggregates generally identified as the substance *earth*.

Once in a while we launch a little spaceship at a velocity of fifteen thousand miles an hour from our bigger, sixty-thousand miles per hour speeding spherical Spaceship Earth which is only 8,000 miles in diameter. We launch our little ship from our bigger Spaceship Earth at only one quarter the speed of our own sun orbiting travel. Our 8,000 mile diameter may seem big to the only-one-thousandth-of-a-mile-high *you or me* but our spaceship’s size is negligible in respect to the macro distances of the sky. The nearest space ‘gas station’ (or energy station) from which we get energy to regenerate life aboard our spherical spaceship is the Sun which is flying in formation with us at 92 million miles distance. As our Spaceship Earth flies formation in annual circles around the Sun it rotates 365 times per orbit and thereby exposes all of its surface to the Sun’s radiation, thus permitting optimum impoundment of this prime life supporting energy. Our next nearest energy supply skyship ‘Star’ maintains space flight position with us at 100 thousand times greater distance than the Sun as we altogether fly formation through the vast reaches of the ever transforming Galactic Nebula.

I am a constant traveler around our spaceship’s spherical deck. Together with several million others I have now—in my lifetime—walked, run, ridden, floated, or flown over 3,000,0000 miles around the spherical surface of the earth. My travel is one hundred-fold the average distance around the surface of our Spaceship Earth heretofore accomplished in an average lifetime by any one of the generations before our time.

Lots of people say to me, “You know, I don’t like travel, I don’t like motion. I couldn’t stand your kind of life.” And I reply, “You apparently don’t know what you are doing!” My lifetime’s traveling around our Spaceship Earth’s surface is but a negligible mileage addition to our mutually accomplished nine million miles annual spinning around our polar axis, plus our six and one-half billion miles annual orbiting around the Sun and our multi-quadrillions of annual miles of milky-way peregrinating and inter-nebulae deploying. Therefore my total lifetime’s to and froing around our Spaceship Earth’s surface of only three million miles is only one-millionth of one percent of yours and my simultaneously accomplished macrocosmic traveling of *one hundred and forty quadrillion miles* which enormous total is however only one-third of the distance simultaneously accomplished in the microcosmos by each of the six trillion of atoms comprising each of our individual human organic systems.

I then repeat to my unwitting and involuntary co-travelers aboard our Spaceship Earth the admonishment of our once-upon-a-time Harvard cross-country running coach Al Schrub who used to say “Take it easy and go faster.”

The utter unreality of our conscious preoccupations is manifest by the foregoing macrophysical-microphysical event reconsiderations. Our misconceptioning is occasioned by the fact that most changes that occur in our entirely dynamic environment do so faster or slower than may be tuned in by our sensory faculties. We cannot see the hands of the clock move. We cannot see the airplane propellers when they are in motion. We cannot actually see humans, trees and plants growing. As with the clocks hands, we only become conscious in due course that their pattern aspect has changed. We can’t see the stars or the atoms “move.”

I am going to review a few more of those imperceptible events of our environmental evolution which most people acknowledge only in retrospect. For instance, one of my own experience “scenarios.”

I was born in 1895; the airplane was not invented until I was 9 years old. With a lot of other young people, I thought that our parents were wrong when they said "man can't fly." But many 10-year-olders like myself kept on making and throwing paper glider-darts while also trying to make little experimental models of full size man-carrying flying machines and sent them gliding out the attic windows. When flying did come, we expected it while our parents found it almost unbelievable.

The year I was born, the automobile was also born in America. Even though I lived and was brought up in Boston, I didn't see an automobile until I was 7 years old. That is how scarce autos were. The cranking of the car was quite a job and every few minutes some item failed. I grew up thinking of gasoline engines, pneumatic tires, automobile brakes, and storage batteries as being very unreliable. It has, therefore, been quite a change in the environmental verities of my life for motors and brakes to become generally reliable and for man to attain everyday mastery over larger blocks of energy than that of our own muscle or of the muscle of hundreds of horses. How then in contrast to myself and my contemporaries did the 21-year-old of 1967 come to think spontaneously of the automobile as organically reliable. It happened as follows.

At the beginning of World War II, before the United States came officially into the conflict, generally unknown to the public, the US Air Force began using the DC4, as the first transoceanic airplane, to carry all kinds of cargoes overseas, for instance, to the Burma Road. We sent these great skyships outbound around the world—full of various war items. These DC4's were however returning to the United States empty. The air force decided to take scientific advantage of all the homebound cargo space by shipping to Wright-Patterson Field at Dayton, Ohio, the airplane engines from any of our aircraft that had crashed in foreign operation. At Wright-Patterson they took those engines apart. They didn't have inventors looking them over to see "How do we design a better engine?" They simply wanted to know which part had failed and caused the accident.

The aeronautical world maintains not only logs of *all* its flight activities but also detailed, hour by hour records by qualified mechanics of the case histories of every airplane engine. Thus, it was learned at what hour and minute this spark plug or that connecting rod had failed. Thus it was also learned what the *earliest time* was, at which any connecting rod or any category of engine part had ever failed—say for instance—that the earliest time a connecting rod in a specific type of engine had ever been known to fail was on the 37th hour of use. "Therefore," the air force said, "inasmuch as we have routine overhauls every so many hours, if we always replace each part at the nearest routine overhaul occurring immediately before the earliest known failure for that type part of that special model engine then the probability of such failures will be approximately eliminated."

That proved to be true. Thus, it happens today that when you fly around the world your engines are extremely reliable. Though many as yet feel that flying is hazardous, air travel is far safer than railroading and automobiling. But even the automobile's component technology has been vastly improved as a consequence of the general improvement in design which ensued.

A mechanic will not falsely certify that he has made an airplane repair. If he did, he could not sleep. The imminence of death is too dramatically imaginable to be subconsciously avoided. But the same mechanic working in an auto repair shop might falsely certify that he has fixed an automobile because his subconscious knows well that automobile users are not going to fall out of the sky. But even the automobile technology has improved—in lesser degree—sufficiently to give the youth of today spontaneous confidence in its functioning for reasonably long periods between servicing. Thus, the transportation aspects of our ever evolving environment have greatly altered and with them the spontaneous human reflexing which they condition.

Lindbergh's conquest of the Atlantic with cloth-covered wings occurred in 1927. The first night flight airmail did not start until 1929. The aluminum air transport did not appear until 1930. When our second daughter was born in 1927, I was pushing her in her baby carriage in Lincoln Park in Chicago and a little airplane went overhead. Though I myself had been flying for ten years, to me at that time, the experience of seeing an airplane in flight over Chicago was as yet an exceptional experience. However, airplanes became, at that initial stage of her life, an a priori part of my daughter's *everyday* environment events—that is to say they became to her what humans speak of as a *natural*

everyday phenomenon. To each human, "natural" means the state of the environment as he first encountered and continues to experience it in his youth.

My daughter's daughter—ie, my granddaughter—was born in New York 13 years ago. Her parents lived in an apartment on the top floor of an old three-story wooden house situated at the highest point of the hill section of Riverdale just north of Manhattan. Their house stood directly below the westward flight paths of all the planes landing and taking off from both LaGuardia and Idlewild Airports. By now jets were coming into use. Over the roof of the house several times a minute went the roaring airplanes. As she cocked her head to listen someone would usually say, "an airplane!" It was not surprising that the first word my granddaughter said was not "Mummie" or "Daddy" but "air"—her sound expression for *airplane*; people took her to the window to see these roaring machines fly by overhead.

She was born in the late fall of the year when there were no leaves on the trees. As a consequence she saw thousands of airplanes before she saw one bird. Airplanes became much more "natural" inhabitants of her sky than birds.

My granddaughter also saw hundreds of thousands of automobiles coming up the Westside Expressway of New York City. Friends of the family sent her the same children's books that they themselves had received in their childhood. The books were full of pictures of cows and pigs and other of yesterday's "natural," everyday items and events none of which, however, my granddaughter had ever seen. She was as unfamiliar with their appearance as she was with the appearance of a polio virus; but sensing the grown-up's expectant pleasure she accommodated them by laughing at such absurdly "unnatural" pictures.

In other words, the so-called "natural" environment is constantly changing and consists not only of constantly accelerating rates of performance of man's ever-changing everyday tool functions but consists also of progressively occurring, inadvertently negative, by-products of the change, such as the pollutions not only of air and water, but of the whole mental, spiritual, and emotional environment which deteriorates the meanings of our expediently abused vocabularies. Thus, fallacious concepts, superstitions, customs, and shortsighted exploitations frequently pollute the environmental information and, therefore, "common sense," and its frequent stimulations of "practical" but shortsighted and worse than worthless decisions or permissions. Thus, the young world has now come to look upon both new events and yesterdays conditioned reflexes quite differently from the way older people do.

Because of the alteration of fundamental meanings and trend implications, it is difficult for the older people to realize what is motivating the young, for instance at Berkeley, Calif., in 1964 to 1965. The "Berkeley" group—whose predominant numbers graduated in 1966—and may thus be thought of as the world around "class of 1966"—are the first generation in history to have been "brought up" with television. Television is of major importance to them. The "Berkeley Event" age group throughout the United States, as well as their contemporaries in many countries where TV is in operation, have averaged 1,000 hours each year looking at and listening to the TV—more time than they have spent listening to or looking at their "natural" parents. Though the parents know only the well-known movie and TV stars, the children know all the minor actors as well as the famous ones who appear on TV.

We have learned from behavioral science research that the speech patterning of the parents—the way in which the parents employ words—is of greatest importance to the IQ development of children between the ages of 4 and 7. If the parents using their minds seek to formulate their own thoughts and develop a good vocabulary and pronounce their words well, the children also are inspired to do so. If the parents don't trust their own thoughts and use only other people's clichés, and echo only other peoples judgments the children are inclined to forsake their highest intellectual capabilities and revert to muscle and cunning.

When I was young, in addition to the family voices and personalities with which all children are familiar, there were also the speech patterns of the postman, the grocer, our family's cousins, uncles and aunts, and the friends outside into our home. Television now provides the most prominent of all of these outside speech influences. But the TV personalities, thought of by the grown-ups as coming "from outside," seem to the new generation to reside realistically inside the home, usually in the children's own room. I, therefore, combine all the TV personalities into one which I call the "Third Parent."

The children sense much more spontaneously than do the grown-ups that the people appearing on television in various roles and functions are just playing

games which include their attempts to sell some product. The children too can all play games. They play "shoot grandmother" and don't mean it seriously. Nor do they take the TV stories and plays seriously as the parents fear they will.

What the children really sense about the TV actors which appeals to their fundamental survival senses is that those human beings are earning their living by *playing* their roles—and the children sense spontaneously that TV actors get their jobs through good diction and verbal versatility. Often the television personalities have much better diction and vocabularies than have the TV viewing children's parents.

Parents are often away at work. The Third Parent—the TV—stays at home. When the blood parents come home, though they may be dearly loved and a welcome sight, their conversation is frequently of little or no informative or inspirational interest to the children who turn to their "Third Parent," who tells them all the major news about the world and not just about local trivia. Thus the "Third Parent" becomes both the most authoritative as well as *most interesting* and best spoken parent.

Lots of people were shocked when the Berkeley students said they felt no sense of loyalty to their college or to the United States. But further inquiry shows that they are not lacking in idealism or in compassion. The young people simply feel loyal to the whole human family. They refuse to accept yesterday's "you-and-me" cultivated biases. They feel that the whole world should be made successful for everybody. The TV bred youth also learn from their "Third Parent" all about the inventions of which men are capable—such as voyaging for thousands of miles under the polar ice and soft landings on the moon. They feel—quite reasonably—that man can produce *anything* he needs and wants.

Learning from the "Third Parent" that the majority of the human family is in trouble, the TV generation feels that its parents are much too locally pre-occupied with irrelevant ideas and obsolete customs and are blinded by misinformed conditioned reflexes. The young people see that we cannot correct such negatives as air and water pollution by local means for obviously the air and water flow everywhere around our planet and affect everybody, and thus, if anything may "belong" to anybody, they realize that the Spaceship Earth's prime resources belong to everybody. The young people see clearly that we cannot control our environment until we gain enough confidence both in ourselves and others to permit us to use both our physical resources and our higher faculties to induce each one of us to deal as intelligently with all the world and all people as we would with our most trusted and beloved friends.

To be able to coordinate and take the initiative, the TV generation see that they must face up to these facts of the organic, omniinterdependence of our whole Spaceship Earth's component resources and people. The young feel the older ones are no longer capable of such realistic farsightedness. The older generation has been frustrated too long. It is too slavish and lacks fundamental confidence that technoscientific innovations can be made to work and that man can both physically and metaphysically successful. The older generation is wrong in its axiomatic assumption that all history teaches us that there is not enough for both of us and that it has to be "you or me to the death as there is not enough for us both to live." This assumption automatically induces cunning and the conclusion that it is foolhardy to trust the other fellow.

The European people who first settled in North America put up little wooden houses to permit their survival in the rainy days and cold months. To live they had to employ nature's progressively disclosed biological regeneration scheme for maintaining life aboard Spaceship Earth. The heart of this scheme is to obtain energy from the sun by the photosynthetic chemistry of the green vegetation on the land and the algae in the water. Men and animals cannot impound sufficient sun energy directly through their skins to both survive and regenerate. Nor can man eat the energy-capturing trees and grasses. He can eat some of the fruits, a few leaves, nuts, and roots. The vegetation is consumed primarily by insects and animals which in a complex chemical energy relaying system—culminating in animal flesh—can eventually be eaten by man. In his early farmstead, man had to spend all his daylight time *cultivating* high-bred vegetables, animals, and fruits; his pioneer housing was minimally conceived with just a few windows to enable the wife to see whereabouts in the fields her man might be so that she could find him quickly in an emergency.

As time went on man developed tools to improve and speed his work so that he had more time to spend around his house. He built a front porch to keep off the rain so that he could have a chance to sit, look around, think, and plan. Then

with even more time saved by even better tools he found time to screen his front porch. Later with even more time, he glazed it. At first his young people used the parlors to do their courting. Later they resorted preferably to the new palm-, rubber-tree-, and geranium-filled, glassed-in porch—the “conservatory.” Gradually, evolution, in effect, “put wheels” under the glassed-in front porch concept and, like a hydra’s spawned new life, the front porch broke off and went rolling along the road in the form of the “automobile.” The automobile, thus, became today’s young people’s parlor. That is where they do their courting—parked at the drive-in theater or elsewhere in their mini-sized mobile home.

The old farmsteads of a half century and more ago had a great many buildings, each of which employed associative or disassociative phases of energy as positive or negative heat to produce and maintain certain environmental conditions—of dryness, wetness, heat, or cold within which to preserve or process foods, fodder, and materials. The windmill, the woodshed, the icehouse, cowbarn, corncrib, hen house, hayloft, cold frame, and warm cellars, etc. were used to establish and sustain these preferred energy phase conditions. The subsequent development of electric refrigeration brought refrigeration into the house and obviated the wintertime’s cutting of ice and its storage in a large separate icehouse from which cut-up cakes were brought progressively indoors and put piece by piece into the ice box. Thus, we were inadvertently innovating mechanizations for no one realized that those *buildings* were indeed machines and as all machines, they converted energy into work which in turn produced and maintained preferred environmental conditions—the environment itself always consisting of a complex interaction of different energy phase events.

Now I would like to get a little more scientific about what I’ve been saying: in 1927 I began to feel that in this total evolutionary process, man was extremely ignorant and vain. For instance, though our leading scientists have had 500 years opportunity to adjust themselves to their own theoretical knowledge and scientifically disciplined experimental findings they have always realistically “seen” and as yet “see” the sun going “down.” All scientists continually use the words *up* and *down* although we know that no unique direction of the universe may be identified as either up or down. These words up and down were invented when mankind admittedly thought the earth was flat and that all perpendiculars to it were parallel to one another with one set of ends pointing up toward the heavens and with the other set of ends pointing in the opposite direction, ie, down toward hell. Today, the aviator finds as he flies around our spherical spaceship to China that his plane is up-side down in respect to the United States but not upsidedown to himself or anyone else in the vicinity. Therefore, he has to formulate new terminology to accommodate his experience and eliminate the misconception. As a consequence he now says that: he “*comes in* for a landing” and “*goes out*” when he “takes off.” When people say up they really mean *out*, and when they say down they mean *in*—toward the center—the center of some specific, focal, unitary mass in the universe. Each individual *inwardness* is *unique* and specifically directional. The *outwardness* is *common to all* the individual *in*’s and is omnidirectional. On televised programs of our manned satellites we frequently hear the ground control scientists and doctors saying to the astronauts in orbit, “How are things *up* there this morning, boys?” often asking this as the astronaut’s around-the-earth zooming capsule is at the moment of querying in the direction of the inquiring scientist’s feet.

All the foregoing is just to remind us how we are cerebrally booby-trapped by yesterday’s misinformation-polluted mental stimulus environment. Possibly the most lethal pollution we have is the information pollution the effect of which is blinding us from seeing the costly eventualities of the more familiarly recognized water and atmosphere pollutions.

Young people have a very great advantage over us oldsters because they have so much less to unlearn. Much of my life has been of necessity invested in unlearning all the erroneous information that has been given to me as both curriculums and extracurriculums *education*, albeit often with the most loving motivations.

In 1927 I decided that all our hope for humanity’s survival and possible prosperity lies in the young, because the older people in general are so preconditioned with error and are, conceptually, so statically and locally preoccupied that they are unable to deal competently with our Spaceship Earth as a complex life-regenerating energy processing system. They cannot break away to think and operate in the terms of our whole earth as an organic and entropic machine

equipped and continually "refueled" by radiation from our mother spaceship, the Sun.

I had good reason to think that children may have clearer and less damaged brains and minds than grown-ups. Our first child died just before her fourth birthday. She was born at the end of World War I and in rapid succession caught the flu, infantile paralysis, spinal meningitis, and finally a fatal case of pneumonia. She was not able to run around like other children, so she used her brain and mind in most extraordinary ways in order to acquire the environment-comprehending information obtained by the physical experiments of normal children. She often spoke out anticipatorily the sentences about to be spoken by people around her, thus disclosing a degree of sensitivity otherwise unrevealed. I concluded that I was experiencing direct proof that the young are born with a much greater brain capacity information-tuning range and mind capability than any of us have been accrediting to them. This made me feel, in 1927, when our second child was born five years after our first daughter died, that we had the unbelievable renewed opportunity and vital responsibility of trying to protect these higher capabilities and giving them a chance to develop. At that time, I committed the rest of my life to working on ways of reforming the environment—instead of trying to reform man—intent thereby to accommodate and protect humanity's probably much higher intellectual and productive potentials.

For too long we have been working under the false assumption that the young child's brain is in effect an empty receptacle into which we may pour our precautions and know-how. The behavioral sciences are now disclosing that the young have innate faculties of comprehension and wisdom frequently surpassing the damaged cerebral equipment of the nonetheless "acceptably normal" older people.

I have tried to fashion an environment within which it is possible for the young to experiment without getting hurt and within which they can get the information they really need without their parents having to say "Don't" for fear the children may be hurt in one way or another. Within such a completely designed patterning of environmental events the children may experiment without something falling on their heads, when the parents don't say "don't" or are not around to "don't" them. When such accidents happen, the child subconsciously questions: "Why is the home environment so ignorantly organized that when I make experiments I must get hit on the head and be constrained spontaneously or be commanded to abandon my efforts to find out what I need to know regarding successful employment and enjoyment of my faculties and the resources about me?"

The environment is entirely dynamic that is to say it is a complex interaction of physical and metaphysical experiences of varying frequencies and quantum magnitudes. To each of us the environment is *everything that is not "me."*

It is essentially significant that, despite our having learned theoretically about the speed of light and the new thinking of Einstein, very few of us as yet think realistically in those supracomprehensible speed terms. Most people as yet think of universe as a single static, instantaneous, geometrical system whereas our universe is an aggregate of nonsimultaneous and only meagerly overlapping events each of which is continually transforming, disassociating, and reassociating in new ways. We now realize on deeper reconsideration that the *combined physical and metaphysical universe*, as the aggregate of all humanity's consciously apprehended experiences, must also be taken to be a *complex aggregate of nonsimultaneous and only partially overlapping transformation* events with complementary, positive and negative, non-mirrorimaged, maximum and minimum, microcosmic and macrocosmic, associating and disassociating, compressive vs tensional, concave vs convex, inside-out vs outside-out, etc. limits.

We can clarify that accurate but formidably complex definition. A moving picture scenario is an aggregate of nonsimultaneous and only partially overlapping events. One single picture—one "frame"—does not tell the story. The single picture of a caterpillar does not tell or imply the transformation of that creature first into the chrysalis stage and much later into the butterfly phase of its life.

When people say of universe, "I wonder what is outside its outside?" they are trying to conjure a unitary conception and are asking for a single picture of an infinitely transforming nonsimultaneous scenario. Therefore, their question is not only unanswerable but unrealistic and indicates that they have not listened seriously to Einstein and are only disclosing their ignorance of its significance when they boastfully tell you that the speed of light is 186,000 miles per second.

Realizing that both the inside and outside environmental influences impinging upon man all originate with atoms, and are omnidirectional, I started off by

thinking of how all the heretofore unrecognized, or unwelcomed micro-macro events might be turned to advantage. Instead of trying to insulate man against them, it seemed that I should try to learn what must be intercepted, how to intercept them, and how to turn them to human advantage?

Man needs lots of water but he can't use all the water while it rains so we must learn how to intercept that rain and shunt it into holding patterns—in cisterns or reservoirs—and then pipe it and valve it so that it may become controllably available in the increments and at the times most favorable to humanity's schedule of metabolic regeneration processing.

The total environment interaction going on is as beautifully designed as is the Spaceship Earth itself—aboard whose spherical hull men have been able to live for 2,000,000 years unaware that they were aboard ship—simply because they were so physically tiny that they rarely lived to see more than one millionth of its total surface.

Intent upon designing the most effective means of valving the environmental events to humanity's maximum advantage—in 1927 I set out to catalog all the things I could think of that ever happened to man. I thought this inventory might take months but it took only a few weeks. Later on I published this list. On looking at its sometime afterwards, in neatly compressed print, my eye saw new patterning that I had not seen before. My eye happened to fall on a part of the list where "tornadoes" were listed next to "mosquitoes." This seemed suddenly to be so incongruous that I rearranged all the items in order of *relative severity* of hazard to human survival. This order ranged from "lethal" through "disastrous," "very dangerous," "fairly dangerous," "bothersome," to "innocuous," to "pleasant."

When all the items were arranged in strict order of relative severity a new pattern of surprising significance emerged. *It became apparent that the larger and more severe the event, the less frequently it occurred.* This is because in the expanding diffusion of ever moving, transforming, disassociating, and newly associating energy islands of universe the number of times that there will be large amounts of energy in one given place to bring about large transformations is inherently less frequent than the number of times there will be small amounts of energy in any one specific place to bring about relatively minute or meager transformations. We have "bugs" much more frequently than we have "earthquakes." Suddenly I realized that what we speak exactly of as "tornadoes" and "mosquitoes" may be very specifically identified in the hierarchy of energy events which form the Quantum Laws of relative *frequency* and magnitude of "waves" and "particles." Thus, an environment can really be analyzed and treated in powerfully selective scientific terms and predictable frequencies, magnitudes, and specific longevities of effectiveness. I began to realize that we can scientifically control these omnioriginating and self-convergent energy event factors—to high human advantage.

It also became retrospectively visible that the universe is a dynamic continually evolving process within which man himself is continually evolving. Dr. Waddington, the famous animal geneticist of Edinburg University, points this out when he speaks of what he calls the "epigenetic landscape" in which we have all of the biologicals continually altering the environment and the altered environment continually realtering the biologicals. There is manifest a chain reaction of extraordinary pattern interactions whose consequently progressive intertransforming we recognize as "evolution." Evolution is both you and I and the comprehensively dynamic, macro-micro environment—i.e., universe. Due to entropy, the physical evolution of universe is irreversible. There are cyclic patterns which are repeated but not reversed. Only the metaphysical abstract thoughts can review and reconsider the evolutionary transformations, individually or collectively, but cannot "turn back the clock."

In view of all the foregoing we learn that the planning of new cities embodies possibilities for progressive attainment of highly favorable stages of ever more effective environmental event controlling.

I have been retained to develop a large city in Japan (up to possibly a million) and am also on the steering committee of an "Experimental City" to be situated in Minnesota. In studying these two projects, it has become evident that the basic concepts, drives, decisions, and actions of humans, which produced all the *great cities* around our Spaceship Earth occurred long before man had thought of electricity or telephone or any of the present technological advancements which are so greatly changing our lives. Cities developed around yesterday's patterns of caravan and ship trading. These points of exchange generated wealth not as

much for the prime producers of the goods and services as for the entrepreneurs and for those who by prowess of physical might "protected" the trading with their swords and thus also sustained their sovereignty claims and deeds to the right to the land.

To sustain their fundamental economic advantage the land manipulating entrepreneurs enacted property laws as arbitrary accessories, only after the fact, of the anarchistic ways of permissive favoring of the independent uncoordinated enterprise multiplication of strategic land exploitations which result in the coral reef like random growths which we call cities.

City planners at university schools learn how to make good theoretical plans, but as practicing professionals they have no power to do anything but suggest. Their plans are continually disrupted and overridden by those who exploit our highly prized rights of free enterprise for exclusively selfish reasons. However, too shortsighted enterprise often takes advantage of society in thoughtless ways. In order to safeguard enterprise which also has many favorable evolutionary transformation advantages for all of humanity, it is not necessary to allow some men to trespass shortsightedly on the evolutionary developments of their fellowmen. The almost totally anarchistic piecemeal development and remodification of cities exclusively for the benefit of the prime investors and without comprehensive consideration of the total welfare of all mankind for all future time is getting us into ever greater trouble.

In a very realistic sense all of society is beginning to realize that this is so and there is a powerful trend in basic drives of human consciousness towards the swiftest corrections which will not be too disruptive of the total evolutionary welfare of all humanity. In view of that evolutionarily emerging propulsion of human consciousness toward discovery of any other alternative courses of action, which may have hope of fulfillment, it is encouraging to discover at least one other realistic and much more socially promising way of looking at future city designing. This alternative derives from the observation that the *Queen Mary* is of course an extraordinarily beautiful and comprehensively organized small city. This lecture was given to the American Medical Association, April, 1967. Six months later Los Angeles decided to purchase the now competitively obsolete *Queen Mary* for a convention facility.

Such mammoth ships are not only the competent products of, comprehensively anticipatory, design science but are also the prime demonstration of the effectiveness of the general systems theory. General systems theory originated in the design and operation of world encompassing and commanding fleets of navy and merchant ships. For a few centuries the general system theory commanded and operated the world but only as anarchistic exploitation systems whose immediate and directly perceived profits went exclusively to the benefit of less than 1% of humanity.

I found in 1927 that one of the New York hotels happened to have the same number of passengers or occupants and the same amount of private and public space as the Cunard Line steamship, the *Mauretania*. I made a critical general systems theory analysis of their relative performance characteristics which were as follows: the hotel was able to get its supplies of food, linen, power, heat, and light daily for the local suppliers situated in the city—outside the hotel—and therefore did not have to include these capabilities within their structural design, while on the other hand the *Mauretania* did have to store on board a 30-day supply, had to generate its own power and light, and had to structurally support and float the weight of the engines and fuel to drive it through the sea at 30 knots. I found that if I turned the hotel over on its side in a horizontal position like the *Mauretania*, just one of the little waves that the *Mauretania* had to handle would break the hotel into pieces. Yet the hotel weighed 18 times as much per usable cubit foot than the ship. This was fairly typical of the difference between the fundamental technologies of the sea and the superficial and inefficient building contrivances of the land.

On land, men have thought in terms of fortresses and guarding their positions and of hoarding their supplies so the heavier and more durable the building, the more secure they feel. They thought of buildings as permanent while ships were designed for relatively short service.

The ship has first of all to float. Each more useful ship has to do more with less, have greater and greater strength, and be able to continually increase power without increasing its weight. The competition advantage goes always to the latest ship to do even more with less. Therefore, the design evolution is in constant acceleration on the sea and in the air but not on the dry land building.

The foregoing explains why it is possible for a whole organic city to be floated. It is also evident that in an organic floating city—which unlike the *Queen Mary* need not cross the ocean at 30 knots—but can remain anchored at a desirable location—the amount of weight which must be invested per each organic function can be decreased greatly.

We are actually undertaking this in Japan. Since this lecture was given the Japanese patrons have changed their plans and are now going in for a high tower community on the land. Fortunately, the idea of the floating city has been espoused by others and the project is going forward but in other waters than those of Japan.

The Japanese as island people think in terms of the sea so we are planning our first city to float on the ocean. Its floating hollow reenforced triangularly shaped concrete base will reach 100 feet below the water surface. This is well below the ocean turbulence depths. This means that the floating city will not rise and lower with the waves but will hold its "altitude" as does an island or iceberg. The waves will "break" against the floating base as they do on any breakwater. Inside the deep floating triangular base a vast lagoon will act as a large sea-going ship's harbor.

Ships that must be driven economically and swiftly through the seas must be long and sleek and therefore are subject to "beam" and "cantilever" stresses as they first span between waves and a moment later mount one big wave at their mid-length, their ends being partially out of the water. Such stress alternations twist and rack the ships. However bell buoys which remain anchored have no such asymmetric conformation and float integrally with but little redundant stressing even in great storms. The triangular base conformation of our organic floating city is similar to the bell buoy and will not permit any redundant stressing—and will therefore have maximum structural stability with minimum effort and therefore greatest economy.

The organic, floating city starts off with its prime power and water requirements at hand for it can combine atomic power reactor cooling and desalination of the sea around it—by use of the by-product heat. Therefore, as practical experiment has now shown both water and electricity can be produced at lower costs than in any other known way for producing either independently of one another. The Japanese are not even mildly adverse to using dry packaging toilets instead of liquid "splash-back" toilets, which continually later pollute the conveying waters as the latter are shunted through the plumbing systems, enroute their passage from the sky as rain down the mountain sides, toward and into the sea system. Inasmuch as it is economical and desirable to have the food supplies inbound to our digestive system plastic packed, it becomes equally economical and desirable for the outgoing products to be electronically sealed in plastic packages for dry conveyance to chemical resource collection points, subsequently to chemical processing works, and finally to valuable by-products distribution uses.

I would like to point out here that, in relation to all our pollution problems of the air or water, very valuable chemical products are continually lost. For example, the stack fumes of one nonferrous metals refinery disgorges somewhere around \$500 worth of chemical substances a day, but the cost of, the precipitation would be about \$500 so the company does not attempt to recover it for the cost of the installation could not be amortized. If air pollution control were really enforced, a lot of very valuable products could be salvaged at a real profit if we consider the far more gargantuan costs of society's ultimately coping with the physical ills resulting directly, and must later indirectly, from the fume-polluted atmosphere.

I mention this because, as you doctors begin to study environmental health problems in depth, if you apply general systems analysis—as the computers will now permit you to do—you will begin to know the overall profit and loss to society of doing or not doing thus and so. You also will inevitably encounter much inertia and shortsighted thinking which can be overcome only by education regarding the overall costs or profits to all human society—all of which must be inexorably paid for by some large numbers of humans sometime and somewhere about our Spaceship Earth's surface. It is therefore extremely important for you to be able to point out the ways in which atmospheric control will pay off magnificently and *that* you can now do with the computer's aid.

Dr. Benjamin Bloom, an educator in Chicago, author of the book *Stability and Change in Human Characteristics*, sets forth the results of his investigations of the critical effects of environment on the brains and minds of the young.

These results were arrived at by a significant number of periodic tests under controlled conditions. Combining Bloom's observations and those of geneticists, neurologists, and the electromagnetic probes of the brain, we discern that the various apprehending and coordinating capabilities of the brain—as scheduled and actuated in the children by the unique chromosome "tickertapes" of each individual—are measurably affected by the environment of the individual. As far as we know by any experiments neither the environment nor anything else can produce a better intellect and brain than that with which we are born—but an unfavorable environment can very greatly impair the functioning of the innate faculties.

I have found that the ability of man to use his highest faculties to cope with his environment is more favorably affected by design science reformation of the inanimate environment than by direct legalistic, punitive, physiological, or psychological attempts to reform human beings. I am convinced that 90% of humanity's problems can be solved only by comprehensively anticipatory design science reformations of the environment.

I have made many experiments with measurably improved environmental controls in over 5,000 structures in more than 50 countries. Concurrently, over a period of 50 years I have continually undertaken to solve those design problems by use of the most advanced technologies for doing ever more with ever less fundamental resource investment per each unit of functional performance. It has, thus, been experimentally evidenced that by such ever more economical and more effective environment reforming means we have the greatest hope of achieving both physiological and economic prosperity for all humanity. Furthermore, this environmental reformation strategy now seems to be both scientifically feasible as well as economically desirable.

In substantiation of that statement I find that many geodesic prime environment valving controls (that is my scientific identification of structural "dwelling machines," ie, geodesic buildings) are running only about 3% of the weight per enclosed cubic foot of the best known alternative engineering strategies for coping with the same given magnitude of the omni-hazard events of nature. Furthermore, my geodesic structures can be put in place and in operation in fractions of the time for alternative structural strategies and unlike any other previous buildings are both 100% demountable as well as economically deliverable around the world by air transport.

The US building for Expo 67 was a very large energetic environment-controlling device. I am its architect. I can tell you, therefore, that it was not put up there to be pretty or novel but simply to be the most economical tool for coping to advantage with all weather, and earthquake events. It is an effective energetic valve. It lets in what humanity needs and wants, when they most need and want those services in the most acceptable, useful, and necessary quantities, for instance, of light, air, and other chemical conditions of the atmosphere, sound, and olfatorial conditions, and as tuned most compatibly with man's complex variety of frequencies and chemical energy increments.

Our Expo 67 geodesic environment valve is 20 stories high and 250 feet in diameter. Istanbul's Santa Sophia Mosque or the enclosed volumes of any one of the great cathedrals of the world could be put inside it, for instance, Seville Cathedral in Spain, St. Peter's in Rome, or Notre Dame in Paris. The total US geodesic pavilion building weighs only 800 tons. This is approximately the weight of just one of the many internal stone columns in Seville Cathedral—the second largest such edifice in the world.

I find that I have improved thirtyfold the environment valving capabilities of humanity as measured in terms of units of weight of structure per given performance schedule capabilities of that structure. Therefore the aerospace type of building technology which I employed in the Expo geodesic holds real promise to humanity of doing so much more with so much less in all branches of technology as to attain total success for all of Earth's inhabitants. The young world, seeing it, will feel encouraged. This is the first time at a world's fair that we have had a building designed specifically for its scientifically demonstrable high performance per units of invested weight, time, and energy. It is the first time in history that architecture has been presented exclusively in terms of efficiency of weight, energy, and time units of resource investment. The aesthetics of such an undertaking take care of themselves. Not an ounce of weight goes into the design, building, and outfitting of an America's Cup defender. That boat's beauty, as with a snowflake or a human being, is inherent in the exquisite economy of an exactly adequate performance capability.

Inasmuch as humanity on the land has not been thinking of what buildings weigh, it certainly has not been operating its construction industry on a performance per pound basis. Architecture has been superimposing millions of tons of superficial appeals to aesthetic applause to that already overbuilt land structuring.

Between 1900 and 1967 world society has inadvertently and all unpredictably gone from taking care of less than 1% of humanity to taking care of 40% of humanity at a higher standard of living than that known or dreamed of by any king before the 20th century. During the same period the metal resources of the earth, both mined and unmined, have continually decreased per each world human. Therefore the sudden advancement of 40% of humanity's living standards to an unprecedented and previously undreamed of degree has not resulted from finding more resources, but, paradoxically, from the development of weaponry where the inherent design requirements of the water-borne and the air-borne and the space-borne weapon carriers—as the evolutionary products of the great international armaments race—have continually been accomplished by doing more with less. It is the unexpected fallout of that more-with-less technology into the domestic economy which alone has brought about the politically and commercially unpredicted improvement of the living standards for an ever increasing proportion of all humanity. This standard of living augmentation for ever larger numbers occurs every time an armaments producing contractor is displaced by a producer of newer and more efficient weapons technology. The displaced contractor then looks around in the domestic market for an outlet for this technologically high productive capability. Thus, for instance, refrigeration which developed in the ships of the navy 30 years earlier was brought ashore to land-based homes. This fallout is specifically responsible for all the great advances in our home technology.

The time has come when you, as medical men for all the people on the land must realize that what we are all faced with is the necessity for a revolution in our education which in turn will result swiftly in an around-the-world design revolution which will progressively rework our environment to favor humanity's innate potentials.

You are faced with the challenge of helping society to know what its problems are. You are going to be implemented by new educational technology which will make it possible to do much more accurate informing with so much less that your admonitions can be heeded. We have the technical wealth capabilities to carry out your suggestions so do not be inhibited or deterred from forthright suggestion as to what we now should do if we wish humanity to succeed as Spaceship Earth's passengers. Science now says for the first time in history that Malthus is wrong. It is not normal for the majority of humanity to be, both or either, physical or economic failures. Science now realizes that it is normal for all of humanity to be a success. Failure is abnormal. That abnormality is wrought by the unnecessarily hostile conditions of the everyday environment on the majority of humanity.

But all the great ideologies of all the powerful nations are predicated upon Malthus and his assumptions that there is not enough to sustain both you and me. He assumed, erroneously, that eventually one of us must perish—far short of our potential lifespan—wherefore it seems popularly expedient for large sovereign country groups to implement themselves with big guns in preference to individuals seeking to survive independently with their separate little guns. Because of the foregoing all the ideologies on earth mistakenly assume and give highest wealth investment priority toward preparing for an inexorable Armageddon.

Because each department head of every industry in both the socialistic and private enterprise economies must make a "profit" of one kind or another, "this year" industry and commerce are inherently shortsighted. The politician's vision also cannot look beyond the next election. The only long distance-sighted activity of humanity is that which is focused upon Armageddon. Your own medical science has been underwritten first to ward off eventual death. It is toward this assumed eventuality that science has been almost exclusively fostered. Science has never had a mandate to make all of humanity a living success. This is because neither the great dictatorships nor the democratic electorate knew that comprehensive success was feasible. Science now says, however, that physical and economic success for all is feasible but that it cannot be accomplished with continuation of the political sovereignties which inherently frustrate the industrially essential integration of all the world's resources. Only a politically transcendental design

science revolution can provide enough for all. The world's resources as now designedly employed can take care of only 44% of humanity. No strictly political act or revolution can per se correct that condition. And that condition attended to only by political leaderships means inevitable war.

Keep all the world's political systems in force and all the world's politicians and political workers at work, and at the same time take all the machinery of industrialization, all the tracks, pipes, and wires and dump them in the oceans away from all the countries of the earth, and within six months 2,000,000,000 people—half of humanity—will die of starvation. Lacking the industrial tooling no political system could alter that result. Contrariwise, leave all the machinery, wires, pipes, and tracks in place and all the humans, who now operate them, at their daily tasks, but take away all the world's politicians of any and all ideologies and send them and their party workers on a trip around the sun by a slow speed rocket ship and all those who are now eating will go on eating and with all the sovereign nation's barriers unmanned the foods will begin to cross the borders and the resources will be integrated and soon all of humanity will be eating and prospering.

Quite clearly world literacy of all the world's people regarding what the survival problems are must be placed on highest priority of educational undertaking if we are to avoid blowing ourselves up or so polluting our biosphere that the energetic regeneration of life on Spaceship Earth will soon become impossible.

As the body of professionals having the highest initiative potential your challenge is clear. Is it to be an environment of life or death? Is our Spaceship Earth's biosphere to be an *omnihumanity-sustaining environment* or an omnilethal one?

This is the imperative challenge to all of humanity's intellectual integrity.

It is not your challenge exclusively, but your potential contribution is of the magnitude of the highest order.

Will we muster our self-disciplining capabilities to transcend our ill-conditioned reflexes? Having done so will we go on to cooperate with our fellow men in the realization of our mutually successful potential?

If the design revolution is initiated by a few capable humans—just as Marconi, Edison, and the Wright brothers altered man's environmental advantage to a marked degree—then the inevitable emergencies ahead for humanity may bring the new tools into use which in turn will bring about the physical welfare of all.

NEED TO IMPROVE DELIVERY OF HEALTH SERVICES

The trends toward greater specialization, greater reliance on a team approach to health care, and growing institutionalization of health care have all arisen quite spontaneously and their development has been largely without planning or structure. A great need of the future is for the rational development of improved organization and methods for health care and the delivery of health care.

The field of medical education needs to turn its attention to the matter of improved delivery of health services in three ways. First, those in the field of medical education themselves need to devote greater attention to studying how health care can best be provided. Second, they need to teach medical students and young physicians to provide health care in the ways that are most effective medically and efficient economically. Third, the medical school of the future can contribute significantly to the health field by providing the "model" or "demonstration" of how health care can best be delivered.

Schools of medicine should be taking the lead in studying the ways medical care is delivered to patients. Their concern should be not only with acute care but also with preventive care and rehabilitative care. Their concern should be with comprehensive family care as well as with specialty care. The university-sponsored medical school is in an unequalled position to draw on the resources of many disciplines—medical practice, economics, business administration, sociology, psychology, education, engineering, and others—to study the way in which comprehensive health care is provided. The need is for careful study of how health care can best be made available—including how medicine can best be practiced—and for the development of more effective plans of organization and delivery of health care.—Coggeshall, L.T.: *Planning for Medical Progress Through Education*, a report submitted to the Executive Council of the Association of Medical Colleges, April 1965, pp. 37-38.

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE,
Washington, D.C., July 26, 1968.

HON. HENRY M. JACKSON,
U.S. Senate,
Washington, D.C.

DEAR SENATOR JACKSON: I was most pleased to attend the Colloquium on Environmental Quality held on July 17, 1968. I do believe that a major contribution has been made in bringing into clearer perspective the principal issues and needs for a national policy.

It was indicated that the record would be held open for comments for several weeks. I am forwarding herewith a paper "Environmental Pollution Control in the Department of Defense," given at an American Society of Civil Engineers' meeting in San Diego in February of this year. It highlights the administrative methodology being used in the Department of Defense to bring together the diverse interests and responsibilities in the military departments concerned with environmental pollution. I believe it is pertinent to the record, in that within the Department of Defense there is in effect the sort of "Cabinet for the Environment" suggested by Mr. Rockefeller and envisioned by Congressman Daddario. It has shown that a coordinated, cooperative management tool can be developed for environmental problems, within the framework of existing departmental structures.

There is in my personal view a real need for some improved and strengthened administrative mechanisms in this wise, in the organization of both the Executive and Legislative Branches. The role of the Committee on Environmental Quality, Office of Science and Technology, needs better definition, and the overlap of various Congressional Committee interests could be reorganized. These are my personal views, and do not reflect necessarily a Department of Defense position.

Again, thank you for the opportunity to attend this stimulating meeting.

Sincerely,

ALVIN F. MEYER, Jr.,
Colonel, U.S. Air Force, BSC,
Chairman, DOD Environmental Pollution Control Committee.

ENVIRONMENTAL POLLUTION CONTROL IN THE DEPARTMENT OF DEFENSE

(By Col. Alvin F. Meyer, Jr., U.S. Air Force, BSC, FASCE*)

The military departments and agencies have had a traditional concern for the control of environmental pollution at their installations or arising from their operations. A steady increase in public, Congressional and Executive concern with regard to environmental pollution which has been evidenced in the last 15 years has resulted in an expansion of these existing programs, and a reorientation of policies and procedures within the Department of Defense. In the main, prior to issuance of the Executive Orders on air and water pollution abatement, and the establishment of requirements for submission to the Bureau of the Budget of five year plans for each of the Federal department's contemplated pollution abatement works, there was relatively little need to assemble a comprehensive program element package. The various military construction projects for air and water pollution abatement, research programs, and personnel requirements had been recognized and established as part of the ongoing responsibilities of the military departments. The various individual base programs and projects stood on their own merit and were not necessarily identified or justified on the basis of national program requirements. It is emphasized, however, that the needs for air and water pollution abatement were understood, and that appropriate action, both with regard to installations and with new weapons systems, was undertaken. The extensive air and water pollution control development associated with the Titan II missile system of the U.S. Air Force being a typical case in point.

It became evident in 1964 that there was a need for improved interservice coordination and cooperation on the problems of environmental pollution, both

*This paper is to be presented to the American Society of Civil Engineers, San Diego, California, February 23, 1968.

among the military departments of the Department of Defense and with other Federal departments having primary responsibilities in pollution control, principally, at that time, the Department of Health, Education and Welfare, and subsequently, the Department of Interior. As the result of some specific problems with regard to missile and rocket propellant testing, a "Tri-Service Working Group for Environmental Pollution Abatement," consisting of representatives of the three military departments' medical services, engineering and research activities, was established. Among the problems requiring the establishment of an improved means of insuring that unified and coordinated Defense Department views and positions were developed for cooperation and discussion with other Federal agencies, were the following:

- (a) Air quality standards for beryllium.
- (b) Water quality standards for munition manufacturing wastes.
- (c) The time-phasing of corrective works for pollution control of installations of the military departments located in the same geographical area.
- (d) Increasing requirements for presentations to Congressional Committees.
- (e) The development of long-range pollution control plans.

A comprehensive Department of Defense policy on environmental pollution abatement was developed and promulgated as DOD Directive 5100.50, environmental pollution control. That Directive establishes policy, provides for procedures and coordination for program development, constituted a DOD Environmental Pollution Control Committee, and clearly enunciated responsibilities with regard to air, water, and other environmental pollution abatement. The principal features of this Directive and the program it establishes are discussed following.

DEPARTMENT OF DEFENSE POLICIES AND PROGRAMS

It is a fundamental policy of the Department of Defense and of the subordinate military departments that pollution will be controlled from military installations, facilities and operations. Defense components are charged with the responsibility of taking positive action to accelerate the pace of corrective measures and to take the lead in pollution abatement in respect to surrounding communities. This is consistent with the intent of the Congress and the specific directives contained in Executive Orders 11258 and 11288.

As in the past, maximum efforts are made to incorporate environmental pollution preventive measures in the basic design for military facilities and systems. Because of the requirements of the statutes and Executive Orders for cooperation and collaboration with the Federal departments having primary mission responsibilities for pollution, and with state and local agencies, the need for more extensive cooperation and coordination at the state, local and Federal level is facilitated through the Department of Defense Pollution Control Committee, which will be discussed further in a moment.

It has been recognized that there is not an unlimited supply of funds to accomplish all the measures which are necessary to provide an optimum quality of the environment. The long-range plans of the military departments do envision meeting all established criteria and standards in a time-phased sequence. Priority of effort on those projects which are strictly within the Department of Defense's sphere of responsibility have been established as follows:

- (a) Those situations constituting a direct hazard to the health of man.
- (b) Those having economic implications.
- (c) Those which affect recreational and esthetic value of natural resources.

It is noteworthy that Department policy provides for applying, insofar as practical, similar considerations to overseas areas as well as those within the continental United States.

RESPONSIBILITIES OF THE MILITARY DEPARTMENTS

In meeting the requirements of Defense policy, the three military departments and the Defense agencies are responsible for identifying environmental pollution problems at their installations and for the initiation of planning the necessary budget and fiscal actions to undertake the necessary corrective measures. The military departments, through their medical services, are required to monitor environmental pollution abatement control methods to insure that the required degree of pollution control is being achieved. There are no special provisions for environmental pollution control program funding, as these are contained in the routine budget estimates and financial programs. The military departments

are also responsible for including in their research programs appropriate projects dealing with pollution associated with new weapons systems, and for providing membership and support to the Department of Defense Environmental Pollution Control Committee.

THE DEPARTMENT OF DEFENSE ENVIRONMENTAL POLLUTION CONTROL COMMITTEE

The Department of Defense Environmental Pollution Control Committee has been assigned the duties of developing, proposing and reviewing policies and procedures with respect to pollution control in the Department of Defense. It also assists the Assistant Secretary of Defense in the resolution of interservice problems on environmental pollution control. It serves as the focal point for coordination and cooperation with other Department of Defense agencies and with Federal agencies involved in pollution control. It is responsible for preparing reports on pollution control required of the departments, and undertakes any necessary studies on pollution control matters required of the Department of Defense.

In effect, the Environmental Pollution Control Committee serves as an advisory board for the Assistant Secretary of Defense (Installations and Logistics), the Defense Director of Research and Engineering, and the Deputy Assistant Secretary of Defense (Health and Medical). It provides a means for rapid coordination of Department of Defense views and positions on proposed legislation and regulations.

The structure of the Department of Defense Committee is shown in Figure 1. Since each of the members nominated by the military departments and agencies are also the action officers within their particular element of their department, it is evident that these individuals also have responsibilities for the programs, policies and procedures developed by the Committee. In addition to military departmental representatives as shown in the illustration, there are full voting members from the Office of the Assistant Secretary of Defense (Health and Medical), the Defense Director of Research and Engineering, and several of the principal Defense agencies, notably the Defense Supply Agency.

One of the major working tools of the Defense Committee has been the establishment of working groups to deal with the variety of problems. The principal of these include working groups concerned with prevention of pollution from vessel operations, air pollution associated with rocket and missile testing, the development of the five year plans for air and water pollution abatement, new and unusual methods of solid waste disposal, prevention of oil pollution of the seas and navigable waters, environmental quality criteria, and support of the Committee on Environmental Quality, Federal Council for Science and Technology, Executive Office of the President.

Experience of the last several years has shown that the Department of Defense Environmental Pollution Control Committee is an effective management tool. It is not a purely review and deliberating assembly, but rather a functioning action organization. Specialists in pollution and related functions of the offices of the three Surgeons General, and Civil Engineering activities, research and development functions, and supply and logistics activities comprising the Committee, represent a corporate body of professional expertise which is unique in the Federal establishment.

PRINCIPAL PROBLEMS AND ACHIEVEMENTS

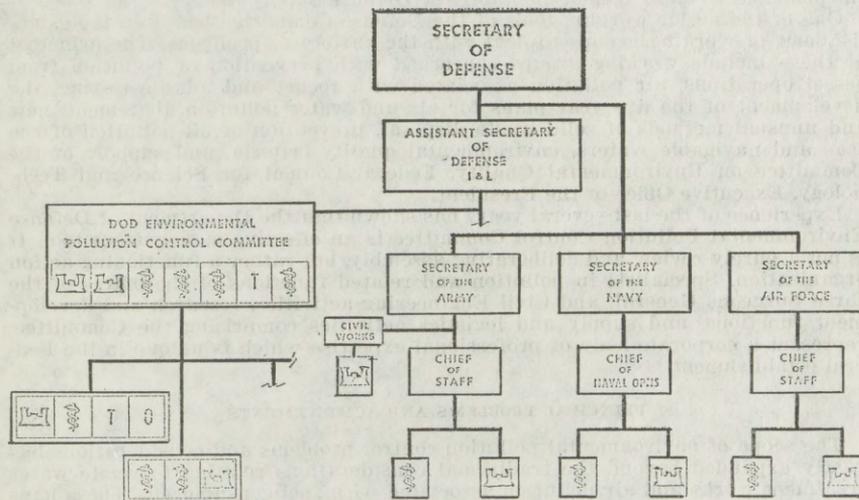
The scope of environmental pollution control problems and considerations has vastly expanded beyond the traditional considerations relating to waste water treatment works and air pollution associated with fuel consumption. These have included the problem areas covered by the various special working groups of the Committee. In addition, there has been major action on the problem of photochemical smog, reactive solvents and other materials, the initiation of planning to deal with hazardous chemical spills or other accidents which could cause air or water pollution, and the preparation of a draft tri-service manual on environmental pollution monitoring and control.

In the field of the traditional considerations for air and water pollution, the five year abatement plans for the three military departments are summarized in Table I. In order to meet the requirements of the Executive Order on water pollution abatement, the estimated five year expenditure for the three departments will be on the order of \$87 million, and for correction of air pollution problems,

the expenditures are estimated at approximately \$129 million. A major problem in this regard is the need for bringing the procedures for development of five year plans required by the Executive Orders in phase with the normal operation of the military budgeting system. It is emphasized that these estimates and plans do not represent firm budgetary programs. The various projects contained in each year's element of the plan must be supported in the military departments' annual budget submission. A wide variety of influences can affect the ultimate fate of these projects, although experience has been that in the main, Congress has supported departmental proposals. Of special interest is the fact that in the current year's Military Construction Authorization Act, strict rules were enacted requiring that there be close coordination between the Department of Defense and the Department of Interior's Federal Water Pollution Control Administration, to ensure that Defense projects are accomplished in the proper time-phase with nearby civilian communities, being neither too far in advance nor lagging behind. Obviously, constraints arising from such situations as Southeast Asia and other military operational requirements, may necessitate changes in phases and priorities. This requires a major coordination effort to insure that these changes are reflected in the overall national planning of other agencies, such as the Federal Water Pollution Control Administration and the Department of Health, Education and Welfare.

SUMMARY AND CONCLUSIONS

It is evident that the problems of environmental pollution and improving and maintenance of the quality of the environment will not diminish, but rather shall increase in the future. The formalized arrangements within the Defense Department serve as a pattern which hopefully could be extended to other Federal agencies to assist in achieving a coordinated Federal departmental effort. Existing procedures for cooperation with the other Federal Departments will be continued and expanded. The Department of Defense has demonstrated its leadership in this important element of national policy and expects to continue to do so.



AIR AND WATER POLLUTION ABATEMENT PLANS, FISCAL YEAR 1968-73

	Water	Air
Army.....	\$24, 413, 000	\$51, 227, 000
Navy.....	49, 512, 000	55, 143, 000
U.S. Air Force.....	13, 886, 000	23, 464, 000
Total.....	87, 811, 000	129, 834, 000

TEMPLE UNIVERSITY SCHOOL OF LAW,
Philadelphia, Pa., August 2, 1968.

HON. GEORGE P. MILLER,
Member of Congress, House of Representatives,
Committee on Science and Astronautics,
Washington, D.C.

DEAR CONGRESSMAN MILLER: I had forwarded to me to my summer home in Indiana your kind invitation to the Joint House-Senate Colloquium To Discuss National Policy for the Environment. It unfortunately reached me too late to make it possible to attend, since it conflicted with a previously-made business appointment.

I was extremely sorry about my inability to come and very honored at your including me in your invitation. I was impressed by the scope of the subject-matter to be covered and I would appreciate receiving any published material which may have resulted from the meeting.

I hope to meet you in the future on a visit to the Capital, for this kind of dedicated work is what is so badly needed at the legislative level. Allow me to congratulate you on your initiative and once again to thank you for asking me to participate. The loss is mine at having been unable to join in the colloquium.

Sincerely yours,

EARL FINBAR MURPHY,
Professor of Law.

CENTER FOR THE BIOLOGY OF NATURAL SYSTEMS,
WASHINGTON UNIVERSITY,
St. Louis, Mo., August 22, 1968.

HON. EMILIO Q. DADDARIO,
Chairman, Subcommittee on Science, Research, and Development,
House of Representatives,
Washington, D.C.

MY DEAR MR. DADDARIO: Your request for comments on the Joint House-Senate Colloquium of July 17 is welcome; I hope that the following brief remarks are in time for inclusion in the printed record.

In the Colloquium, as in other discussions of policy for the environment, three general kinds of problems seemed to be under consideration: conservation of natural resources; the quality of life in the man-made environment of cities; unwanted or unforeseen effects of modern technology on the environment. Although there are many overlaps among these three topics, they seem to be easily distinguished in the discussion. Only the last of the three is a new area for Federal policy.

Conservation of natural resources has been a prominent political issue for at least one hundred years in England and the United States. Stanley Jevons warned of shortages of coal in England in the early Nineteenth Century; prospective shortages of lumber and petroleum spurred conservation interest in the United States. Although none of these shortages have come to pass, the concern for natural resources continues. The population of the United States has grown to the point at which the air and water available to us are limited, and must be husbanded.

Concern for the quality of life in the city has an even longer history, possibly longer than that of our legal system. Certainly there are very few cities which have caught up again to the Roman law which barred chariots from the city's streets during the night.

In both these areas, conservation and city problems, there is a proliferation of Federal, State, and local policies. The area in which policies seem to be lacking is that very difficult one which has been explored somewhat in recent hearings and discussions before the Subcommittee on Science, Research and Development: the environmental effects of new technologies. This is a distinctly new kind of problem, for which there seems to be no adequate solution at present.

In the past few years, books like *Silent Spring*, by Rachel Carson, and *Science and Survival*, by Dr. Barry Commoner, have aroused public concern over the largely unforeseen environmental hazards of insecticides, atomic energy, and the host of other new devices, from detergents to jet aircraft, which have come

into wide use since the Second World War. In almost every case, these new technologies have resulted in unexpected and unwanted damage to the environment. The problem of assessing such damage in advance, and preventing it where possible and desirable, is clearly a difficult one, and may indeed require new governmental mechanisms. Present assessment procedures, and many were mentioned during the course of the Colloquium, tend to analyze the economic and political effects of a proposed technological innovation, such as the supersonic transport, without much regard for environmental effects.

Assessing new technologies in advance, and catching up on the effects of all the large-scale technological enterprises undertaken in the last twenty years, or the last forty years, seems to be a different kind of problem from that of overall conservation of our resources and maintenance of decent living conditions in our cities. Yet it is the effects of new technology which have drawn our attention once again to these older problems, and they are clearly related in many ways. Nevertheless, it would seem to be useful to keep them somewhat distinct.

It is not new technology, but simply the inexorable growth of our numbers which has caused the present critical shortage of clean air and water. It is the increasing density in which these growing numbers live that has caused the present crisis of our cities. The very scale on which the United States carries its most trivial activities endangers the fabric of the biological community of which we are a part. We are like a bull in a china shop: our every movement endangers some previous species, and threatens to bring down the whole structure of the environment. Our simple needs for power have seriously raised the carbon dioxide level of the atmosphere, whose upper layers are disrupted by our aircraft and whose lower layers are fouled by our cities. Our bodily wastes foul the rivers and our agriculture destroys the soil.

As Secretary Weaver pointed out, these problems should not blind us to those older ones of the city. The city's ancient problems are those of poverty and crowding. These, too, have been made acute by the growth of population, growing so much more rapidly in the cities at the expense of the countryside, to the detriment of both.

There is no single, or simple, solution to the problems which follow from the growth of our population, the migration to the cities and the introduction of radical new technology. It is difficult to envision a single declaration of policy that could embrace the whole range of problems.

It seems likely that policy in these general areas will continue to develop piecemeal in response to public pressure. In retrospect, it seems that the passionate national debates over the effects of fallout from nuclear weapons tests, and more recently, over the effects of pesticides, served to awaken public awareness of the degradation of the environment. Increasing awareness has led to increased knowledge which has, in turn, led to still greater public pressure to halt pollution of the air water and soil.

It seems to be the critical role the private citizen has played that prompted Congressman Ottinger to propose an intervenor to represent and give voice to the private citizens' interests in Federal enterprises.

Perhaps a more critical need is a mechanism for informing the public of threats to the environment, of the potential benefits and hazards of new technology, and of the effects on the environment of society's everyday activities.

One such mechanism is the Committee for Environmental Information, in St. Louis, Missouri. Among other activities, CEI publishes the journal *Scientist and Citizen*. Through this journal, and through the mass media, CEI has for ten years been disseminating information regarding intrusions into the environment, and the uses of technology, as part of a broad effort to provide the technical and scientific information which is often so crucial in political and social decisions. This information is provided without bias and without prejudice.

The working nucleus of the Committee is a group about equally divided between scientists and laymen, an arrangement which assures the relevance of the group's activities to public concerns while maintaining scientific accuracy in the information provided. Articles for the journal, as well as material for newspapers and television, deal with aspects of environmental pollution, the uses of nuclear energy, and other science-based political and social issues. No position on these issues is taken: CEI is not, for instance, against air pollution. It simply tries to provide information about the benefits and risks of activities which produce pollution.

The success and value of this approach is attested to by the rapidly growing circulation of *Scientist and Citizen*, and the formation of groups similar to CEI

in a dozen cities across the country. The Scientists Institute for Public Information, in New York City, has been formed to assist such groups and to develop communication among them.

It is public concern which has led to present progress in the attempts to halt environmental degradation, and to assess new technology. Public concern can continue to play a useful role so long as the public is well informed.

Respectfully yours,

SHELDON NOVICK, *Program Administrator.*

SUPPLEMENTARY STATEMENT OF S. DILLON RIPLEY, SECRETARY OF THE SMITHSONIAN INSTITUTION, TO THE JOINT HOUSE-SENATE COLLOQUIUM ON ENVIRONMENTAL QUALITY.

Mr. Chairman, I would first like to extend my thanks to you for inviting me to participate in what I am sure will be referred to as a breakthrough in the history of the legislative process, the Joint House-Senate Colloquium on Environmental Quality. With no established models to guide you, you and your staffs have done a marvelous job in assembling a thoroughly mixed and well-balanced group of informed citizens to participate in the Colloquium. I am greatly encouraged by the initiative you have shown, and it is my belief that this conference has shaken loose a sequence of events which will markedly improve the manner in which we operate in our environment. I would add, however, that the Colloquium has provided a stimulus, and if we do not take advantage of the momentum created, harness it, and direct it to responsible action, these discussions will lose significance and join the ranks of many well-intentioned conferences and symposia that have passed without issue.

During the course of the Colloquium, it was clear that our most pressing need is for an articulation of the specific components that must comprise a viable policy on the quality of our environment. We all recognize, I am sure, the enormous complexity of this task, and I do not propose to have all or even any definitive answers. Nonetheless, it is to this problem that I would like to direct my attention.

Any exploration of the elements of a policy on environmental quality might well begin with mention of a commitment that pervades our entire public philosophy—the primacy of individual liberty. The exercise of freedom is the exercise of choice, and choice implies that meaningful options are available. Much of our history as a nation reflects the unceasing effort to maintain, through our institutions, a full range of options within our social structure, to insure that the pathways of liberty remain open. Our present concern with civil rights and the conditions of poverty is a case in point.

We pride ourselves, and rightly so, that our ancestors were gifted with remarkable foresight. But every generation has a responsibility to examine critically its place in the mainstream of American history, to reassess in the light of its own experience the principles upon which this country was founded, and to commit itself to a future that is in harmony with the best and most persistent of our ideals. We must exhibit something of the foresight that we so admire.

We are faced today with circumstances that our forebears did not anticipate—indeed, our own awareness is relatively new. I am referring, of course, to the subject of this Colloquium and our response to what has been ominously termed the ecologic crisis. The growing incidence of severe air and water pollution, the gradual degeneration of plant and animal communities, the prevalence of excessive environmental stimuli, the accretion of crowded and competitive social contacts that characterize so much of contemporary urban life—all are symptomatic of the general malaise.

How shall we react to these conditions and move progressively toward a viable image of the future? What kind of an environment—social, cultural, and natural—do we seek? What kind of environment will allow fruition of the human spirit?

We can no longer neutralize these questions by ignoring, hiding, or downgrading them. We cannot reserve them for the remedial action of the, hopefully, better informed generations that will succeed us. We must make choices now while the choices are available—or watch our opportunities erode under the pressures of population growth and technological development. We delude ourselves if we think that these problems, themselves largely the products of technology, will be solved by even the most clever technologist.

The question of a national policy on the environment is thoroughly immersed in considerations as far-reaching as the needs of human nature for fulfillment. The concern is general and pervasive. Ultimately it affects all the learned disciplines. That the social scientists are involved is evidenced by the recent Senate Hearing on Social Indicators. As a biologist, I shall restrict myself to recommendations that are, in my opinion, firmly rooted in my own science.

Since man is the product of evolution, we must first look to biological, and particularly ecological, processes to find the principles that have supported, and continue to support, our existence and evolution. Volumes have been written on these subjects and it is nearly impossible to be thoroughly representative of present knowledge. This difficulty, however, does not release us from the duty of synthesizing pertinent concepts and translating them into a form useful to both the general public and the decision-maker in the establishment of policy. Suffice it to say that much supporting evidence is available for the arguments that follow.

DIVERSITY

There is in nature an analogue to the role of options that was mentioned earlier in the context of our social structure—and that is the role of diversity. The path of biological evolution on this planet is from the simple to the complex, with increasing diversity. It was the emergence of complexity that established the opportunity for man, the most complex of all species, to evolve. Complexity and diversity are components of our biological inheritance, and we must, in our own interest, accommodate both our social engineering and our technological development to this fact. To live is to experience, and to live well we must maintain ecological diversity, a full range of environmental options so to speak, to insure that a wide range of possibilities exist among men.

Diversity is operative in the natural system as a stability-controlling mechanism. Reduction in diversity is generally matched by a reduction in stability. This principle applies not only to physical stability but to mental stability as well.

Sir Julian Huxley, the great English biologist, has written that man is evolution conscious of itself. Perhaps we are not conscious enough. Clearly man has not evolved in a vacuum—but in association with countless species of other organisms and constantly shifting environmental conditions. Today, even more than before, our own welfare is intimately and elaborately related to the ecological systems with their innumerable interacting components in which we live. There is no biologist alive today so familiar with the dynamics of nature that he can determine with precision the role played by all the various species in a complex system. This alone should give us pause. We cannot conceive of an optimum environment for man by considering man alone.

Consequently, policy recommendation number one:

All technological development shall be planned to avoid reduction of diversity in the natural environment.

This position would include the concept espoused by Dr. John Cantlon at the Colloquium that neither any species nor any ecosystem type should be put in jeopardy by man's activity.

IRREVERSIBILITY

Once a constituent of ecological diversity is lost, it is lost forever. Evolution is a cybernetic process controlled by a sequence of changing conditions over long periods of time. Consequently a species, or the association of species that forms a community, is the product of an unrepeatable and irreversible process. What is eliminated cannot be restored—we cannot recreate a passenger pigeon or an estuary that has been filled.

We must respect finality. The clumsiness with which we rearrange our landscapes leads one to believe that our philosophy of development is underdeveloped. We must recognize that we are working with living systems that have potentials and limitations peculiar to themselves. They have capacities of their own, and our goal must be harmony rather than subjugation.

Whenever permanent alteration of the environment is contemplated we must make every effort to insure that the results of our activities have no unforeseen and undesirable consequences. This will require that we give much more attention to the role of ecology than we have in the past.

Policy recommendation number two:

Environmental modification shall be undertaken only after thorough ecological analysis, the projection of probable effects, and the inclusion of measures to minimize those effects that are considered undesirable.

This, of course, implies that we must develop mechanisms at the state and interstate levels to formulate land-use plans for entire regions (including freshwaters and adjacent marine waters) of the United States.

QUALITY OF LIFE

Every species is adapted to the environment in which it has evolved. In its own environment a species manifests its full nature. Here, however, we must be careful to distinguish between a full range of behavior and mere existence. A grizzly bear can exist and reproduce in a zoo, but it does not manifest the complex behavior patterns of which, in its own domain, it is capable. Although man has added to biological evolution the dimension of cultural development, this lesson is, nonetheless, extremely important. Our culture may have blurred our dependence on the natural system, but it has not replaced it. Man is a rational animal, he has, therefore, expanded into an entirely new horizon of cultural fulfillment.

Our concern reflected in this Colloquium is that certain aspects of man's cultural development are degrading and, in fact, destroying his natural environment and, in a very real sense, producing an incomplete man. By an arrogant and shortsighted appraisal of man's technological abilities, we are in danger of reducing opportunities for fulfillment through the heavy handed manipulation of our environment. Rather than create a culture which expands our nature, we are in danger of having our disorderly activity restrict fundamental parts of man's nature. In a sense we are robbing Peter to pay Paul. We need not and since, in our analogy, if Peter becomes bankrupt Paul ceases to exist—we must not.

We are, in a very real sense, building our own zoo. Perhaps it is true, as Dr. Fredrick Smith told the Environmental Biologists meeting at Madison, Wisconsin, that man could technically exist if he paved all terrestrial environments. He could provide food, water, and, of course, material things. Such existence, however, would represent the manifestation of only a trivial portion of human capability for experience. Man can find satisfaction of unparalleled degree in the beauty of a woodland and the insight he can gain there, he can find beauty and spiritual uplift in a neighborhood or place of work which is established in harmony with the natural environment. However, if we eliminate the woodland, if we establish our living and working quarters in complete disregard of the environment, as we have done and still do in our sprawling cities, we eliminate—I repeat—we eliminate some opportunity for human experience. The freedom, the liberty our Constitution and democratic processes seek to preserve, our technology and population growth are in danger of destroying.

This is not necessary, and our national policy should make this clear. It is uplifting of the human spirit to experience a well conceived urban or suburban landscape, a Rockefeller University, for instance; or an Industrial Park such as that at Sterling Forest. Parenthetically it might be added that the fact that most economically successful individuals in our society live in pleasant surroundings is surely evidence that social success is at least partially a function of a pleasing environment. On the other hand, there is nothing more depressing to the human spirit than an urban slum or a suburban highway with overhead wires, surrounded by abused land, and lined by ugly structures.

Policy recommendation number two:

Develop planning and regulatory processes at all levels, local, State and Federal, that require development to be in harmony with the environment.

POPULATION

The most frightening aspect of Man's cultural development has been the establishment of conditions which permit the fantastic population growth we are witnessing today. No single development, excepting possibly the harnessing of nuclear energy, has raised such an ominous specter over the future of mankind as the present expansion of population. Unrestricted population growth out of

phase with supporting natural resources not only compounds the problems of poverty and famine, the resolution of which provides mere existence; population size, combined with concentration, affects our ability to express the full range of our human potential. Crowding, herding, queues at every turn, noise, and ugliness are caging us and preventing us from finding the quality of life that we are striving for.

We know that the level of population resulting from the extrapolation of our present and even more conservative rates of growth simply *cannot* happen. We further know that even the 40-year prediction cannot be tolerated. It is a *fact* that population size will ultimately be controlled by factors such as violence, famine, pestilence, or intelligent action. The first three, of course, exercise control in favor of existence. Only the latter course permits control in favor of fulfillment of the species.

Policy recommendation number four:

Population growth must be stabilized and brought into harmony with resources for the indefinite future by inducing voluntary compliance through:

- (1) negative tax incentives;
- (2) intensive educational programs; and
- (3) furnishing readily available methods to control reproduction.

Population considerations have, of course, very telling international implications, as with all problems relating to environmental quality. We must include these implications in our policy on the environment.

ECONOMICS

The development of the United States is rooted in the belief that the private enterprise system is the best economic device to allow us to achieve maximum freedom of the individual in his pursuit of fulfillment. With this premise there is no argument. However, we must continually remind ourselves that our economic system is only one means, albeit an important one, in the quest for human fulfillment.

There is often a tendency in human behavior to focus on the means to the extent that they become confused with the end. Often our shortsighted concentration on the means results in the alteration, if not destruction, of the goal we sought to achieve. Thus, highways have destroyed the beaches to which they were designed to carry people. Thoughtless commercial developments to bring people to a pleasant resort area have destroyed the values they used to attract, as we see for instance occurring at Lake Tahoe. In the extreme, to repeat what Dr. Smith has inferred, economic considerations could conceivably prescribe paving terrestrial environments—but what of the quality of human life?

In a decision making process economic values such as labor, capital, energy, material, products, consumers, etc., are commodities and easily quantifiable values. Because we are not yet confident of our human judgment we tend to ignore those values which are not so readily quantifiable. The real result has often been that the quantitative factors are evaluated against nonquantitative factors on a quantified scale. Since nonquantifiable factors such as the future quality of life, natural and cultural diversity, aesthetics, etc., cannot be plugged into this system, the quantifiable factors become, in fact, the end or the goal of the decision making process.

A system which permits factories, highways, and urban sprawl to occupy fertile lands or flood plains, or allows denuding the landscape prior to instituting a development project simply because now it is cheaper in quantifiable terms, is a misguided system. We can have development and environmental quality.

Policy recommendation number five:

Develop decision making processes which treat nonquantifiable factors equally with quantifiable factors as means toward the goal of human fulfillment.

BURDEN OF PROOF

In introducing new technology in our cultural development, we generally proceed with the technology on the assumption that the natural environment can assimilate it. Thus we have created technology which, in contradistinction to the recycling of natural systems, takes material at the input end, modifies it, and discharges material that cannot be reintroduced. It accumulates. We have great quantities of effectively inert effluents pouring upon the land, the air and the

water. Yet we know that at some point the natural system will collapse if these effluents are not productively recirculated.

The same inclination appears elsewhere. We build instruments of technology that emit noise, or create ugliness and assume that the natural system, including man, will tolerate it. Apparently man can tolerate noise and ugliness, but he tolerates it as the grizzly bear tolerates its cage—it is not fulfilling his nature. The grizzly bear has no choice—man does.

The issue is not whether technology is useful. It underlies our entire civilization, but we must insure that it is serving the ends of civilization rather than subverting them. There are ample precedents. With food and drugs that have dramatic and immediate effects on health, for example, we require a demonstration of compatibility with the natural system. We must expand this concept to include those technologies which have indirect, cumulative, and long-term effects on the environment.

Policy recommendation number six :

There should be established mechanisms to assess and predict the effects of technology on the environment prior to its introduction into the public domain.

These methods must certainly include detailed ecological analysis and must, of course, be complemented by sociological, engineering, and economic analysis so that each perspective can be evaluated within the context of human fulfillment. Additionally, these devices must be available at all decision making levels, governmental and private. Inclusion of this recommendation in a Congressional statement of national policy would stimulate their development.

RESEARCH

One of the great weaknesses in the amorphous policy on civilian scientific research is the overemphasis on investigation that contributes to direct economic development. This, of course, is stimulated by the fact that it is readily reduced to cost-benefit terms. We must recognize that some forms of research do not lead to direct or present economic benefit. They are, nonetheless, essential to the goal of human fulfillment.

It is difficult to put a cost benefit index on research into the effect of super highways on an urban community. It is conceivable that a super highway through a neighborhood, especially a concentrated neighborhood has a devious sociological effect. In any event, we should know something of this before we impose on areas the burden of super highways. Likewise it is difficult to conceive of general ecological research in strict cost benefit terms, however, we must know how the ecosystem functions if we are competently to judge and predict the effect of alteration. The problems encountered in obtaining adequate support for the International Biological Program and for the Office of Ecology in the Department of the Interior are unfortunate illustrations of how reticent our decision makers are to support ecological programs.

Policy recommendation number seven :

We must balance our scientific research effort with increased support to ecological and sociological studies of Man in the ecosystem.

EDUCATION

The character of a nation is very much a product of its educational system. Our genius in technological-economic development reflects the success of our educational system in preparing our youth for such development. Conversely, our environmental decay is an index of the failure of the same educational system to inculcate into our youth an understanding and respect for the complexity of the ecosystem and its components.

Policy recommendation number eight :

Encourage all levels of our educational system, from the grade schools through the University, to include programs for instilling in our youth the necessity of living in harmony with our environment.

It would seem that the tremendous discontent and energy we are witnessing in our youth is a resource we can ill afford to neglect. One argument in their quest for reform should be for an environment of quality which will make possible the quality of life they seek to achieve. Our educational system has a responsibility

to provide the background and opportunity that will enable students to channel their energies to this most worthwhile goal.

COMMUNICATION

A complement to the Nation's educational system, and in large part an extension of it, is the pervasive communications media we have developed. And agency of our society which has such acknowledged power to influence our behavior has a special responsibility to devote part of its resources toward creating a better environment in which to live. The communications media could play a large role in focusing the public attention on the issues which relate to environmental quality. In carrying out this role the popular media could inform the public on the mechanics of the zoning process, on the opportunities available to the citizen to participate in administrative hearings, on the effects of technological development and so on.

Policy recommendation number nine :

The communications media should be encouraged to inform continually the citizenry concerning problems relating to environmental quality.

This would not, of course, mean dictation to the media on specific issues, it would simply indicate the interest of Congress in encouraging such presentations.

RESPONSIBILITY

The essence of any national policy on the environment must be an acknowledgment that the attainment of a total environment which will allow fruition of man's nature emanates from the exercise of responsibility on the part of each citizen—individual or corporate. Without this exercise we will not achieve environmental quality. Government cannot do it, nor should it. Environmental quality can be attained only through the responsible behavior that stems from a respect and knowledge of the environment.

We must offset the ominous trends which are developing in our society, trends which can be summarized in the statement: "an institution will take care of it" What else could go through the minds of middle-aged men or women as they nonchalantly dispose of cigarette packages through the windows of a recent model auto. What else could motivate the teenager to dump his beer cans on the roadside. More fundamentally, why do our citizens tolerate pollution, ugliness, noise, and the many other affronts to their senses? We can only conclude that we are facing the very real possibility of our citizens abandoning their personal responsibilities to a system. Let the system stop pollution. Let the system give our children sex education. Let the system take care of the disadvantaged. Let the system take care of the aged. Some have said that government is encroaching on personal freedom. It is more accurate to say that the government is merely assuming the necessary tasks that our citizens are abandoning.

Policy recommendation number ten :

A national policy on the environment must make specific mention of the fact that ultimately the quality of the environment rests on the responsible behavior of individual citizens.

INTERNATIONAL

I would like to reiterate and reemphasize the point that Mr. Train and I mentioned during the Colloquium regarding the international aspects of any consideration of environmental quality. Air and water are the world's circulatory systems; there is simply no discontinuity in any of the processes of the natural system. For these, as well as humanitarian reasons, we cannot isolate our efforts to achieve environmental quality.

Policy recommendation number eleven :

In all our international relations we shall take every opportunity to encourage and assist in developing concepts and programs to achieve environmental quality.

CONCLUSION

Before I close I would like to add a few comments about the utility of a Congressional declaration regarding national environmental policy. This is largely in confirmation of those expressed in the excellent Report to the Senate Interior and Insular Affairs Committee.

First of all, the issues relating to environmental quality need public visibility. The public must concern itself with these very difficult and complex questions,

and a Congressional expression of policy would contribute to public awareness. It would also have the effect of putting these issues before the individual legislators and insure political activity of increasing intensity. There is no disputing the divisions that run through our country at the present time. Nor is there any dispute that there must be reconciliation and a rededication to the goals for which, ostensibly, this nation stands. To accomplish this renewal we need an orientation that can serve to attract the energy of all of our citizens and stimulate their sense of contribution and their sense of pride. One area that can furnish this kind of synthesizing force is the issue of environmental quality. All citizens of every age, class, and color can and should participate in it. All citizens are affected by it. To put this issue in this kind of perspective will take courageous leadership and that leadership should begin in Congress.

A second important function of a statement of Congressional Policy would be its influence on the administrative decision making processes, not simply at the federal level, but at all levels of government, and in private agencies as well. A decision maker with a statement of policy before him for reference will feel more at ease in his role with the authority of Congress behind him.

Significantly, too, when resource development decisions are challenged in a court of law, it will help the judiciary especially in statutory interpretation if it can refer to a clear set of Congressional guidelines setting forth public policy. Without such policy the courts often refer to time-worn principles generally resting on economic or personal injury. Such standards are grossly inadequate to measure the full impact of any particular project or development on the habitability of the Earth by Man.

UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH,
Boulder, Colo., July 24, 1968.

HON. GEORGE P. MILLER,
*Committee on Science and Astronautics,
House of Representatives,
Washington, D.C.*

DEAR MR. MILLER: First, my sincere thanks for the invitation to participate in the Symposium on Environmental Quality in Washington on July 17th. It was a very rewarding experience. In my opinion the enterprise was a successful start towards real leadership.

While I realize that the panel statements and also the statements by visiting participants were rather broad in scope, there are several added points that I would like to make.

Since you mentioned that the record will be open for some weeks, I submit these for your consideration for inclusion.

The area embraced by the symposium is important. I will be very pleased to do anything I can to help with the next steps.

Maybe we should hold the next meeting at the National Center for Atmospheric Research!

Very cordially yours,

WALTER ORR ROBERTS.

Enclosure.

JULY 22, 1968.

HON. HENRY M. JACKSON.

HON. GEORGE P. MILLER.

From: Walter Orr Roberts, President, University Corporation for Atmospheric Research.

Subject: Comments regarding Symposium on Environmental Quality.

MR. CHAIRMAN: I have a comment that I would like to make regarding the excellent symposium of July 17th. Following that, I have a question to pose—though in some ways it is in the nature of a rhetorical question. In any event it is a question that we must indeed concern ourselves with, as Senator Jackson himself emphasized towards the close of the symposium.

The Time Is Propitious

My comment is addressed to the fact that, in my view, the time is now propitious to focus a major part of the scientific and technical strength of the nation to questions of environmental quality. There are many signs over the land that indicate the engineers and the scientists of the nation are keen to redirect

greatly increased fractions of their total efforts to matters of environmental quality enhancement, repair, and preservation.

Moreover the time is a favorable one in part because recent years have taught us a great deal about how to do cross-disciplinary research. The International Geophysical Year, towards the end of the last decade, and the complex character of the systems-problems that we have been called upon to attack in recent years have given us experience and a measure of confidence. However environmental problems are formidable ones. Moreover the mix of problems involved in environmental quality-enhancement is an unusual one. It offers utmost challenge from the intellectual standpoint, and in terms of practical realization of the potential benefits inherent in new knowledge.

Let me cite an example of one of the kinds of problems that must be attacked in this new mixture of cross-disciplinary research. It is in atmospheric chemistry-medical science area. Only modest efforts have been made, unless I am grossly mistaken, to mount a sustained research program on the medical effects involved in slowly-developing health impairments—like aging—that result from low-level but long-persistent alterations of the atmospheric environment. The environmental alterations that I am talking about are those, for example, that are involved in subtle alternations of the chemical constitution of the atmosphere, through pollutants added in the form of trace gases, liquids or solids that result from industrial activity or urbanization. This is an area of bio-meteorology that has significance to every living person, and yet we have not yet seen the first beginnings of an adequately sustained research effort in this area.

Moreover I mention this as but a single example of a large class of problems that we must confront when we get serious about the system-solution that so many symposium participants have mentioned.

I have had the unusual opportunity, this year, as President of the American Association for the Advancement of Science, to see something of the intensity of the concern over these matters by scientists. Under the AAAS Charter the Association's effort is particularly directed towards questions of how best to advance the public understanding of science and the use of science in the promotion of human welfare. One of the strongest winds of sentiment within the AAAS, related to these goals, is that calling for increased concern with questions of environmental quality. In response to a vigorously expressed recommendation of our members, the AAAS has recently created a new and highly important committee—the Committee on Environmental Alteration. It is headed by Dr. Jack Ruina of MIT who was present at the Symposium, and you heard some very pertinent comments by Professor John E. Cantlon, of Michigan State University, who is a member of the committee. Your symposium documents include an excellent statement by Dr. Barry Commoner, of Washington University, another member of this committee. The Committee aims to serve, among other things, as a "watchdog committee," in the very sense that Mr. Daddario has called for: a watchdog committee to alert the public to possible threats to the environment through premature introduction of insufficiently-screened technological innovation. Our members have greeted the creation of the new Committee with great enthusiasm.

Global Aspects of Environmental Quality Control

My question, perhaps rhetorical, can be simply put. How does this nation most effectively express leadership for effective prosecution of the international aspects of research and practice in environmental quality control? Dr. Ripley, Mr. Train, and Senator Jackson, all mentioned these matters briefly, and Dr. Malone further called to our attention the importance of the international aspects of these questions.

My wish, in phrasing my question, is simply to underline forcefully the degree to which the nations of the world are becoming interdependent in respect to enhancement or even the mere preservation, of the quality of the natural environment.

In his statements, for example, Dr Hornig mentioned that some estimates suggest a 25% increase in the carbon dioxide pollution of the world atmosphere by the year 2000. This is an increase of one-half percent per year; the increase is believed to result from the burning of fossile fuels—coal, oil, gas for the most part. Dr. Hornig mentioned that some scientists and engineers believe that world-wide temperatures may rise from the increased "greenhouse" effect or "atmospheric blanketing" of this carbon dioxide. However, there are, as he mentioned, serious gaps of our understanding of climate changes, and this effect may indeed not occur. Something different, perhaps not less important to world weather

trends may occur. But with these uncertainties in our knowledge of the influence of carbon dioxide on the quality of the world environment, it would be ridiculous to consider a regulation banning the burning of gasoline, fuel oil, natural gas, and the other primary combustible fuels that man uses.

What Dr. Hornig might further have said is that the greatest part of the increments to carbon dioxide pollution of the air over the United States can probably be expected to come from nations other than the United States, between now and the year 2000. For it is in less developed regions of the world where the burning of such fuels is likely to expand most rapidly. So that it would be quixotic indeed for the United States to ban the fuels, without enforceable participation by all major nations. The problem is a larger-scale analog of the problem faced by interurban, intercountry, and interstate entities as we deal with smog from the cities of today. But for carbon dioxide, the atmosphere of the entire globe is the "airshed."

Another striking example illustrates the importance of the question. And it involves equal uncertainties in basic science, and they must be solved before we know what control measures are desirable. This is the question of effects on meteorology or climate resulting from possible increase in the world's cloudiness due to cirrus cloud cover formed from stratospheric pollution by jet aircraft. I have seen many many occasions when the skies over my home city of Boulder, Colorado are criss-crossed with expanding jet airplane contrails. Often these grow, in hours, to a general cirrus cover that blankets the entire sky. On these days it is eminently clear that the jet exhausts are stimulating the formation of a cloud deck. Theory suggests that these clouds, in turn, almost certainly modify the strength of the incoming sunlight, and the degree to which outgoing infrared radiation is permitted to escape from the earth to outer space. No one can say for sure, today, to what degree, if any, this alters the weather. But it is somewhat unsettling to realize that we may already be engaged in an inadvertent large-scale weather-modification program with long-term and wide-ranging consequences. And we have no way, yet, to know this for sure.

It is questions like this that make me very sure that an international scheme of cooperative "benchmark" observations must be made. One of the earlier speakers mentioned this, but I wish to underline it forcefully. Cirrus cloud prevalence should be accurately studied in regions of earth where jet planes are still rare stratospheric visitors. Then when the planes come we will have some idea of the degree of change.

It is now very difficult for us to say anything quantitative or certain about the degree to which the atmosphere above New York City, or Zurich, Switzerland or the rural regions of the United States, Europe, Siberia, have been changing in the respect to the burden of liquid or solid wastes (dust and smoke and haze) that they carry. Airplane pilots say that the air looks drastically smoggier, and that the resultant haziness persists over the whole country, and all the time. But the length of time during which adequately precise observations have been made is far too short, and the number of such observations far too few, for us to have any secure knowledge about it. Our eyes and our intuitions tell us that the magnitude and range of this pollution must be severe. But quantitative data are sparse. Standards for measurement must be set up, as well as time tables and international exchange agreements for data.

Though my own field of scientific expertise has to do with the atmosphere, there are many other domains in which benchmark observations of a global character are required. This is true not only for atmosphere-related questions (like measuring silver iodide content in water for knowledge about the effects of deliberate weather modification) but it is also necessary for many other environmental variables, like regional water table data, long-term vegetative changes, and a whole host of ecological variables.

Benchmark observations must be initiated promptly and on an adequate scale if we are to assess quantitatively man's degree of insult to the environment in the decades to come. Measurements of this sort are absolutely necessary prerequisite to the development of intelligent guidelines for government or the private sector, when we get down to the brass tacks of setting control standards.

In conclusion let me say that science and engineering has already committed not inconsiderable effort to protect and preserve from contamination the environments of other planets—like Mars—through systematic programs of sterilization of spaceships, both by our own NASA, and by the Soviet Union. While I am in favor of such concern with the environment of neighboring planets, I am even more vitally concerned that as we look to deep space we do not forget our responsibilities to our own planet.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., August 8, 1968.

HON. GEORGE P. MILLER,
House of Representatives.

DEAR MR. MILLER: In his letter of July 24, 1968, Dr. Tape indicated that his statement for inclusion in the public record of the Joint House-Senate Colloquium to discuss national policy for the environment would be forwarded to you following his departure from the States.

I have received Dr. Tape's statement from Vienna and am pleased to forward it to you for inclusion in the record. I will be glad to be of any further assistance to you in this matter.

An identical letter, along with copies of the statement, is being sent to Senator Henry M. Jackson.

Sincerely,

E. J. BLOCH,
Deputy General Manager.

Enclosure.

STATEMENT OF DR. GERALD F. TAPE FOR INCLUSION IN THE RECORD OF THE
JOINT HOUSE-SENATE COLLOQUIUM ON A NATIONAL POLICY FOR THE ENVIRONMENT

The convening of a Joint House-Senate Colloquium to discuss national policy for the environment is in itself a manifestation of the intense national interest in preserving and restoring the quality of our environment. Emphasis rightly is being placed on the protection of public health and public welfare, defined in the broadest sense. The scale of values assigned, however, is wide, with the health of man at the highest level, followed by concern for the welfare of useful animals and plants. Other elements, for example, convenience, aesthetics and recreation, generally occupy lower levels. But different individuals place different values on these various elements. What is of great importance to one individual is not always that to another; thus, there is often considerable conflict in establishing social judgments.

With the rapidly increasing quantities of waste, either as materials, heat or desecration, resulting chiefly from our increasing affluence and population, we can no longer use the environment freely or indiscriminately. Waste disposal must be controlled. There are, for example, several approaches to minimizing the undesirable effects.

1. Reduction of waste generated per capita through changes in practices or regulations which will promote a more efficient use of material resources.
2. Reduction of total waste generated through technological process improvement.
3. Collection of wastes and reuse of materials contained in them.
4. Segregation and control of more toxic wastes.
5. Increasing efficiencies in energy conversion processes.
6. Managed use of the environment to lessen the impact in any one location.
7. Determine the fate of waste materials in the natural environments and their current and potential effects on plants and animals and the welfare of man.
8. Restoration of the environment, especially where land is utilized.

Proper management of the environment of man's total good and extending to the restoration of the quality of the environment or even improvement of the quality of the environment should be the major goal of our national policy. In many ways we have been going in that direction for many years. As examples, we have come a far way from a course of allowing denudation of land and subsequent erosion to well-planned programs of reforestation; and from hydro power sites that, while producing only power, deface the environment, to hydro power sites with pleasant lakes stocked with fish and providing recreational facilities of considerable aesthetic quality. In this same context, I should note that some electric power utilities are planning to build cooling ponds that can be used for recreational purposes. They are planning to create small lakes where none existed before and to provide to the community needed water recreational facilities.

We cannot escape the fact that man generates waste, and it is unfortunate that the higher his standard of living, the greater has been the waste generated per person. With an increasing world population there is no escaping some degradation of the environment as we have known it in the past. The issue is one of minimizing such effects through the reuse of materials that are now considered wastes, more knowledgeable use of the environment as a recipient of wastes, and

prudent use of time, for optimum benefits from dispersion, dilution, organic decay, radioactive decay, etc. Technology can assist but attitudes and behavioral patterns are an essential ingredient to the preservation and enhancement of our environment.

The Atomic Energy Commission has maintained, since its inception in 1946, that the development of peaceful uses of atomic energy be predicated on the assurance of public health and safety. A far-sighted Congress incorporated in the Atomic Energy Act a requirement that the public health and safety be a paramount consideration in the development of the atomic energy industry. This interest and concern for the public health and safety has been the basis for maintaining a very broad program of research in the physical, biomedical and environmental sciences including not only the more traditional disciplines but also genetics, biophysics, ecology, aquatic biology, seismology, etc. All this was necessary to develop a detailed scientific knowledge and understanding of the effects of radiation so that a newly acquired tool to improve man's welfare could be utilized and controlled in a way that would adequately safeguard man and his environment from detrimental effects. The research necessary to understand the effects of radiation and establish sound standards and requirements for its control had to precede, or at least parallel, the development of the many uses of atomic energy in medicine, industry, science, power generation, propulsion and other applications.

The knowledge gained through research on the effects of radiation has been incorporated into the development of a completely new technology for the production of energy, and a completely new technology for the management of radioactive waste. All of this has been accomplished with a remarkable record of safety and a high level of protection for man and the quality of his environment. The search for better understanding of effects, improvement in controls and greater protection continues.

The need to develop detailed knowledge and understanding of the short term and long term effects so that scientifically sound standards for control can be established is needed for every potential environmental pollutant. Standards which are arbitrary, or technically unsound, are indefensible. If they are set too loose, there may be continuing risk to public health and safety; if they are set too rigid, desired social and economic benefits will be lost.

Understanding of the alternate courses of action and their benefits and costs are required. Public understanding is then needed to make rational and binding decisions. For example, the conversion of fuel to energy results in the production of waste heat which must be dissipated either to the water environment or the atmosphere. Restrictions on the amount of heat that may be discharged to surface water requires the installation of cooling towers which are costly. Further, other environmental problems may be introduced such as the use of corrosion control chemicals, local fog and icing conditions and the aesthetic impact of cooling towers which, in the case of natural draft towers, may be 30-40 stories high and 300 feet in diameter. Clearly the restrictions on thermal discharges to water courses must be based on sound technical understanding of thermal effects on water quality in order to justify the effect of alternatives on the environment as well as their cost. The most unpalatable alternative of all would be restriction of energy generation and the rationing of electrical energy. Fortunately this is not an immediate prospect.

This illustration highlights an important consideration that has frequently been overlooked in the development of environmental pollution control standards and requirements, i.e., the need to examine and evaluate the consequences of alternative courses of action. Excessive concern or preoccupation with one aspect of environmental pollution can lead to courses of action which are at least equally detrimental to other aspects.

I concur with Dr. Hornig that a national policy for the environment should provide a framework against which priorities and programs can be considered and evaluated. Such a policy should also include the guidance necessary to provide that the effort to control pollution and improve environmental quality is pursued in a manner that will provide maximum protection of man's health and welfare in the broadest and most far-reaching concepts of physical and mental health, and social and economic well being.

There are many complex decisions confronting us. The problems will not be solved overnight. Progress can be made however, and every reasonable step will help. It is better to move wisely in the right direction where we know we are right than to move impulsively on less than adequate information.

SUPPLEMENTAL STATEMENT OF RUSSELL E. TRAIN, PRESIDENT OF THE CONSERVATION FOUNDATION, WASHINGTON, D.C., TO THE JOINT HOUSE-SENATE COLLOQUIUM ON ENVIRONMENTAL QUALITY

This statement will expand on two points I made at the July colloquium—on the global nature of the human environment, and on the importance of the process by which we make decisions which affect the environment.

INTERNATIONAL ASPECTS OF ENVIRONMENTAL POLICY

A national environmental policy which fails to recognize the global nature of the human environment would be short-sighted. Indeed, many of the most critical long-range environmental problems can only be dealt with effectively by cooperative efforts among the governments of the world.

The challenge is international in scope and requires new leadership by the United States.

The earth and the life that exists upon it is an interrelated system, and the fundamental processes upon which all life depends are worldwide in their operation. The raindrop falling upon a garden in Washington may contain water evaporated from a puddle in Southeast Asia. The air we are breathing may contain oxygen produced by a leaf of a tree along the banks on the Amazon. The environment for life is a complex whole; each part depends upon every other part. The healthy functioning of any element of the bio-physical environment is inevitably related to the healthy functioning of the whole. It is a marvelous system that knows no political boundaries; to pretend otherwise is to ignore reality. To manage that environment so as to produce and maintain the highest quality of living for mankind is the ultimate goal of conservation.

Such a goal can only be achieved by a cooperative international effort. It is a goal that provides a major challenge as well as an extraordinary opportunity for United States leadership.

There are compelling reasons why the pursuit of that goal should become a basic ingredient of United States national policy.

First, as a people, we have a stake in the quality of the environment and the management of resources throughout the world. The American people comprise less than one-tenth of the inhabitants of the earth but we consume over six-tenths the raw materials produced on earth. Thus, we and our standard of living are dependent to a substantial degree on the natural resources of other parts of the world. We have a paramount interest in their wise management. In addition to our immediate needs, it is obvious that improved conservation and management of the soils, forests, and water of other parts of the world are essential to the support for their growing populations and to reduce the demands upon the United States for assistance.

Second, as the nation with the most highly developed technology in the world, the United States is responsible for a major share of the adverse impacts of modern technology upon the quality of the world environment. Our economic development programs has produced major environmental impacts in the undeveloped countries, many of them deleterious. Environmental pollution is the most obvious of these impacts. The atmosphere of the earth carries lead which is in large part a product of the exhausts of American automobiles. The penguins and seals of Antarctica carry in their flesh appreciable quantities of DDT and other poisonous substances which are a product of our modern agricultural technology. The most difficult aspect of the technological revolution is that we have consistently failed to understand the risk involved in each application of new technology.¹

Third, some of the most significant of the world's resources can only be managed effectively by international action. The oceans, and the resources they contain, both renewable and nonrenewable, are a clear example. The resources of the seas can never be developed and harvested in a non-destructive manner by national action alone; international cooperation is essential. For example, the great salmon fisheries that once flourished along the Atlantic coast of Canada and the northeast United States are doomed to disappear unless the

¹The problems caused by unplanned introduction of new technologies in developing nations and particularly the ecological consequences have been discussed in an article, "Resources in America: The Coming Crisis," by John P. Milton, director of The Conservation Foundation's Office of International Affairs. See Population Reference Bureau Selection No. 23, May, 1968.

indiscriminate harvesting of salmon on their wintering grounds off Greenland is brought under international control.

Finally, the promotion of international conservation—call it the pursuit of an international conservation ethic—would be in keeping with the highest traditions of this country. For example, the United States gave the world the concept of the national park, a concept which recognizes that there are places of such high value in their natural state that their preservation is a matter of not just local interest but of overriding concern to the entire nation. Conservation seeks a living environment that is healthy, productive, diverse, and beautiful¹ because only in such an environment can the individual live in decency and justice and only in such an environment can the infinite possibilities of human fulfillment be achieved. Let America summon the nations of the world to the pursuit of such a goal to the end that man is no longer the destroyer but the trustee of the earth. To what more challenging role could any nation aspire?

THE IMPORTANCE OF PROCESS IN ENVIRONMENTAL DECISIONMAKING

I would also like to emphasize the importance of our policies concerning the processes or procedures which we use to arrive at decisions on environmental choices.

On the question of standards raised by Dr. Brooks and others, I tend to be skeptical of efforts to specify uniform standards in this context.

I think we should be careful to build diversity into our approaches, as Dr. Eliassen and others have pointed out.

More or less objective and precise standards, minimum standards, can be agreed upon for some aspects of environmental quality: the parts per million of certain chemical compounds in a community's air or water supply or the number of decibels on a street corner. But some environmental dimensions cannot be expressed in objective, quantitative terms. These include the esthetic: what different men see as beautiful. Other environmental values determined by interacting biophysical forces are more subject to objective evaluation but typically remain poorly identified for decision-makers.

We have not yet developed satisfactory criteria or procedures for evaluating *all* the costs and *all* the benefits of a proposed program or project—the long-term environmental and other social costs and benefits as well as the short-run values which can be priced in the market place. And representative of all the major interests and values at stake generally do not yet have opportunity to take part in many decisions which have significant environmental implications.

While recognizing the difficulties of precise or uniform measurement or standards for these kinds of values, we can be quite specific about *process*—about the procedures by which we agree to decide among environmental choices. Democracy itself is such a process; we have committed ourselves to it as a procedure for making choices even though we cannot foresee the end results—where it will take us. The law's due process is another.

So with environmental choices, we can agree—as a matter of national policy—that the extremely complex process of environmental decision-making should be illuminated not only by all that can be learned about what is happening and our best estimates about what is likely to happen, but we can also agree to involve certain different kinds of interests and institutions in making these decisions.

We can commit ourselves to the interdisciplinary process in environmental decision-making just as we are committed to the democratic process, and certain procedural checks and balances, in political decision-making. We can, for example, decide to involve from the beginning of the planning process, and to take fully into account the counsel of, such professionals as sociologists, ecologists and landscape architects—as well as engineers or hydrologists—when deciding whether and where and how to build highways and dams.

And we can, as a matter of policy, do much more to facilitate the timely participation of informed citizens in environmental decision-making. The biophysical environment is such a complex web that to deal with it successfully—to manage it in a rational way for the benefit of mankind—surely should involve the diverse elements of our society: business and industry, labor, education,

¹ See "Conservation and Rational Use of the Environment," a report submitted by the United Nations Economic and Social Council and published by UNESCO in March 1968. The report was prepared by Dr. Raymond F. Dasmann, The Conservation Foundation's Director of Environmental Studies, under a contract between UNESCO and the foundation.

private citizen groups and professionals of many kinds, as well as government at all levels.

I have confidence that out of appropriate environmental decision-making process, appropriate standards and other decisions will evolve that will recognize differences among individual human preferences and aspirations and value judgments—that is, that will recognize the importance of maintaining the widest possible diversity in both natural and man-made environments.

One of the essential services which a more rational environmental decision-making process will require surely is a comprehensive and systematic environmental "overview" function.

I am inclined to think, therefore, that overview institutions will be very useful both in Congress and in the Executive departments: In the Congress a Joint Committee on the Environment, and in the Executive Branch a Council of Environmental Advisors.

It may well be that we are not ready for this structure yet, and I think there is a great deal of merit in Mr. Rockefeller's suggestion of a study commission or task force on environmental policy and organization. I agree that the Legislative Branch, the Executive Branch and the public should be represented and that its makeup should not be limited to scientists and technologists alone. With all due respect I think those gentlemen have created some of the very problems with which we are confronted; I would plead also for the inclusion of generalists. I am not sure whether this should be a temporary or a more permanent commission, but it should in any case be created soon and kept in being until such time as the next step becomes clearer than it is now.

THE ROCKEFELLER UNIVERSITY,
New York, N.Y., July 23, 1968.

HON. GEORGE P. MILLER,
House of Representatives,
Washington, D.C.

DEAR SIR: Thanking you for your part in convoking the joint House-Senate Colloquium on Environmental Policy, and for extending to me the privilege of attending, I am responding in the enclosed memorandum to your call for general comments and suggestions.

Sincerely,

PAUL WEISS, *Professor Emeritus.*

Enclosure.

MEMORANDUM

Since I have noted with gratification that point 1 of Annex 1 of the background material sent to the participants in the Joint House-Senate Colloquium on National Policy for the Environment is a literal citation from my report on Renewable Natural Resources of the National Academy of Sciences-National Research Council, more fully cited as Item 2 in the compilation by Wallace D. Bowman, inserted on Senator Jackson's request in the Congressional Record of February 6, 1968, I shall refrain from reiterating the major conclusions and proposals presented in that report, especially Section VII; (see enclosed copy). I shall confine myself to supplementing that report by some comments that seem to me pertinent in the light of the discussion at the Colloquium, taking for granted the consensus of the group that national planning and action in matters of environmental control require (a) the application of *systems methodology* to the man-environment continuum in its unitary totality, and (b) a corresponding organizational framework for the continual assessment from an unfractured overall perspective of the totality of factors that influence the steadily evolving ecology of man in modern society.

(1) Taking the long-range view, emphasis in environmental control must shift progressively, like in medicine, from cure to prevention. This requires that there be kept on record in a single center a comprehensive running account of all diagnostic data relevant to the health of the system and that this record be continually scanned for signs of existing or incipient divergencies from an optimal course of development, so that forestalling anticipated error might increasingly supplant the need for correcting errors made.

(2) In order to keep both the collection and the continuous evaluation of the data for this diagnostic processing as objective and impartial as possible, it would

seem indicated to separate the fact-finding, correlating, and evaluating procedures from the therapeutic decisions, which naturally lie in the political arena. The former could be carried out through a hierarchical system of clearing house operations integrated in an "intelligence" center, while the latter could operate through appropriate governmental agencies.

(3) Human ecology owes its "system" character to the confluence of many disparate component lines of human life and concern in a multi-dimensional unitary network of relations. The task of the "intelligence center" of point (2) should be to determine the net balance of the effects of developments in the various lines on the overall state of human ecology. As in all network systems, the same optimum effects can be reached through a variety of alternative pathways. The intelligence center should identify such existing and prospective alternatives as will insure the attainment of optimal stability of the total system.

(4) Examples of the different lines bearing conjointly on the well-being of man and his society (point 3) are: the natural sciences; the social sciences; education; the arts; law, technology; commerce; medicine; agriculture; demography; etc. Each of those diverse lines ought to have its own intelligence subcenter within its narrower range of competence and concern for the correlation, evaluation, and integration of the lessons from events within its own sector relevant to the total picture; the results would be communicated to the top intelligence center for guidance in its overall assessments. These sectorial intelligence functions could be served by such existing organizations as the National Academy of Sciences, National Research Council, National Academy of Engineering, American Council of Education, Social Science Research Council, Smithsonian Institution, Brookings Institution, and similar bodies. Broadest intercommunication and close cooperation should be maintained wherever necessary among these various subcenters in the hierarchy, as well as between them and the appropriate agencies and task forces of the federal, state, and municipal governments.

(5) As the setting up of methodology and machinery for long-range prospecting and planning, indispensable for balanced progress, might be too slow to cope with currently existing predicaments, it might be indicated to start out on a dual course—a far-sighted one for planning for the future, as outlined, and a short-range one for dealing with emergent acute problems. The setting up of a Commission, recommended at the meeting, seems a realistic device for the latter task, while the former objective would require a more comprehensive and durable form of organization.

(6) No long-range planning can become fully effective unless there is a better preparation of the public mind for the acceptance of judicious middle-of-the-road solutions in terms of optima rather than of "either-or" decisions between extremes. Therefore, a board program should be developed, drawing on education and the media of public communication and enlightenment (e.g., press, museums, radio, TV), to promote the understanding of the inner connectedness and interdependence—the systems character—of the natural, sociological and economic universe in which man lives.

(7) Some obstacles to rational conciliation of man-environment issues are not substantive, but due to mental blocks. Some of those can be reduced by omitting innuendo from our phrasiology. A sample step in this direction of decontamination was taken by Senator Muskie at the meeting in substituting the term "enhancement" for "preservation". Similarly, "protection" of health should be upgraded to "promotion" of health. Such terms as "preservation", "conservation", "protection", carry a connotation of "status quo" philosophy, in that they stress only the prevention of decline, rather than the raising of the positive balance of the whole production-consumption account which denotes the state of growth of a system, such as the affairs of man in a growing society. "Enhancement" (or perhaps "amelioration") stresses excess of gains over losses. If man is to come to terms with nature (including his environment and other people), he will have to be deconditioned from his political habit of polarizing issues artificially around opposite extremes in the sense of "either-or" validity and become conditioned to accepting them as interconnected by graded scales, along which he must establish the points of optimum "ecological" balance between trends involved. Every change affecting the environment exacts a price; man must decide whether, on balance, the net benefit to the advancement of man's physical and cultural health is worth the price.

(8) The estimation of the optimum cost-benefit ratio of a given trend, referred to in the preceding point, is a matter of evaluation; that is, it calls for value judgments not amenable to quantification. It would be incongruous to expect

dollar equivalents for natural beauty or freedom of movement or other intangibles. Even so, a conciliatory depolarization of such conflicts as, for instance, that of economics vs. esthetic interests, would be easier to attain, if the growing centrifugal polarization toward extreme attitudes, which focus on differences, could be deliberately counterbalanced, in education, press, publicity programs and the like, by greater stress on the basic community of interests of populations in self-development, let alone self-preservation. I question whether organizational measures from the top down could become fully effective without a collateral building up of increasing receptiveness and responsiveness of people on the ground floor. In conclusion, the language in which to deal with issues of man vs. environment, whether to speak in terms of one-sided dogmatism or of positive pointers to realistic conciliation, is in need of careful scrutiny.

(9) Most of the discussions of the man-environment problem complex deal with the reciprocal effects of man on his environment and vice versa, tacitly posing the environment as variable, while man is viewed as relatively constant, both physically and psychologically. This premise is false; for it leaves man's power of adaptability out of consideration. That faculty must be reintroduced in any serious attempt at arriving at a balanced standard of an "optimal environment." Whether it be a matter of pollution, drug hazard, carcinogenesis, food admixtures, traffic risks, pesticides, rain making or what not, the simple verity remains that life cannot be made risk-free. Absolute security is unattainable and the quest for it is not only illusory, but outright self-defeating for reasons which I have sketched in a statement inserted by Representative Rhodes (from the State of Arizona) in the Congressional Record of June 24, 1966. A stress-free environment, offering maximum comfort and minimum challenges, is not only not optimal, but is detrimental. To be exposed to moderate stress is a means of keeping the human faculty for adapting to stress alive and in practice; lacking the opportunity for such exercise, man loses that faculty and becomes a potential victim of any unforeseen, but inevitable, stressful occurrences. The optimum environment consists of a broad band of conditions bounded by an upper limit far short of the stress limit and by a lower limit considerably above an ideal zone of zero stress. Within those margins of reasonable safety or tolerance, man must navigate on his own responsibility. To tell him otherwise would mean to make him act against his own best interest. Realization of the considerable latitude of tolerable environmental stress can significantly reduce the host of conflict-breeding contentions conjured up by such unrealistically and unbiologically purist notions as "zero tolerances" or other "absolute" standards of safety.

(10) The Colloquium has given evidence of the superiority of balanced reasoning over fanatical one-sidedness. My comments here have been intended to strengthen, if only in a very modest measure, the arguments in favors of that trend.

A STATEMENT FOR THE HOUSE-SENATE COLLOQUIUM ON A NATIONAL POLICY FOR THE ENVIRONMENT

(By G. M. Woodwell, Ph. D. Brookhaven National Laboratory, Upton, N.Y.)

It is my thesis that much is now known about the central requirements of a National Policy for the Environment and that the directions such a policy must take are clear, at least in broad outline. The central objective must be, of course, to find ways of relating population to resources, for it is overpopulation and the degradation of resources that are a principal cause of social tensions. Even the Urban Crisis, so often the topic of this colloquium, is but one part of the greater problem of adjusting the quality of life by arriving at a more favorable relationship between population and resources. But even more importantly, the next decades will see foreign relations increasingly sensitive to the fundamental rule that the ignorance and unrest that is a part of the hunger, poverty and squalor of overpopulation are major factors contributing to international tensions. Any National Policy on the Environment must start with a commitment to work for a Policy on Population, but the realm must be the world and not merely the nation. Clearly the challenge is great.

The problem is the greater because not only must population size ultimately be controlled but resources must be measured. The difficulties of measuring re-

sources are compounded by the fact that technology has succeeded in expanding certain resources almost infinitely, simultaneously degrading others to the point where survival itself is threatened. The productivity of agriculture, for instance, has been pressed to phenomenal heights but agricultural pesticides have become what is probably the world's most serious pollutants and governments at present are incapable of eliminating the problem.

Despite the difficulties, much progress has been made recently in defining the basic laws governing the structure and function of ecosystems and these laws have general applications in human affairs. Compositionist approaches to science and to human affairs are now possible, supplementing the single factor, single agency approaches that have contributed importantly to the present inability of government to treat the environmental crisis effectively.

Such approaches have for many years not been fashionable in science, are still not widely understood, and are generally absent from the high echelons of the scientific and political bureaucracy, which has been slow to accept them.

Three steps are indicated now to incorporate these approaches into government and to move toward a national policy:

1. Incorporation into the Executive Branch a Council of Ecological Advisors, a majority of whom would have had their principal training and research experience in study of the structure and function of ecological systems.

2. Establishment of a Joint House-Senate Committee on Ecology.

3. Enhanced support of research and training that will lead to continued growth of knowledge of the structure and function of ecological systems. The research falls in the realm of Big Science, now supported by the U.S. Atomic Energy Commission through national laboratories, and by the National Science Foundation through the International Biological Program.

These three steps would bring us considerably closer now to closing the widening gap between what we know about ecology and what we do in government. They would also ensure that our knowledge of how the world works will continue to grow.

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FEDERAL POLICY PLANNING FOR THE MARINE ENVIRONMENT

(Edward Wenk, Jr., National Council on Marine Resources and Engineering Development, Executive Office of the President)

Enactment on June 17, 1966, of the Marine Resources and Engineering Development Act, P.L. 89-454, was the turning point in federal planning for use of the marine environment. For the first time in our nation's history an explicit policy was enunciated to improve scientific understanding of the oceans, to accelerate their exploration, and to assert a national consensus that untapped marine resources should be developed to serve mankind's broadest needs and aspirations. That policy required, and the Act provided, new approaches to federal administration of marine science affairs.

The marine environment was defined to embrace the great oceans, their living contents, and the seabed. Also included were the vital margins of continental shelf, bays, and estuaries, and the Great Lakes.

The primary goal of this new mandate was more effective use of that marine environment. Ways and means of achieving such a goal anticipated a new synthesis of oceanography with the mainstream of public policy—a blending of classical science; of a frontier spirit of exploration, engineering, and innovative technology to transfer scientific discoveries to practical purposes; and of concerted efforts to improve management of the coastal zone where multiple uses may be in conflict. Marine science and engineering were thus to be brought together with considerations of law, economics, and public administration. Existing institutions and new combinations in both public and private sectors would be expected to share in the responsibility for renewing this nation's historic involvement with the sea.

Some 11 major federal departments and agencies have statutory authority for some activity in marine sciences, a situation which the Congress considered ineffective. But while strengthening marine activities of these agencies, the legislation created no major new federal agency. Instead, Congress conferred on the President the responsibility for providing momentum and coherence to these diverse efforts. On an interim basis, it provided him with a cabinet-level policy planning and coordinating council chaired by Vice President Humphrey to assist

with implementation, and an advisory committee to recommend a long-term optimum federal structure.

In examining the question "What's new in oceanography?" the response is not a striking new scientific discovery or a technological breakthrough. It is neither a crisis of military threat from the sea nor natural catastrophe. Most unprecedented are the important initial steps to mobilize science and engineering, capital, and institutions for a systematic, coordinated venture to better utilize the sea.

This paper is concerned with the relationship of the marine environment to our national interests. It is primarily directed, however, to a discussion of the policy planning and coordinating machinery which the Marine Sciences Act provided the President to advise and assist in implementation of the congressional mandate. This account of actions taken by the Executive Branch may facilitate evaluation of further developments in federal structure for marine sciences, as well as of government apparatus that may have to be fashioned in other fields such as urban affairs that concern diverse national goals and are multidisciplinary, multiinstitutional, and multiagency.

BACKGROUND TO THE LEGISLATION

It is paradoxical that a nation with a rich maritime heritage should require stimulation of marine sciences by explicit legislative action. It is even more surprising that after initial efforts by the scientific community, it took almost eight years for Congress and the Executive Branch to develop the necessary governmental charter and structure.

The first step was the 1959 report by the National Academy of Sciences¹ that illuminated the long-range potential of the oceans to serve the nation. Despite the attractive possibilities there presented, federal funding of marine research and development, as a measure of its importance, was only about \$70 million per year (using current definitions) and was not increasing. A budget amendment in 1961 provided the major exception to years of level funding,² and funding remained unsteady.

Congress and the Executive Branch seemed in full agreement on the potential role of the sea:

- to maintain this nation's security and safeguard maritime commerce from disruption
- to acquire fish protein for the undernourished and rehabilitate domestic fisheries
- to supplement continental reserves of fossil fuels and minerals
- to diminish danger of pollution from domestic, industrial, and atomic waste
- to use oceanic data to improve weather prediction
- to expand seashore recreation
- to promote international understanding and cooperation
- to exploit the ocean as a laboratory for scientific study.

While the two branches concurred on objectives, there was no concrete expression of urgency or focus. Among other considerations was the fact that the federal responsibility for program development and support had been historically spread among missions of 11 different departments and agencies, no one of which could serve as a natural advocate for civilian marine science affairs.

What seemed lacking was impetus to transform a largely scientific enterprise to more advanced phases of exploration and development. Congress questioned whether a committee of the Federal Council for Science and Technology that had been coordinating federal oceanography had sufficient authority to meet this emerging need for leadership—to clarify responsibilities diffused through so many agencies, to identify and correct gaps or duplication. Furthermore, Congress was concerned that the Federal Council was established by Executive Order rather than statute, and chaired by a special assistant to the President. They thus inquired whether a committee of the Federal Council could operate at a sufficiently high level, continuously, for policy rather than project development.

The field itself, small as it was, further suffered because of fragmentation between the different sciences, between science and engineering, between the different federal agencies involved, between the federal government and non-federal interests, and between the U.S. and other nations.

A legislative mandate of national purpose thus seemed required to assure translation of marine-related opportunities into programs of public benefit.

¹ *Oceanography, 1960-1970* (Washington, D.C.: National Academy of Sciences, 1958-59), 12 volumes.

² "Letter to the President of the Senate on Increasing the National Effort in Oceanography," March 29, 1961.

To meet this deficiency, seven different bills were proposed in the 86th Congress, four in the 87th, seven in the 88th, and 24 in the 89th.³ During this time the congressional rationale evolved from post-Sputnik pleas to "outrun Soviet oceanography," to new dimensions of purpose—to apply the nation's maturing scientific capabilities to an imaginative, productive ocean technology. Congressional remedies ranged over a wide spectrum—from additional studies to the creation of a new super agency. One bill passed in the 87th Congress but was pocket vetoed because, rather than establishing an institutional focus, it tried to specify the internal structure of the Office of Science and Technology.

The bills that became P.L. 89-454 combined elements of several measures of both Houses⁴—a clear statement of purposes; designation of presidential leadership; top-level, policy planning machinery which could confer stature and prestige on marine sciences; an explicit site for specialized marine planning and program development not thought appropriate to the broader role of Office of Science and Technology; full-time professional staff, independent of agency ties; and a public advisory commission to study what stake this nation has in the ocean and to make recommendations as to what federal machinery would best meet this need over the long run. The initiative for action was taken largely by individual members of Congress: Senators Warren G. Magnuson, E. L. Bartlett, and Claiborne Pell; and Congressmen George P. Miller, John Dingell, Alton Lennon, Paul Rogers, and Charles Mosher.

OBJECTIVES OF MARINE SCIENCES ACT

The Marine Sciences Act declared it to be a policy of the United States "to develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine science for the benefit of mankind—to assist in protection of health and property, enhancement of commerce, transportation, and national security, rehabilitation of our commercial fisheries, and increased utilization of these and other resources." The President was given continuing responsibility to implement the legislation:

- by developing a comprehensive program conducted by federal agencies in cooperation with nonfederal organizations
- by establishing long-range studies of economic and social benefits of marine science activities, and legal studies concerned with resource management
- by clarifying responsibilities where missions cross agency lines
- by evaluating the government's program annually
- by reporting on it in terms of accomplishments toward broad purposes, with recommendations for budgets and legislation to attain objectives of the Act.

Marine Sciences Council

To advise and assist the President in these tasks, a National Council on Marine Resources and Engineering Development was created, composed of the Vice President, who serves as chairman, and the Secretaries of State, the Navy, the Interior, Commerce, Transportation, and Health, Education, and Welfare; the Chairman of the Atomic Energy Commission; and the Director of the National Science Foundation.

The Act also provided for a professional staff, headed by a presidentially appointed executive secretary, to perform such duties as requested by the President or Vice President in support of Council activity.

After the Council was activated, the Vice President invited as observers the following heads of agencies having sufficient responsibility in oceanic matters as to warrant their being continuously informed and consulted on issues coming before the Council: Administrator, National Aeronautics and Space Administration; Secretary, Smithsonian Institution; Administrator, Agency for International Development; Director, Office of Science and Technology; Director, Bureau of the Budget; and Chairman, Council of Economic Advisers.

Since its inaugural session August 17, 1966, the Council has met 11 times. The Vice President has presided at all but one session.

³ *Abridged Chronology of Events Related to Federal Legislation for Oceanography, 1956-66*. Prepared by the Library of Congress, Legislative Reference Service, for the use of the Committee on Merchant Marine and Fisheries. July 15, 1965 (revised January 9, 1967).

⁴ "Marine Resources and Engineering Development Act of 1965," Senate Commerce Committee Report 528, July 29, 1965 (to accompany S. 944). "Marine Resources and Engineering Development Act of 1965," House Merchant Marine and Fisheries Committee Report 1025, September 17, 1965 (to accompany S. 944). "Marine Resources and Engineering Development Act of 1966," Conference Report 1548, May 24, 1966 (to accompany S. 944).

The Council has endeavored to: (a) identify unmet needs and opportunities to which federal marine science programs could be directed, especially gaps in programs that cross agency lines; (b) recommend priorities on a government-wide basis by selecting areas deserving additional emphasis; (c) identify impediments to progress and strategies for their circumvention; (d) develop policies by which the objectives and programs of one agency will not inadvertently conflict with equally valid but independent activities of another; (e) recommend—in those cases where missions of several agencies may overlap—that one agency assume a lead responsibility for government-wide planning, guiding, coordinating, and assuring fiscal support; (f) coordinate—through a committee structure—programs which are of concern to many agencies; (g) insure that the appropriate resources of the federal government are brought to bear on mutually agreed-upon goals; (h) evaluate programs so as to eliminate marginal activities; and (i) develop background legal, economic, and technological studies for identifying alternative policies and criteria for choice.

The Council has also carried out policy planning functions for the sea grant program, established by P.L. 89-688 and administered by the National Science Foundation; and, as explicitly provided for in P.L. 89-454, coordinated federal programs of international cooperation, such as the Decade of Exploration, mentioned later.

To foster exchange of information, coordinate policies and programs, and develop recommendations as to issues requiring Council-level action, the Council created four interagency committees which report to the Vice President: Marine Research, Education, and Facilities; Ocean Exploration and Environmental Services; Food-from-the-Sea; and Multiple Use of the Coastal Zone.

Additionally, at the request of the Vice President, the Secretary of State has established a fifth committee on International Policy in the Marine Environment to serve the mutual interests of the Council and the Department of State.

The Marine Sciences Council's professional staff of 14 persons includes specialists in ocean sciences, engineering, national security affairs, public administration, law, economics, and international relations. The Council staff serves to identify policy issues, to develop and analyze facts, and to propose alternative plans for Council deliberation and action.

More than 70 consultants contribute as needed to the work of the Council.

Council staff maintains communication with various public and private groups—the White House staff, Bureau of the Budget, Congress, federal and state agencies, industry, the academic community, and professional societies—to insure that considerations affecting all marine science interests are brought to the attention of the Council, and, reciprocally, to interpret government-wide plans and policies. Consultations have also been undertaken with officials of other countries and international bodies with which the U.S. has or contemplates cooperation in marine science policies and programs.

The key products of these Council activities are formulated into recommendations to the President. When approved, these become incorporated into the operating policies, programs, and budgets of the participating agencies. The Council secretariat is expected to assure "follow-through." Only in a few cases does the Council, through its staff, undertake any continuing program responsibilities.

Analysis of Council Activities

Council activities include: (a) actions by the Council in plenary session—through recommendations to the President, or by mutual agreement to implement new programs and policies, consistent with existing presidential policy; (b) generation of studies, program coordination, and policy recommendations by the secretariat; (c) conduct of policy studies on contract through the secretariat; (d) generation of studies, program coordination, and policy recommendations by Council Committees; (e) monitoring and review by Council secretariat, with the aid of consultants; and (f) guidance of special government-wide projects, such as the Decade of Ocean Exploration.

The public products of Council activities are represented by presidential statements and actions, presidential and Council reports, testimony before Congress, and other publications and public statements.

PRESIDENTIAL STATEMENTS

President Johnson made statements concerning the marine sciences on four separate occasions early in 1968.

In his State of the Union address on January 17, President Johnson said, "This year I shall propose that we launch, with other nations, an exploration of

the ocean depths to tap its wealth and its energy and its abundance." The significance of the oceans was underscored in his foreign aid message, in his special message "To Renew a Nation," when he proposed that other nations join in "an historic and unprecedented adventure—an International Decade of Ocean Exploration for the 1970's," and in his transmittal to Congress of the second annual report on marine resources and engineering development.

Policy Planning—New Initiatives

These presidential initiatives largely emerged from areas selected for special emphasis by the Council, centered around identifying unmet opportunities to serve national goals. In fact, such topics represent the first task of the Council—designating targets, programs that define the necessary activities, funding requirements, and, if necessary, the agency responsible.

In the first year of operation priorities were selected of some nine initiatives from over 100 recommendations of the President's Science Advisory Committee, the National Academy of Sciences, and other sources.⁵

In his second annual report to Congress, the President again highlighted particular domestic programs deserving increased funding and gave a strong foreign policy orientation to the program. The total federal program for Fiscal Year 1969, within the rubric of marine sciences, is projected at around \$500 million. New initiatives and areas considered to require additional emphasis total roughly \$79 million.⁶ These are summarized below to describe the substance of the program.

1. Accelerate our efforts to *expand international cooperation in ocean exploration* to encourage all countries: (a) to develop their marine science opportunities through cooperative exploration of the oceans and their living and mineral resources; and (b) to develop new patterns of collaboration in the peaceful uses of the oceans that will contribute to sound international policy decisions on marine resource questions.

2. Intensify the *food-from-the-sea* initiative in the war on hunger by undertaking market surveys and feasibility studies for fish protein concentrate (FPC) in three countries abroad, and by accelerating development of new technologies for producing low-cost FPC.

3. *Foster rational development of the coastal zone* by strengthening research, development, and systems studies of pollution, economic development, and conflicting uses of the coastal zone. Federal-regional-state-local cooperation will be intensified, including use of existing statutory instruments such as river basin commissions. A special project to study problems of the Great Lakes area will be initiated by the Council.

4. Prepare for new programs for *port development and redevelopment* with preliminary work for a comprehensive planning study to incorporate new technology in a national port system that will serve ocean shipping of the future, characterized by deep draft vessels, containerization, express and feeder services, and other technical innovations. Attention will be given to relations between harbors and urban renewal and to regional interrelationships including mutual support between harbors.

5. Institute new measures to insure *safety of life and property* along our coasts in light of intensified coastal traffic by: (a) implementation of basic recommendations of the presidential study of oil pollution by contingency plans, research, and new legislation; (b) improved ship navigation systems; (c) establishment of additional safety standards for offshore structures and designation of sea lanes; and (d) establishment of safe procedures and rescue services for civilian submersibles and underwater activities.

6. Increase *sea grant program* investments for: (a) training specialized manpower, particularly ocean engineers and technicians, that will be urgently needed for technological development of marine resources in the 1970's; (b) meeting regional maritime concerns by establishing research and training centers in state and private universities, community colleges, and technical schools; and (c) disseminating research results to industry and the public.

7. *Foster marine applications of new technology* of benefit to science and industry by: (a) use of spacecraft already programmed for observations of sea ice, currents, temperature patterns, and surface waves; (b) development of buoy technology to collect oceanographic and meteorological data as a basis for later decisions on a worldwide network; and (c) introduction of automatic data pro-

⁵ *Marine Science Affairs—A Year of Transition*. The First Report of the President to the Congress on Marine Resources and Engineering Development, February 1967.

⁶ *Marine Science Affairs—A Year of Plans and Progress*. The Second Report of the President to the Congress on Marine Resources and Engineering Development, March 1968.

cessing capabilities at the National Oceanographic Data Center to improve services available to government and nongovernment users.

8. Intensify work in *deep ocean technology* to provide a reservoir of advanced engineering knowledge upon which the Navy can draw to meet requirements of future military systems. The same reservoir of technology may contribute to industrial engineering activity and development of deep sea resources.

9. Intensify *Arctic and subpolar research* programs to strengthen U.S. capabilities in these regions of strategic and economic significance.

10. Encourage *international regional cooperation* in marine science and technology, and resource exploration and development. Special emphasis will be put on use of many bilateral and multilateral channels to promote regional stability and cohesiveness and to counter concerns about the growing disparity between U.S. technology and the relative capabilities of other nations.

11. Strengthen the nation's base of *marine research and technology* by support of educational institutions to accommodate the rising student enrollments in oceanography.

12. Continue last year's initiative of *mapping of the continental shelf*. Improved reconnaissance-scale mapping will assist in identifying new mineral, oil, and gas deposits and will contribute to timely private investment in resource development.⁶

Preparation of President's Report

The second major task of the Council has been preparation of the report which the President is obliged by law to submit annually to the Congress. The report includes:

A description of the government-wide program, with funding and activities delineated by purpose as well as agency. This step in program planning and budgeting was intended to facilitate resource allocation in terms of the program's contribution to public needs. Funding by purpose is summarized in Table 1.

An abstract of individual agency accomplishments, including a progress report on implementation of earlier initiatives.

Justification for new federal initiatives and the program as a whole.

Recommendations for new legislation (none on federal reorganization were developed because the legislation gives this primary charge to the advisory Commission).

Discussion of unresolved issues—especially those deserving of further study by nonfederal as well as federal interests. These were developed in the purpose categories mentioned earlier, but joined in a concluding chapter intended to open a broad inquiry as to "What is the nation's—and the world's—stake in the oceans?"⁷

TABLE 1.—TOTAL FEDERAL MARINE SCIENCE PROGRAM BY MAJOR PURPOSE¹

[In millions of dollars]

	Estimated, fiscal year 1967	Estimated, fiscal year 1968	President's budget, fiscal year 1969
1. International cooperation and collaboration.....	7.1	7.6	8.2
2. Military security.....	161.8	136.9	150.1
3. Fishery development and seafood technology.....	38.1	41.2	42.7
4. Transportation.....	11.9	15.2	15.4
5. Development of the coastal zone ²	21.4	28.7	28.6
6. Health.....	6.6	5.2	6.0
7. Nonliving resources.....	7.2	8.1	9.8
8. Oceanographic research ³	61.5	78.4	99.7
9. Manpower and education.....	4.0	7.2	7.9
10. Environmental observation, prediction, and services.....	24.4	24.5	26.5
11. Ocean exploration, mapping, charting, and geodesy.....	77.4	74.5	92.1
12. General purpose ocean engineering.....	14.8	18.2	26.8
13. National data centers.....	1.8	2.0	2.4
Total.....	438.0	447.7	516.2

¹ Details may not add to totals due to rounding.

² Includes shore development, pollution management, recreation.

³ Research beneficial to more than one of the headings above.

The report deliberately emphasized the transition from a knowledge- to a use-orientation by the selection of the title "Marine Science Affairs" rather than "oceanography." Chapters are organized by basic needs or notional purposes, rather than by agency. The scope of federal activities so embraced is roughly twice what had early been defined by the Federal Council for Science and Technology as a "national oceanographic program," because technology as well as science is embraced by the scope of the legislation.

After drafting by the secretariat, the report was submitted to Council members and observers for clearance, at which time numerous unresolved issues, unclear jurisdictions, or controversial programs were clarified and resolved.

By its scope and content, the report serves as a planning document to assist the federal government at various echelons to focus on common goals. It can aid Congress in relating elements that come before some 20 appropriation subcommittees and an equal number of legislative subcommittees concerned with the complex matrix of marine science affairs. Industry, academia, state governments, and foreign governments may also be aided in articulating their individual goals and programs to the federal effort.

As a further aid to program coordination, the Council has recently begun preparation of a catalogue of federally sponsored marine sciences research—a compendium of who is doing what, where, and with whose funds. The Science Information Exchange will undertake the compilation, on contract, following precedent in the field of water resources research.

CONGRESSIONAL RELATIONS

The Council Secretariat provides information to individual members and committees of the Congress on such matters as:

- interpretation of the President's annual report to Congress in "posture" hearings;
- defense of appropriations for the Council and other activities to assist the President with implementation of the Act;
- provision of testimony on issues that cross agency lines, such as shore stabilization and protection of marine sanctuaries;
- interpretation of the administration's position on such questions as international legal regimes for resources of the seabed and safety of research submarines;
- assistance with defense of individual agency appropriations on items that contain government-wide benefits.

Informing nonfederal interests, including the general public, about federal marine science programs is clearly implied in the legislation. Obtaining viewpoints from the nonfederal sector is equally important to assure adequate consideration in Council deliberations of all interests involved—professional, industrial, state, and foreign. The Council chairman and executive secretary have thus conducted informal consultation, conferences, and correspondence; prepared magazine articles; engaged in public appearances; and sponsored formal symposia involving the scientific community, state or regional bodies, and petroleum, transportation, food, aerospace, and banking industries.

The Council has also released reports or general background information concerning oceanographic ship operating schedules, university curricula in oceanography, oceanographic or marine science activities of some 100 countries, and economic statistics concerning maritime-related industries: gross income, employment, fish catch, oil production, etc. In addition it has prepared contract studies on legal regimes affecting fisheries, exploitation of seabed resources and research; conflicting uses of such areas as the Chesapeake Bay and the Seattle Harbor; systems analysis techniques applied to the fishing industry; the potential of aquaculture for fisheries development; economic potential of minerals on the Continental Shelf; and incentives required for private investment.

One of the most serious shortcomings that Congress sought to correct was the lack of advocacy for marine science affairs. Notwithstanding the "sex appeal" that this field enjoys, no economically viable industrial base or politically effective constituency is available to make the case for the national interest. In the competition for scarce resources and with the complexities of the issues and the field itself, the designation of a site for advocacy was recommended by the President's Science Advisory Committee in 1966.⁷

⁷ *Effective Use of the Sea*. Report of the Panel on Oceanography, President's Science Advisory Committee, June 1966.

The statutory responsibility for leadership was placed by PL 89-454 in the President. The Council fulfills the role of advising and assisting him. Operationally, it has been a task assigned to the Council chairman and executive secretary—reflected by activity within the government in the budget process—in the rationalizing of programs to gain support at a program level, at the bureau level, at the level of cabinet officer, before the Bureau of the Budget, and finally, when appeals are necessary, to the President and to Congress in behalf of the President's program. It is also reflected publicly in the previously cited activities.

A third role of the Council, largely carried out through the secretariat, has been follow-through of programs approved by the President to assure adequate assignment of funds, manpower, leadership, and organizational framework, or resolution of conflict between contending agencies if two or more claim—or all disclaim—responsibility.

Assistance by outside consultants has been especially helpful in gaining objective, independent critiques of agency operations.

GENERAL CONSIDERATIONS

Certain characteristics of each particular field condition and stimulate the pace, and constrain flexibility of implementation. For marine sciences, these are summarized below:

1. New developments depend significantly on science and technology.
2. The federal government is likely to be the major sponsor of research and exploration.
3. Exploitation of marine resources, as with resources on land, will be undertaken by competitive private enterprise.
4. Geographically localized problems in the management of the in-shore marine environment will require local solutions and federal/state cooperation.
5. Gains from the world ocean will increasingly be sought by other nations and will continue to require resolution of conflict through bilateral and multi-lateral agreements.
6. Civilian and military considerations are both important to the national interest, but may conflict.
7. The industrial base and a political constituency in the marine sciences lacks economic viability and political effectiveness.

In considering these federal programs, it should be recognized that the marine sciences area differs significantly from that of outer space with which it is often compared. First, development of marine resources anticipates substantial private as well as public investment, thus extending beyond the water's edge what has been traditionally the role of private industry in the development of resources. Second, decisions as to programs and priorities require extensive cooperation between federal and non-federal institutions as, for example, with the states when dealing with conflicting uses of the coastal zone; with academia when projecting maritime research; and with industry in the development of resources so as to encourage investment where risks are high, profits long-deferred, and the public interest not served by marketplace economics.

Attention of the nation has been directed by the popular press and by the heightened public interest in science to the mysteries of the ocean. But this emotional attraction fails to meet the tougher question of "what portion of the nation's energy and wealth should be devoted to ocean endeavors?" The plurality and diversity of these endeavors themselves add to the difficulty of any monolithic approach which would consider priorities for ocean-related activities by themselves, and not in relation to other national purpose.

The first prerequisite for a solution to this present situation is the need for leadership. The legislation provides for this through the President, but it by no means can guarantee that the field will earn presidential support except as the President himself may assess priorities in relation to other topics on his own agenda. The 20 months that have elapsed since passage of the Marine Science Act are too short an interval to evaluate the merits either of the organic legislation or of the implementation. However, the President's reference to marine sciences in his recent State of the Union address and his budgetary support for new initiatives accord this field high-level recognition and attention intended by framers of the legislation.

The President, in transmitting Council recommendations to the Congress, credits the Marine Sciences Council with "significant progress in mobilizing the resources of the Federal Government" in this area. The direct contributions by the Council chairman and members have certainly been a factor in any such accomplishment: in seeking to utilize science to meet national problems; by encouraging a goal-oriented, activist style of operation; by a focus on quality rather than quantity of operations; by communication with the Congress, the scientific, industrial, and academic communities; and by willingness of the chairman to resolve issues and mediate conflicts.

There is some question in public administration as to how feasible it is for this role in other fields to be placed upon a man or an office having many other responsibilities in government.

Given compelling, diverse national objectives and the need for development of coherent, multiagency policy, this experience in marine sciences permits an assessment of whether the collective wisdom and power of high-ranking officials for a limited time is an effective mechanism to assist the President in accelerating a field to a viable momentum, whereby it can be subsequently self-sustaining through an operating agency and incentives for private investment.

The Marine Resources and Engineering Development Act gave permanent responsibility to the President to advance this field. The Council was given only interim authority to advise and assist until June 30, 1969, so as not to inadvertently inhibit the Commission in its analysis. Thus, in marine sciences, options for the future are completely open. Decisions may be required as to more permanent policy planning and coordinating machinery, requirements for a new federal operating agency, and means whereby public and private interests may be blended and the necessary capital attracted to advance the nation toward the long-range objectives now being identified by the Council and the Commission.

Before January 9, 1969, the National Commission on Marine Science, Engineering and Resources will table such proposals for national review and action.

Faint, illegible text, possibly bleed-through from the reverse side of the page. The text is arranged in several paragraphs, but the characters are too light and blurry to transcribe accurately. Some words like "the", "and", "of", and "is" are barely discernible.

