INTERNATIONAL ENVIRONMENTAL SCIENCE

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OF THE

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BEFORE THE

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AND THE

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SCIENCE AND ASTRONAUTICS
HOUSE OF REPRESENTATIVES

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JOINT COLLOQUIUM ON INTERNATIONAL ENVIRONMENTAL SCIENCE

TUESDAY, MAY 25, 1971

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

The joint committee was convened at 10:10 a.m., in room S–228, the Old Supreme Court Chamber, U.S. Capitol.

Present: Senators Magnuson (chairman, Committee on Commerce), Baker, and Hatfield; Representatives George Miller (chairman, Committee on Science and Astronautics), Hechler, John Davis, Fuqua, and James Fulton.

Senator MAGNUSON. The Joint Senate-House Colloquium on International Environmental Science will come to order.

Ladies and gentlemen, I am pleased to introduce the distinguished chairman of the House Committee on Science and Astronautics, Hon. George P. Miller of California, who has long been an advocate of doing the things we are here today to discuss.

OPENING REMARKS OF HON. GEORGE P. MILLER, U.S. REPRESENTATIVE FROM CALIFORNIA, CHAIRMAN, COMMITTEE ON SCIENCE AND ASTRONAUTICS

Mr. MILLER. Thank you very much, Senator.

Senator Magnuson, my esteemed colleagues, distinguished participants, invited guests, and ladies and gentlemen.

I want to welcome you all to this Joint Senate-House Colloquium on International Environmental Science.

This is only the second such colloquium ever held in the history of the U.S. Congress; the one was held in 1968 under the auspices of my committee and the Senate Committee on Interior and Insular Affairs.

And it is interesting to note that the subject of both colloquiums is the environment.

The Congress is involved in environmental affairs in virtually every one of its committees.

In its oversight over the operations of executive agencies, approval of appropriations, and consideration of treaties and international agreements, the Congress affects the role of our Nation in contributing to the resolution of national and international environmental problems.

Therefore, this colloquium offers a unique means to acquaint a broad sector of the Congress and the general public with the status, needs, and opportunities of international environmental science.

The rationale for this colloquium is that environmental science and environmental quality are now recognized as parts of a major public policy issue—the proper relationship of man to his natural surroundings.

Societies throughout the world are at various stages of examination of their attitudes—values—and activities with respect to their natural surroundings.

Scientific information will necessarily lie at the base of wise future decisionmaking.

The information that will be required—the international institutional structures suited to provide it—and the political and related problems that are involved will be covered in this colloquium.

I don't believe we will solve all these problems at this colloquium.

Nor do I believe that we will ever solve them by trying to talk them to death.

But I do believe that we can achieve a better understanding through this colloquium about those areas where there is a consensus—and those areas where there is an honest disagreement.

Therefore, let me again say that I am happy that all of you could be here. I look forward to these 2 days of discussion with you all.

Thank you.

OPENING REMARKS OF HON. WARREN G. MAGNUSON, U.S. SENATOR FROM WASHINGTON, CHAIRMAN, COMMITTEE ON COMMERCE

Senator MAGNUSON. Thank you, George.

I have a short statement I would like to present to the group meeting here today.

From this room we have issued many of the laws that have helped all of us grow to greatness in this country, and it seems fitting that we should return here for a spirited discussion in the early years of another great adventure—the survival of man in the global environment.

We come here for a discussion between distinguished leaders and environmental scientists on the problems and the needs of international environmental science. The days are gone when we can be solely concerned with the expanding boundaries of a national frontier. Many of the concerns that will be discussed in these 2 days are global in extent, some regional, and some as between two nations.

We come to learn what information we shall need to take wise national and international action to solve the problems of our environment. And those problems are many.

Some population experts project that by the year 2030, just 60 years from now—and that is not far down the road—the world population will be around 14 billion, over four times the present population. Most of it will be in developing countries, and most of it will be in urban communities. How will we make the world livable for man under these circumstances? That population will add pressure, already great, to the needs for housing, for energy, for natural re-

sources, disposal of our wastes, and many other things you are going to discuss.

It will add to the pollution that fouls the air, that chokes the streams, and finding its way to that fragile sink—I underline the word "fragile"—the world's oceans.

By 1973, I have been given to understand that West Berlin will have no place to put its garbage. Will we be in any better situation in 2030 with the garbage of 14 billion people all over the world?

So, something must be done. All governments must face up to the problems of the human environment and act. But what are the problems of the human environment? How shall we act? What institutions shall we create in order to act? These are some of the questions we would like to discuss.

What information do we need to act? What are the needs of science and technology to combat environmental problems?

Last year 36 Senators joined me to sponsor a Senate resolution supporting the concept of establishing a World Environmental Institute.[1] The resolution passed the Senate unanimously. We passed the resolution to draw attention to the need for an international institutional approach to environmental science—science in the broad sense of knowledge. For we are all agreed that we must know what is wrong before we can act to correct it. But scientific research is not served well by the United Nations at present. It is extremely difficult for the specialized agencies of the U.N. to find money and give support to this kind of scientific research.

The World Environmental Institute resolution draws attention to these needs. We suggested some guiding principles how such an institute might be established. But they are for guidance, not rigid criteria, and must be subject to a give and take of international negotiation.

Having passed the resolution, the matter is, in a sense, beyond the Senate now. I have no doubt, George, that the House will overwhelmingly do the same thing.

The torch must pass to the executive branch of our Government, and be carried to other nations of the world. We can only urge that a strong environmental science institution be proposed. And we hope that whatever institutional arrangements emerge from the 1972 U.N. Conference on the Human Environment they will be strong, effective, and as broad as the problems of the human environment.

One step in that direction is this meeting. We have invited a distinguished group of Government leaders and environmental scientists to present papers in this forum of debate. And I ask that we all share our knowledge and our concerns openly, that we and all men can benefit fully from what we might discuss here. I am looking forward to being with you during these 2 days, and welcome you to this colloquy.

I might say that many members of the Senate who joined with me in the resolution, many members of the House who are concerned, deeply concerned with this matter, will be in and out, and you will have to excuse them for coming and then going out, because in the

[1] See Appendix II p. 128 for text of proposeed resolution, and introductory remarks by Senator Magnuson.

Senate there is going to be a vote about every 20 minutes today on a noncontroversial subject called "the draft." But don't be disturbed that because they come in and out that they do not have an awareness and a concern about this.

We deliberately picked this place because we are half way between the House and the Senate, and many Members of the House will be in and out. So, we all look forward to having a very productive and I am sure interesting and exciting colloquium on this subject.

Mr. FULTON. May I commend the chairman by saying the quality of the Member of the Senate present makes up for the lack of quantity of Senators.

Senator MAGNUSON. Well, we will be in and out, and the House will, too.

Do you have something to add to this, Congressman?

Mr. FULTON. I think Mr. Miller has spoken for me.

Senator MAGNUSON. Any of the rest of you?

Mr. FULTON. We will follow later.

Mr. MILLER. I would like to introduce the Honorable James Fulton, the ranking Republican on the Committee of Science and Astronautics. Next to him is Mr. Don Fuqua of Florida, who is chairman of our Subcommittee on International Cooperation in Science and Space.

The next one down the table is Mr. Ken Hechler of West Virginia, who heads up the Subcommittee on Advanced Research and Technology. Beyond him, Mr. Davis of Georgia, who is chairman of the Subcommittee on Science, Research and Development, a committee that was established and very successfully operated by Mr. Daddario.

Those are the Members of the House.

Senator MAGNUSON. I appreciate that and we all welcome them here.

I am going to turn the meeting over generally to Dr. Thomas Malone, the vice president of the International Council of Scientific Unions, who is serving as rapporteur for the colloquium.

OPENING REMARKS OF DR. THOMAS F. MALONE, VICE PRESIDENT, INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS, RAPPORTEUR FOR THE COLLOQUIUM

Dr. MALONE. Senator Magnuson, Mr. Miller, Members of the Senate and the House, colloquium participants, and friends.

As a point of departure for the discussions which will engage us during the next 2 days, it may be helpful to view the problems of the human environment in the perspective afforded by the dimension of time, to touch on some of the basic processes that link man to his environment, to take note of perturbations in those processes that are created by human activity, and to sketch some of the issues that must be confronted and resolved over the next few decades if we are to achieve the quality of life to which we aspire by reversing a deterioration in our environment that, if unchecked, threatens the survival of the human species.

With respect to time, it is useful to recall that:

Spaceship Earth was launched, in a manner we do not yet fully understand, about 5 billion years ago.

A primitive form of living organism made its appearance a little more than 3 billion years ago when prebiological organic synthesis took place in a mixture of water vapor, methane, carbon monoxide, carbon dioxide, ammonia, nitrogen, and other products of volcanic outgasing, activated by an energy source such as lightning or ultraviolet radiation. These primitive organisms were incapable of manufacturing their own food by photosynthesis and depended on externally formed molecules and a process of fermentation for nourishment.

During the subsequent couple of billion years a critical stage in the evolution of living organisms was successfully passed by the acquisition of the capability by those organisms to nourish themselves, to generate oxygen through photosynthesis, and to fix nitrogen.

Then oxygen began to increase in the atmosphere; invertebrates made their appearance 500 million years ago, and vertebrates a little over 400 million years ago.

Land animals emerged 300 million years ago.

The reign of the dinosaur began 200 million years ago and lasted for 140 million years.

The age of mammals began 60 million years ago.

Human life emerged, say, 3 million years ago.

What has come to be designated as modern man appeared something like 50,000 years ago.

As recently as 20,000 years ago, the Wisconsin ice sheet covered North America with a layer up to 2 miles thick, only to recede during the "climatic optimum" from 4000 to 2000 B.C., with an increase of several hundred feet in sea level.

So much for perspective on the past.

What can be said of the future?

Informed conjecture on the usable solar energy yet remaining, and on the probability of cosmic accidents originating from natural causes, suggests that man's terrestrial home *should* be habitable for at least another 10 million years. One of the central issues in the problem of the human environment is the determination of those steps that will have to be taken over the next five or ten decades to insure the existence of the human species 10 million years from now, given the present relationship between man and environment and current trends in that relationship. More than a defensive posture to insure sheer survival is at stake. In a positive sense, the central issue is: Can the misused knowledge that threatens our survival be redirected to raise the quality of life to a level commensurate with the instrinsic dignity that should be the birthright of each individual?

Throughout most of man's existence on the earth, his relationship to the environment has been governed by three basic and interrelated processes:

The energy process;

The nutrient process; and

The reproductive process.

The sun is the principal driving force in the energy process. It provides the energy for photosynthesis and it is the prime mover in the atmospheric, oceanic, and hydrologic systems. Something like 1 percent of the solar energy reaching the surface of the earth is "fixed" in green plants on land and in algae in water as carbon in the form of carbohydrates. This energy is passed up the successive levels in the food chain with decomposition and the release of waste heat to the environment as the final stage of the process (except for that which is preserved and accumulated in the form of fossil fuels).

The nutrient process provides the additional ingredients required for life by cycling nitrogen, phosphorus, sulfur, and trace minerals through the atmosphere and lithosphere and thence into plant and animal life in a mode of balanced equilibrium under natural conditions.

The reproduction process makes it possible for living things to produce more of their kind and thereby preserve the species. This may take many forms, varying from the fission process by which the simplest plants and animals reproduce by cell division to the sexual reproduction by which highly developed plants, animals, and human beings perpetuate the species through the union of male and female reproductive cells.

These three global processes are actually the aggregate of the processes taking place in an array of ecosystems, each consisting of a biotic community and its physical habitat that make up the thin film of air, land, sunlight, water, mineral, and plant, animal, and human life that envelopes the earth and is known as the biosphere. In the natural world, each of the ecosystems is in more or less stable balance in the natural state and is the culmination of many millions of years of evolution. The number of human beings has been controlled by the operation of the energy and chemical processes and by the interaction of man with other species. Not only the number of men but the nature of man has been determined, to a large extent, by the human environment.

This is now changing. Man has acquired a capability of altering each of the three processes and the near equilibrium of the biosphere is being replaced by a growing disequilibrium. The energy process has been affected in three ways:

Agricultural practice has accentuated the process of photosynthesis by, for example, monoculture that enormously increases the carrying capacity of the environment for man.

Man has learned to draw down the accumulated solar energy stored in fossil reserve so that the rate at which solar energy could be made available through natural and environmental processes is, for the time being, no restraint on meeting contemporary energy needs.

Man has discovered an alternative source of energy in nuclear fission and is probably within a few decades of being able to control nuclear fusion. The first accomplishment introduces a significant perturbation into the relationship between man and his environment and the second development, if realized, would alter that relationship in a revolutionary manner.

The nutrient process has also been altered in several ways:

A capability has been developed to find, extract, and process chemicals and minerals and introduce them into the environment

in a manner which, at man's option, natural life processes in the plant and animal world can be either enhanced or inhibited.

Side effects from man's activity in utilizing energy and manipulating matter to meet his needs result in the introduction of substances into the environment that are deleterious to the natural functioning of the biosphere.

The reproductive process has been altered in ways that include the following:

Understanding of the processes of life, the ability to control disease, and to prolong life, have sharply changed the relationship between birth rates and death rates with dramatic effects on the rate of world population growth.

A general understanding of genetic laws has made it possible to create a great variety of genetically different strains of domesticated plants and animals, with very large effects on the productivity of ecosystems. More recently the elucidation of the chemical structures and mechanisms responsible for the genetic properties of living matter are beginning to bring within reach a degree of genetic control which could profoundly alter the future development of all forms of life.

There are beginning to emerge practical techniques for conscious interferences with the procreation process which make it possible to separate the sexual interaction of human males and females from the reproduction of offspring. By providing a means of controlling birth rates that would match the degree of influence we are exerting over death rates, the way is being opened to conscious control of population growth.

A necessary concomitant to mankind's growing capability to influence the global systems that relate the individual to the environment has been the creation of an economic system which permits men to act in concert in transforming the earth's natural resources into the goods and services needed to satisfy primitive human needs for food, clothing, shelter, and health, as well as those amenities such as culture, recreation, etc., that give meaning to sheer existence. Important elements of the economic system are the technology concerned with the utilization of energy and with the transformation and utilization of materials.

An advance of recent decades that promises to exercise a strong influence on the performance of economic systems during the balance of this century is the capability of modern sensing, communications, and computer technology to perceive, to transmit, to store, to utilize and to retrieve information. Just as access to stored energy has enormously multiplied the effective power of the human muscle to perform work, so is the emerging information science and technology extending the capability of the human mind to utilize information.

The energy technology coupled with the information technology and the materials technology places in the hands of man a tool of almost incredible potential for transforming the natural resources of the world into the goods and services that are required for the necessities and amenities of living. This enormous power, if used wisely, holds the possibility of elevating human life to heights of which man has heretofore only dreamed; if used unwisely, little improvement in the human state can be foreseen in the short term—few decades—and

nothing but disaster in the long term—many decades. Mankind thus appears to be approaching a watershed in his development, at which the words Immanual Kant wrote nearly 200 years ago in "The Critique of Pure Reason," have a special relevance:

> . . . the whole interest of reason, speculative as well as practical, is centered in the three following questions: (1) What *can* I know? (2) What *ought* I to do? (3) What *may* I hope? (Emphasis added.)

To be responsive to these three questions, we need to recognize that there are five basic elements which, taken together, determine changes in the state of human environment. They are:

The growth in population.

Changes in the distribution of population.

Changes in the per capita capability of converting natural resources into goods and services—economic productivity.

Structural changes in the per capita consumption of goods and services.

Changes in the technology by which natural resources are converted into goods and services—including agricultural practices—and the manner in which they are used, or "consumed."

Perhaps the most significant aspect of population growth is that we are now adding increments of 1 billion individuals on the order of a few decades, whereas the first billion required on the order of a million years. With a doubling time something like 30 to 40 years, world population is likely to lie between 6 billion and 7 billion by the year 2000 and, given the age distribution that exists, even if a net reproduction rate of 1 were to be achieved by the middle of the next century, a steady-state population of 15 to 20 billion is about the lowest figure that can be anticipated.

Concentration of population in urban settlements is a phenomenon on a worldwide scale. The percentage of urban population in the more developed countries will rise from 66 to 88 percent by A.D. 2000; in the less developed countries, from 25 to 45 percent. Against a projected doubling in the world population by the year 2000, the world urban population will treble, with the number of urban residents in the developing world increasing from 600 million to 2.1 billion. A billion new urban and rural dwellings will be required, in addition to 2 billion new or modernized work areas, with accompanying public facilities and public service areas. A complicating factor is that the population in slums and uncontrolled settlements of migrants within human settlements in many countries is growing at twice the city population rate, which in turn is rising at a rate faster than industrialization.

Economic productivity has the potential of doubling within a matter of decades and should actually treble between now and the year 2000.

There are complex structural changes in the per capita consumption of goods and services taking place within nations, but on a global scale the most disturbing fact is the widening gap between the more developed countries and the less developed countries. Lord Blackett and Graham Jones in "The Role of Science and Technology in Developing Countries" have pointed out that—

> About two-thirds of the world's population have annual earnings of only $135 per head, while the remainder in the developed countries enjoy $1,800 per head. Over the period 1950–67, the less-developed countries succeeded in increasing

their Gross Domestic Product . . . per head to 2.4 per cent per annum . . . the industrial nations . . . 3.1 per cent per annum.

Changes in the technology employed to convert natural resources into goods and service and in consumer behavior can either ameliorate or exacerbate environmental degradation. It is possible to design processes in industry and agriculture that save or recycle materials and to contain or neutralize the discharge of pollutants to the environment. Only a bare beginning has been made in developing and applying those techniques, primarily because free access has been permitted to our common environmental property. Patterns of consumer behavior are slowly beginning to respond to a growing awareness of the hazards now endangering the human environment.

An understanding of these five elements is crucial for success in the task of either enhancing the quality of the human environment or preventing its further degradation. Very simply, our rapidly expanding fund of knowledge has made possible an exponential growth in population and an exponential economic growth which, if allowed to proceed for more than a few decades, threaten to exceed the carrying capacity of the biosphere. This problem is aggravated by concentrations of human beings in urban settlements—a feature in which, at present, the environmental disadvantages appear to outweigh the advantages. The widening gap in individual consumption between the more developed and the less developed nations may well introduce facets of social and political instabilities into a prospective environmental disequilibrium which is already close enough in time to cause grave uneasiness. Finally, there exists the distinct possibility that the skillful application of technology and wise consumer behavior could provide a temporary offset and delay the day when the twin problems of population growth and economic growth must be forthrightly confronted and resolved.

The five elements listed above may be viewed as the variables in an equation that determines the quality of the human environment. Thus, one can see that, if a "steady state" society is to be achieved, that is, one in which the relationship between man and environment eventually return to a state of near equilibrium, something like the following set of conditions must prevail:

Population growth must soon—within decades—be sharply curtailed and eventually—within, say, a century—be reduced to zero.

Economic productivity initially must be encouraged to rise, but only differentially until there will be some approximate equalization among the demands made by each individual on the environment at some satisfactory level and then the aggregate of all demands stabilized.

The tendency toward greater urbanization must be modulated by technological advances and restraints in consumer behavior that will bring into balance the advantages and disadvantages of increased concentration of population in human settlements.

During the period over which population growth and economic productivity are gradually being stabilized, considerable emphasis will have to be placed on technological improvements in converting natural resources into goods and services, and in ameliorating

the waste load caused by increased consumption, as well as a thoughtful reappraisal of the consumptive patterns of the more affluent members of society.

Whether or not these are the long-term policy issues that must be resolved, and if they are, how society should go about addressing itself to them, would seem to be matters that merit serious scrutiny and discussion at this time. Some prospect for treating these issues in a quantitative fashion is found in the approach sponsored by the Club of Rome in which the societal response to matters such as world population trends, utilization of natural resources, capital investment, industrialization, agriculture, pollution, and the quality of life are analyzed by means of computerized, multiloop, nonlinear, feedback, system models as a guide to the formulation of effective policies for consciously affecting the future.

There are, of course, many specific issues also demanding attention. They include:

The degradation of ecosystems, especially in developing countries, caused by (*a*) inappropriate agricultural management, e.g., transposition of temperate zone, developed-country agricultural techniques into humid, tropical areas; (*b*) fires that are increasing in various regions, thereby compounding problems of soil erosion and water resource management, (*c*) deforestation (of special concern to Asian and Latin American countries), (*d*) bad management of wild animal life, (*e*) lack of proper considerations—in advance—of planned development projects, such as highway construction, irrigation, etc., (*f*) lack of consideration of the ecological effects of increased tourism.

The increasing concentration of long-lived chlorinated hydrocarbons: DDT, aldrin, dieldrin, etc., which have proved to be highly efficacious in beneficial programs such as the control of malaria, but which also undergo successively greater concentration at every step up the food chain with catastrophic results for birds, fish, and marine invertebrates, deleterious consequences on laboratory animals, and, as yet, undetermined effects on man.

The accumulating presence in the environment of toxic heavy metals.

The steadily increasing carbon dioxide content in the atmosphere which has the effect of decreasing the outgoing long-wave radiation, thereby increasing the temperature of the earth. If present patterns in the usage of fossil fuels continue into the 21st century, this effect could produce significant climatic changes in several parts of the world.

The increasing particle load in the atmosphere which may well have an effect just opposite to the one produced by an increase in the carbon dioxide content.

The increasing heat from energy conversion which, at the present rate of growth (4 percent per year) would, within 150 years constitute an input to the atmosphere equivalent to several percent of the solar energy absorbed at the earth's surface.

Questions have arisen concerning the wisdom of using our petroleum resources for energy conversion, since they will be depleted

within a few decades at present rates of growth in usage and they might better be preserved for future food conversion.

The problem of marine pollution is now reaching a level of serious impact on public health, ocean food productivity, and esthetics. Dumping of wastes in coastal zones is aggravated by the release of 2 million tons of oil each year into the ocean, constituting a prodigal waste of resources, a threat to marine life, and a perturbing influence on the exchange of energy and matter between the ocean and atmosphere.

The water resource problem—with its twin aspects of provision of safe drinking water and disposal of sewage—is particularly severe in developing countries where these needs and the requirements of water for irrigation and industrial processes are bound to increase.

Biostimulation of inland lakes, estuaries and even some portions of the Continental Shelf is a result of the discharge of nutrients such as phosphates is beginning to affect marine life and promises to be an alteration of more than regional importance if present trends in nutrient use and loss continue.

The degradation of soils, particularly in the developing countries, by mechanical erosion, pollution, overgrazing, etc., threatens their productivity at a time when it should be sharply rising, not declining.

Future success in improving agricultural and industrial productivity depends to no small extent on the availability of a diversity of germ plasm—genetic pools—of plants, animals, and microorganisms. The trend toward a narrowing of the genetic base needs to be reversed by institutionalizing the conservation of the world's genetic resources.

A higher population density tends to accentuate the demand for the outdoor recreation that nourishes the human spirit. In the United States, attendance at national parks has been growing at a rate of 8 to 10 percent annually and shows no signs of decreasing. This is but one manifestation of the increasing pressures that are being exerted on land use as one element of the human environment.

If the foregoing examples are indicative of the environmental issues confronting the world today, it is clear that profound societal changes will be required for their resolution. In particular, it will be necessary——

To fill in gaps in our knowledge and to generate new knowledge about matters on which we are ill informed.

To reexamine the array of human attitudes and human values that lie at the root of societal behavior.

To provide new or renewed institutions capable of dealing with both the supportive and the operational aspects of international cooperation in environmental matters.

With respect to knowledge:

We have very little understanding of man's perception of his environment, the cultural relativity of that perception, attitudes toward environmental change, and human capacity for adaptation to environmental change.

While we have some relatively simple measures by which to "monitor" the quality of the environment, our understanding of the use of biological indicators is quite primitive; our understanding of "social indicators" that measure certain aspects of environmental quality is abysmal.

We are woefully lacking in understanding of the "carrying capacity" of the world's biosphere.

Our understanding of the behavior of social systems is quite inadequate with respect to implementation of a policy which would seek to achieve balance between population and natural resources.

We have yet to explore the implications of disposing of the waste heat of a worldwide energy-generating capacity that can be expected to grow something like 4 percent a year as far as one can see into the future. Of special interest here are the tradeoffs in material recycling and energy requirements.

We lack adequate information on the rate at which pollutants enter the environment, their dispersion and residence time in ecosystems, and their ultimate disposition. The intrinsically international nature of the problem requires a global system of monitoring.

There are conspicuous gaps in our knowledge about toxicity levels, the economic cost of a contaminated environment, and the psychological effect of a physical milieu which offends one's esthetic sense.

In spite of considerable progress, we lack truly reliable and readily accessible techniques for birth control.

There are major inadequacies in the technology of pollution control and in the economics of properly allocating the costs of such controls.

We need more refined and precise techniques, e.g., modeling and computer simulation, to assess the direct impact and the side effects of technological innovation or large-scale manmade modifications of ecosystems before that technology is introduced or those modifications are made. Promising progress has been made toward development of predictive ecosystem models in the International Biological Program and a solid foundation exists for early applications.

Finally, one of the most pressing needs in the knowledge realm is for a greatly improved capability to transfer knowledge and technology from one nation to another, with appropriate sensitivity in modulating that knowledge or technology in the process so that it is maximally applicable in the new milieu.

With respect to new attitudes and human values:

We need to reexamine the fundamental relationship between man and the natural world in which he lives.

We need to rethink the matter of an equitable sharing of the resources of the world among all men.

We need to develop an ethic on the consumption of goods and services which will provide restraint on those who have an opportunity to exceed reasonable individual limits.

We must foster the acceptance of an accurate pricing system that will take into account external social costs.

The matter of institutional innovations is of special interest to this colloquium for three reasons:

Institutions constitute the framework within which international environmental issues are addressed and resolved by cooperative efforts.

One of the major functions of legislative bodies is to bring into being institutions responsive to societal needs.

Senator Magnuson and his colleagues in the U.S. Senate have, with great boldness and perception, sketched in broad outline an institutional mechanism that merits the thoughtful attention of participants in this colloquium.

It is against this general background that we turn now to our distinguished panelists, ask each to make an opening statement and then we will have a general discussion in which we invite our guests to join.

Our first panelist is Mr. Maurice Strong, who, after a meteoric career in business and industry in Canada, turned his talents to the world problem of economic development, with chief executive responsibilities in the Canada International Development Agency. Six months ago he responded to an urgent request from U Thant to come to New York and become Secretary-General of the U.N. Conference on the Human Environment to be held in Stockholm in June 1972. He has brought to that post all the vigor that one might expect from his name, and it is a pleasure to introduce Mr. Strong.

STATEMENT OF MAURICE E. STRONG, SECRETARY-GENERAL, U.N. CONFERENCE ON THE HUMAN ENVIRONMENT

Mr. STRONG. Thank you very much, Dr. Malone. Congressman Miller, other distinguished Members of the Senate and House of Representatives, very distinguished members of this colloquium. I do want to tell you, first of all, what a very real privilege it is to appear here and have an opportunity to participate on this occasion, which I feel is a very important prelude to an event for which we are now engaged in preparing.

I will not make any remarks on areas in which I believe that there are others present on this panel who are much more able than I to make a presentation. I will confine my remarks to those areas which I think bear on my own principal responsibilities for the preparation of the Stockholm conference.

As an international civil servant, I am sure you would understand that I prefer not to make direct comments on some of the specific points in the proposals which have been raised here and that are going to be the subject of your discussion. Elaboration of policies and making of decisions are within the province of sovereign governments. My role is to serve as an organizer, a catalytic agent—to make sure that the representatives of governments will have before them at Stockholm proposals and alternatives for international agreement in a form that will facilitate their ability to accept, reject, or modify. As you perhaps know, five intergovernmental working groups already have been established and are at work in the first stages of the negotiating process which we have designed to facilitate the development of a consensus around specific proposals in such important areas as marine pollution, soil conservation, monitor-

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ing, and, of course, the universal declaration on the human environment which will be one of the important products of the conference.[2]

I do, however, want to emphasize the critical importance of the kind of global framework to which Dr. Malone referred, which must underline all of our thinking about the environmental problems. Many, indeed most, actions on environmental problems can and should be taken by national governments within their own jurisdiction. But effective action to cope with the environmental crisis will require unprecedented levels of international cooperation and this has profound implications for the organization of international life and the potentially rapid spread of cooperation among nations. It is my firm belief that the unitary nature of global ecosystems establishes an imperative need for a radical departure from the parochial ways in which men and nations have too often been thinking and acting in the conduct of human affairs up to this point.

I should like also to point out the fundamental conceptual problem of reconciling and synthesizing the current drive for environmental quality with the simultaneous drive for economic development in the developing world. I think we must understand, first, that some environmental problems are deeply rooted in poverty; that some environmental problems are rooted in the special problems of highly industrialized societies; that there are environmental problems which are shared by both the more industrialized and the developing countries of the world; and that each country, whether in the more industrialized or in the developing world, has an overriding interest in assuring that all other countries are given every possible help and cooperation in dealing with their particular environmental problems.

Inevitably, of course, priorities will appear different in countries in different stages of development at any given time and within a given country at different stages of its development. We must learn to think about what we have come to call environmental problems and what we have been calling development problems, are really part of a single framework, and that framework is the condition of man's life on the kind of planet which Dr. Malone has described.

I would also like to put the Stockholm conference in perspective, Mr. Chairman. Many agencies of the United Nations system—like the agencies of national governments—have in fact been working for many years on separate aspects of the subjects that are now subsumed under the environmental rubric. Stockholm will neither be the beginning nor the end, but hopefully a first high point in a process which has a past and indeed must have a very long future. It will be, I trust, the launching pad for a major, new international quest for global knowledge about the relationship between the human race and its earthly habitat.

But I wish also to point out that, however careful and thorough we are able to prepare for the Stockholm conference, its success or failure will depend in the last analysis on the level of political will with which governments are armed when they arrive at Stockolm. The United Nations can provide the forum and the housekeeping

[2] See Appendix III p.. 136 for information relating to preparatory work for the conference.

arrangements; the Secretariat can help to prepare the way; but, as the saying goes, you can lead a horse to water, but you can't make him drink. Only if the political will exists on all sides can the nations at Stockholm agree to act in what will be their interest and the larger interest of humanity. For my part, I am optimistic—but I also understand something about the parliamentary energies and the public demands which go into the making of the political world—and this, among other things, is what confers such importance upon activities like this—why I am so pleased to be present, and why I congratulate the organizers for their initiative and their spirit of high interest on this subject.

I have often been asked whether we know enough about environmental conditions to reach any decisions as to what to do about them—whether the lack of agreed scientific data might not hinder rather than help international cooperation and even undermine the chances for progress at Stockholm.

Now, I believe that such questions reveal a basic misunderstanding of the process in which we are engaged in preparing for Stockholm.

One of the main purposes of the Stockholm conference is to identify those areas of environmental affairs in which there is a sufficient consensus in the scientific community to provide a basis for moving ahead with cooperative action, confident that we are on the right track.

But equally important is the task of identifying priority environmental problems where our present knowledge is inadequate to indicate the right lines of action. This will point up the most urgent subjects for cooperative research and information exchange—which will undoubtedly be the lifeblood of the post-Stockholm environmental action plan.

As we see it, the great gaps in available scientific data are not obstacles to international agreement, but powerful incentives to the design of an urgent and cooperative quest for new knowledge about the interactions of the natural elements and the manmade elements of our total planetary life system.

I submit, Mr. Chairman, that it would be inexcusable to fail to act in the face of certain knowledge. It would be equally dangerous, equally inexcusable to rush into action without adequate knowledge of what we are doing. For a well-intended action based on inadequate knowledge is often as dangerous as lack of action in the face of knowledge. But at this point, surely, the most negligent position of all would be to fail to find out what we know, what we don't know, and what we must urgently need to know about environmental problems.

As I see it, the principal issue we are facing in coping with environmental problems is that of devising better modes of systematically gathering knowledge and applying it to our decisionmaking process at all levels of society. Without this knowledge, we are helpless and, worse, we will continue to make the kind of grievous and costly errors that have brought us to the present predicament.

Before the governments of the world can take the basic decisions which will commit them to long-term programs and policies affecting the future of their societies, they must have a vast amount of in-

formation about the nature of the complex interacting relationships on which the health of the biosphere depends. They must know the best and the most that science and technology can tell them about the consequences of their actions and of their inactions.

It would be premature at this point for me to have any fixed ideas on the general subject of organizational arrangements referred to by Dr. Malone and which will be required only after Stockholm, to deal with interaction aspects of the environmental problems, but I think perhaps it is not too early to let you have some of my current prejudices as to the principles which I think should guide us in the decisions which governments will face at Stockholm in this important area.

First, that any organizational arrangements should be based first on agreement as to what needs to be done, and until we decide what needs to be done we should keep an open mind as to the best ways of organizing ourselves to do the job.

Second, that all functions which can best be performed by existing organizations should be assigned to those organizations—both international and national. We should create no unnecessary new machinery.

Third, that it is more logical to consider a network of national, international, functional, and sectorial organizations with appropriate linkages and "switchboard" type mechanisms, with international organizations playing a role of supplementing and complementing national organizations than to think in terms of a global "superagency." I think this would be quite unreal and quite unnecessary at this stage.

Fourth, that anything we do should recognize the preliminary state of our knowledge and understanding of environmental problems and should be flexible and evolutionary.

Fifth, that governments will want to attach the highest priority to the need for coordination and rationalization of the activities and programs of the various international organizations active in the environmental field to avoid overlap and duplication, and assure the most effective use of scarce money and manpower.

Sixth, that any policy center which is expected to influence and coordinate the activities of other agencies should not itself have operational functions which in any way compete with the organizations over which it expects to exercise a policy influence.

Seventh, that it should be an important consideration in the establishment of any additional or new machinery to provide strong capability at the regional level.

Eighth, that the United Nations should be the principal center for international environmental cooperation.

And ninth, that the organization of environmental activities within the United Nations should be so designed as to strengthen and reinforce the entire United Nations system.

This suggests that what is needed most at this time to deal with the task of improving man's global environment is not a new specialized agency or operating body, but policy evaluation and review mechanisms which can become the institutional center or "brain" of the environmental network. It might be charged with maintaining a

global review of environmental trends, policies, and actions, determining important issues which should be brought to the attention of governments, identifying gaps in knowledge, and in the performance of organizations carrying out agreed measures for environmental control.

Such a center would, of course, have to be sufficiently competent, both politically and technically, to have a high degree of credibility and influence with both governments and other organizations in the international system. It would have to have access to the world's best scientific and professional resources in evaluating the information which would be available to it through world monitoring networks operated by other agencies, both national and international.

If I may be permitted, Mr. Chairman, I would like to conclude on a rather personal note and give you a personal view of where we stand at this point in our preparation for Stockholm. In a few days, I will have held my present responsibility for 5 months. At first, it looked like an almost impossible task. But I am now convinced that the task we have set ourselves can be done. Despite all we hear about the lack of cooperation within the international family, my own experience in drawing on the cooperation and support of almost the entire United Nations family has been on balance a positive and encouraging one.

The Stockholm conference itself is, after all, a total United Nations effort for which our secretariat is simply the instrument for organizing, coordinating, and focusing our collective efforts. I can tell you that it is working.

Thanks to the help and support of a great many people in the United Nations and outside of it, things have happened in the last 6 months that some of us doubted might be possible: a conference secretariat has moved into high gear in Geneva; basic documents are beginning to pour in from governments, United Nations agencies, and a variety of other sources, including the world scientific community through their organization, SCOPE, which is represented here. Dozens of scientists and other specialists have been recruited to produce reports and help process the information flow. Five intergovernmental groups already are, or shortly will be, at work on major specific areas in which specific action proposals can be formulated; important pre-Stockholm regional meetings have now been organized in the four major developing regions of the world—Africa, Asia, Latin America, and the Middle East; a meeting of experts is to take place in Geneva next month to examine in depth the key issues bearing on the development-environmental relationship; other meetings of scientists, experts, youth, and various interested nongovernmental groups are being organized around the world to consider particular issues and concerns and feed the results into our preparatory process. And a widely representative group of the world's intellectual and scientific leaders has been commissioned under the chairmanship of Professor Rene Dubos to produce a report on the "State of the World Environment," which will provide a broad conceptual framework for the work of the conference.

This encouraging spectacle leads me to believe that the conference, 1 year before Stockholm, is already having some measure of success.

It has mobilized an important segment of the world's scientific talent and resources, hitherto working in a disparate fashion, and focused them on the specific global problems that will be dealt with at Stockholm.

This, I think, is an encouraging sign of what can be done. And if at Stockholm we can agree on a declaration of the important principles which must guide us in dealing with important environmental problems; if we can agree on a substantial program for work in the international community over the years ahead; if we can stimulate an international movement toward cooperative research, data collection, and analysis; and if, in addition, we can complete, at least through an initial stage, some agreements or arrangements which enable us to deal immediately with a few specific issues which are especially urgent and capable of immediate action, then I believe Stockholm can be a success—will be a success in its own terms. But if at Stockholm, we can demonstrate that the United Nations can make it possible for its members to deal effectively with the global environmental challenge, I think the influence of Stockholm can well go beyond the environmental issue itself. It could indeed be the beginning of a new era of usefulness and of confidence for the unique organization which in my view is so indispensable to the operation of our global technological society.

Thank you very much.

Dr. MALONE. Thank you very much, Mr. Strong. The obvious zest with which this remarkable individual goes about his work, I think, explains why he has been able to galvanize action in both the governmental and nongovernmental sectors of the world.

Our next speaker is a man with experience in the executive, legislative, and judicial branches of the Government, as well as intimate experience with broad environmental problems as president of the Conservation Trust. He was appointed Chairman of the Council on Environmental Quality in February 1970. Mr. Russell E. Train.

STATEMENT OF HON. RUSSELL E. TRAIN, CHAIRMAN, U.S. COUNCIL ON ENVIRONMENTAL QUALITY

Mr. TRAIN. Mr. Chairman and Members of the House and Senate, and distinguished participants in this colloquium.

It is a great honor and a pleasure to participate with you today in, you might say, this historic environment.

Those of us here on this side of the railing, Mr. Chairman, might notice that the clock over your head stopped at 12 o'clock. How many years ago? One might wonder. But it gives me the opportunity to say that maybe it is trying to tell us something, and that is, it is high noon for the environment.

Indeed, the subjects we are discussing here are a matter of urgency, and I think that those here present have a particular sensitivity and knowledge of the urgency of these problems.

In his recent message on foreign policy for the United States, President Nixon said:

> We know that we must act as one world in restoring the world's environment before pollution of the seas and skies overwhelms every nation.

In speaking before this distinguished company, it is a truism to

emphasize that wind, water, soil, and a vast array of plant and animal life have a complete disregard for national boundaries and that problems of pollution, of natural resources, and many other environmental matters are truly international.

We have seen increasing numbers of instances in the past year of one nation accusing another of polluting a shared body of water or pool of air. Now, I would propose, however, that the flow of information across boundaries may generate even greater environmental consequences than any individual physical act. For it is technological information, as well as less scientific but equally potent information on life styles, that is influencing our cultures and causing the reshaping of our planet.

This exchange of information is also, at the same time, our best hope for finding solutions to common environmental problems. I firmly believe that cooperative action for environmental improvement is the single most positive and potentially the most fruitful area for international cooperation in the years immediately ahead.

The industrialized nations share a very great responsibility in connection with this information flow. It has often been pointed out that these nations share the major responsibility for many of the most serious of our pollution problems, as well as for many other environmental problems. At the same time, these nations have great scientific capabilities and resources which must be applied to these problems. Two years ago, during the 20th-anniversary meeting of the North Atlantic Treaty Organization, President Nixon emphasized this very point. He stated that the industrial nations shared no challenge more urgent than that of bringing 20th-century man and his environment to terms with one another—making the world fit for man, and helping man learn to live in harmony with this rapidly changing world. To meet this challenge, we absolutely must have a solid foundation of scientific information. At present, however, we are not yet meeting this challenge adequately, both because of inadequacy of our scientific understanding of critical environmental problems and, in many cases, because of a failure to apply and use adequately the scientific information which we do have.

During the past year and a half, our Government has made several significant changes in its organization to enable it to deal more effectively with the environmental problems which face us and to better obtain and apply the necessary scientific information. The National Environmental Policy Act of 1969, which the President signed as his first act of the decade of 1970, was not just a symbolic act—it established a national policy for the environment, defined ways in which the Federal Government should move toward achieving environmental goals, and established the Council on Environmental Quality within the President's Executive Office, to provide a focal point within Government for environmental policy and legislation, to maintain an overview of environmental conditions and trends, and to provide a point of coordination for all Federal environmental activities. To further develop institutional mechanisms for effective environmental management, existing agencies and functions have been reorganized to provide a more comprehensive administration of environmental programs. Through this reorganization, two new agencies were created last year: the National Oceanic and Atmospheric

Administration and the Environmental Protection Agency. More recently, in order to provide a better means of dealing with the Nation's resources, the President has proposed further reorganization involving the establishment of a Department of Natural Resources which would bring together under one administrative unit a number of the most important Federal functions concerned with management of natural resources.

Although these actions have been national in scope, there also has been a strong international dimension to our environmental concerns. Under section 102(e) of the National Environmental Policy Act, all Federal agencies are directed to "recognize the worldwide and long range character of environmental problems, and where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation and anticipating and preventing a decline in the quality of mankind's world environment." This is a quote from the language of the statute.

Our Council has been deeply involved in international environmental matters since its inception, and we have been active in a number of areas ranging from international intergovernmental and nongovernmental organizations to individual nations throughout the world.

There has been an increasing participation by Government agencies in general in these international environmental matters. This increasing response and involvement is well illustrated by the current preparation for the United Nations 1972 Conference on Human Environment. A group of 15 interagency task forces has been established, each group preparing a basic position paper for the U.S. Government in connection with specific initiatives to be submitted to the intergovernmental preparatory groups for the conference. These interagency working groups have provided a mechanism by which much expertise and information has been focused on specific international environmental problems.[3]

These endeavors have also served to point up the inadequacy of our information base in a number of areas, and this inadequacy has been a matter of continuing concern to our Council in the course of its activities during the past year. Our ecological knowledge, our understanding of the natural processes within the environment is still very limited. In the case of pollutants, for example, we may know where a pollutant enters the environment and we may recognize its impact, at least in extreme cases, on man or some other target; however, we still know relatively little about the route of travel of the pollutant through the ecosystem, about its impact on various organisms and elements of the system along that route, and about the second- and third-order environmental consequences of its presence in the ecosystem. In many cases, we do not know the effect of prolonged exposure of man or other organisms to sublethal or subclinical levels of many pollutants. Oil and associated petrochemical fractions provide a very good international example. We know that oil of certain types has had immediate lethal impact on many marine organisms. We are only just beginning, however, to learn about the

[3] See App. IV p. 154 National Report on the Human Environment.

long-term impact of the presence of the oil or its fractions in the marine environment. Clearly, knowledge of these kinds of information is absolutely necessary, both as a basis for effective international environmental policy and for effective environmental action.

The summer Study of Critical Environmental Problems sponsored by the Massachusetts Institute of Technology last year was probably the first attempt to assess critical environmental problems from a global point of view. The urgent need for further information was emphasized in the sober and sobering results prepared by the 100 scientists and other professionals in that study. From this study, however, and from the experience of our Council, it is clear that, while full information may not be available, some environmental problems—in fact, a number of them—require such urgent treatment that action must be taken on the best available information.

I think that is a point that Mr. Strong also made quite forcefully.

There is clearly an urgent need for accelerated environmental research, particularly aimed at understanding our major environmental problems, and gaining a better understanding of how the environment operates. There is also an urgent need for developing mechanisms for monitoring the environment, to provide better understanding of changes we are causing, and to provide a much needed early warning system for environmental problems.

A major problem area which exists traditionally nationally as well as internationally involves bringing the scientific information and the political decisionmaking institutions together. The development of new institutional mechanisms in the United States to which I referred has as one of its objectives the assuring that adequate environmental information reach those who need to use it, and reach them in a form that is usable. We consider that one of the responsibilities of our Council is to try to obtain adequate scientific information from without Government as well as within it. We recognize that this remains a potentially serious problem internationally. The international scientific organizations and many international scientific activities, such as the international biological program, are nongovernmental. This leads to difficulties of funding, and to difficulties of effective communication of the scientific results and advice to the decisionmakers and policymakers in the international sphere. The 1972 United National Conference on the Human Environment should provide a means of accelerating the development and transfer of this knowledge. I have noted with pleasure that the organizers of the U.N. conference are providing opportunity for the participation of the international scientific bodies, nongovernmental as well as governmental. I regard this as an essential step and one which augurs well for better scientific communication in the future.

I have also noted with appreciation that the organizers of this colloquium have emphasized the combination of environmental pollution, resource management, and environmental quality, rather than equating environment simply with pollution. Many of our most critical environmental problems in the industrialized countries do stem from pollution. However, factors such as land-use policy, resource allocations, and population, also contribute to our critical environmental problems. Further, throughout most of the nonindustrialized countries, pollution, as such, is not generally regarded as a serious

and pressing problem. Resource management, comprehensive integrated resource use and resource capability planning, and provision of adequate basic information are recognized as far more pertinent and critical problems. I am sure that Dr. di Castri of Chile will expand on this theme in his presentation, but I wish to emphasize here the importance of dealing with environment and environmental information in this broad context.

Following this morning's session of this colloquium, I must leave for Indianapolis, Ind., to participate in the International Conference on Cities. This conference deals with another critical aspect of our environmental problems. It is in the cities of the world that the effects of modern technology and rapid changes are felt with special impact, and one very hopeful recent development is the recognition that cities in different countries have common problems and that the quest for solutions to these problems must, therefore, reach across international boundaries. In its way, the International Conference on Cities represents another recognition of the overriding importance of developing and communicating adequate information on environmental problems.

Again, I wish to express my appreciation to the organizers of this colloquium and to express my hope that the colloquium will succeed in placing the problems of international environmental science in a useful perspective that will both inform about the problems and lead to creative solutions.

Mr. Chairman, I will not anticipate the introduction of the gentleman who will be speaking after me, but I would note that there is an increasing development amongst all the nations of the world which I think bears a very important relevance to our subject here today, and that is the fact that, at the highest level of Government, governmental policymakers are now actively engaged in discussing mutual environmental problems and mutual cooperation for dealing with those problems, and I think this is a highly encouraging augury for the future.

Dr. MALONE. Thank you, Mr. Train.

I would like to recognize Chairman Miller.

Mr. MILLER. I want to thank you, too, Mr. Train, but I want to take this opportunity to acknowledge the presence of Senator Mark Hatfield of Oregon, who is now here.

Dr. MALONE. After an active career in business circles in London and service as a member of Parliament since 1961, the Right Honorable Peter Walker in October of 1970 assumed the unique responsibility of bringing together activities in the realms of housing and local government, transport, public buildings and roads, and is now the Secretary of State for the Environment in the United Kingdom.

Mr. Walker.

STATEMENT OF RT. HON. PETER WALKER, M.B.E., M.P., SECRETARY OF STATE FOR THE ENVIRONMENT, GREAT BRITAIN

Mr. WALKER. Mr. Chairman and members of the House and Senate, ladies and gentlemen.

May I first say how privileged I feel at being invited to this colloquium, and say how pleasant it is for a Parliamentarian to attend

such a colloquium in these particular surroundings. I take particular pleasure witnessing the votes in both the House and the Senate and knowing whatever happens my party can't lose.

A few months ago my government decided to create a new all-embracing Department of the Environment, bringing together those aspects of land-use planning, of transportation, of all of the antipollution agencies in my country, so that we could have a total approach to the environmental problems.

There was some debate as to what the name of the new department should be, and there was a moment in time when our Prime Minister considered that perhaps it should be called the Department for Living. But then it was pointed out to him if we did that it would make me the Secretary of State for life, and he felt that this perhaps might decrease his room for maneuverability with his Cabinet.

But it has been exciting to create such a department, and I believe it has enabled the British Government to improve the quality of its decisionmaking in the spheres of environment. Already a number of very important decisions which affect the whole question of the quality of life I think have been decided in a different way from what they would have been decided had we continued on our previous organization of government.

Perhaps the location of the third London airport was a perfect illustration of this, where previously almost certainly the former Minister of Transport would have decided that a particular inland site would have been the most suitable because it was the most convenient site for the building of a motorway and for the communications by train.

The old Ministry of Public Works would certainly have decided it was the best site because it was easier to construct an airport there rather than to reclaim land off the coast for the purpose of an airport. And the Ministry of Housing and Local Government could have perhaps decided in one of two ways.

But when the new department looked at this problem and drew up an environment balance sheet of the effects of the various sites, we were able to strongly advise the Cabinet, an advice which the Cabinet accepted, that on environmental grounds the coastal site was far preferable.

Likewise, when we had applications for heavier macadam on our roads, whereas previously the old Ministry of Transport would have considered in terms of transportation economics it was the sensible thing to do, when we looked at it in terms of the total problems of the environment, we were able to reject this application on the grounds that the damage by vibration, by noise, by pollution in every form was such that on balance we decided that the environmental interest was to reject the application.

Likewise, in our approach to planning, where in my country we do have considerable powers over land and use, we are able now to impose upon all future development and applications for development environmental considerations whereby, for example, if people wished to go in for open-cast mining or wish to go in for taking gravel, we can put very tough conditions as to the manner in which that landscape shall be restored, and if a factory needs to be built, we can lay

down tough conditions as to the proportions which will be taken, to stop pollution of the rivers, and to see that there is a most practical and sensible method of waste disposal.

We are finding that this total approach to the environmental problems is speeding the rate at which we can improve the quality of the environment in our country. We are very interested in obtaining international agreements, for when it comes to pollution of the air and pollution of the seas, as far as Europe is concerned, one country's "out-trée" is very much another country's entrée.

Therefore, we are anxious at the earliest opportunity with our friends in Europe to find methods of agreement. But I do hope that these agreements will be reached speedily and effectively. I am very much in favor of the maximum international collaboration, and I welcome the initiatives that Mr. Strong has already made in organizing the Stockholm conference. He will know in our country we are endeavoring to obtain the widest possible public participation in every form in our preparations for that conference.

But I know he will agree, and I know Mr. Train agrees, that there are matters where we already know what the problem is, where we already know what the objective should be, and the speedier we come to international agreements the better.

I must confess I have a certain fear if we are not careful we will create a great number of international organizations, duplicating each other's work, taking the time of the relative small number of expert people in these topics without making the practical progress that we should be able to make.

Now, we have in my country surveyed all of our rivers; we know the current state of pollution in our rivers. We have a river authority system where we are able to stop various forms of effluent going into those rivers and have a tough control on them.

As a result of this, we expect year by year the quality of our rivers to improve as they have been improving over the past years. We are able with the resources of my new department to switch resources to meet particular problems of pollution. Therefore, I was able to announce a massive increase in our investment on sewage schemes in some of our worst polluted rivers.

But in terms of international agreement, it is important I think to recognize the total problem. For example, there is little point in reaching international agreement of dumping going into the seas if there is no international agreement on the pollution that pours into those seas from all of the rivers surrounding those seas.

When it comes to pollution of the seas, certainly in Europe the pollution from Europe's rivers into the seas and the pollution from the coastal towns of Europe are a far more major problem than any other single factor. Certainly I hope that we will be able to reach at the earliest opportunity agreements with our friends in Europe as to the manner in which the total problem of sea pollution, both from rivers, from coastal towns, and from dumping from ships will be brought under international agreement.

Likewise, in terms of air pollution, we were fortunate that we had a rather forward-looking gentleman who realized the future strength of the environmental lobby called Disraeli, and in 1873 he brought in a measure which set up in Britain an organization called

the Alkaline Inspectorate, which then had one specialized task to perform. But we have now widened the task of this inspector to the inspectorate of skilled and technical people.

I, as Secretary of State, designate industrial processes that shall come under that inspector. There are inspectorates that are entitled to go into any factory carrying out that process and they are able to advise on the method by which pollution can be diminished to the minimum, and, therefore, the industrial undertaking under concern in a reasonable period of time has to go over to that better system of filtering or processing its products.

We are now building up on the strength of this inspector and in 1956 our clean air acts brought in the whole basis of clean air zones, theoretically an impossibility, which has been highly successful so that the air in most of our major cities is of a far higher quality than it was 10 years ago and the London smog of the past is very much a thing of the past and is now never repeated.

Therefore, we are naturally anxious to see that international agreements are reached to obtain the maximum quality of air, and we are also anxious to exchange information of every type. I hope that there is a practical way in which we will achieve international cooperation.

I think it would be absurd if, for example, we were spending a lot of money on research into a particular form of pollution in the United Kingdom and the same research was being repeated here in the United States. I would like to see us inform each other of the lines of research we contemplate going in wherever possible to avoid duplication and to exchange information.

For this is a worldwide problem, and it would be wrong, I think, to keep the results of technical research carried out by any country from other countries involved in meeting this particular problem. Certainly, as far as we are concerned, we intend to spend far more on research.

One of the advantages of the new Department of the Environment is that we can have a total research program, filling in the gaps that we recognize exist. But if this can be operated in conjunction with other countries, if we can avoid duplication, we will certainly welcome it and be very anxious to make any of our findings available to all concerned.

In terms of monitoring, we do already monitor the whole of our rivers system. We are increasing the monitoring of the whole of our coasts, and we already have a system of monitoring the quality of air in many of our industrial areas and cities. Naturally, we are only too happy to make available the information from such a monitoring system to any international monitoring agreements that are made.

May I say in conclusion that certainly I am no pessimist on all of these topics. I thought the remarks of Dr. Malone on how a few million years have gone past and a few million years might be available in the future but there only might be a few decades. I think this is true if we mismanage our affairs.

I do not personally think we will. I think in the ever-developing democracies in the world there is an increasing pressure on the politician to pay far more attention to the quality of living standards. There is a demand of the younger generation who want to have

clean air and clean rivers and clean seas and don't want to lose the inheritance of decades past.

I believe that we have the technical means, we have the political movement that is going to demand these standards, and I don't see decades ahead of increasing pollution and deteriorating the environment. I see from now onward a period where we are going to clear up the considerable mess of the early stages of the industrial revolution and see in the future that it is controlled and monitored effectively and the quality of living, instead of declining, improves.

Certainly, we in my own country are trying to develop this total approach to our environmental problems with the considerable powers that that gives to us, and we welcome working with our friends throughout the world to see if there is a total international approach to these problems, which is practical, speedy, and effective.

Dr. MALONE. Thank you, Mr. Walker, and thank you for that commitment to an optimistic outlook on the future of mankind.

In his remarks Mr. Strong placed great emphasis on the activities going on within individual nations as being an important consideration in the degree of success obtained in the Stockholm conference.

The man heading up that activity in the United States as special assistant to the Secretary of State brings a rare blend of experience in the private and public sectors to this task. Those of us who have been privileged to watch him take hold of something quite amorphous and give it structure and direction are very well reassured.

It is a pleasure to introduce Mr. Christian A. Herter, Jr., Special Assistant to the Secretary of State for Environmental Affairs.

STATEMENT OF CHRISTIAN A. HERTER, JR., SPECIAL ASSISTANT TO THE SECRETARY OF STATE FOR ENVIRONMENTAL AFFAIRS

Mr. HERTER. Thank you very much, Mr. Chairman.

Members of the Senate and the House, and distinguished participants in this colloquium.

I might say at the outset that the executive branch considers it a great privilege to be able to talk a little about what is going on with respect to international environmental problems in the executive branch at the present time, and I would start off by posing the question which has frequently been posed to me:

Why in the light of all the problems we have got in the United States do we fuss around with international concerns? Why do we spend time and effort looking at international problems, trying to participate in their solution, when we have a giant problem of our own right here?

Well, I think the answer has already in part been pointed out this morning. Obviously, there are certain aspects of this entire environmental problem that can only be dealt with internationally. Whatever the form of pollutants, whether in the form of air or water pollution, or even trying to minimize the disequilibrium in international trade as a result of the measures that are taken by various countries, we need international forums to work these problems out.

Second, as far as the United States is concerned, there is a great deal to be learned through the international exchange of informa-

tion. We listened to the distinguished Secretary of State for the Environment on what the United Kingdom is doing. No doubt there are many things that are being done in that country which could be of great use and concern to us.

Equally, in such matters as land-use planning, the Europeans have had many centuries of experience, far more than we have. Even in some technical matters—for example, mercury—the countries of Sweden and Japan have been faced with this problem over a number of years.

So, we do have a substantive self-interest in the international area. We have a moral interest in the sense that we are the world's biggest polluter, and perhaps there is a moral requirement on us to share our technology and do what we can to provide leadership to raise the standards with respect to the treatment of the environment. And I might say, Mr. Chairman, we have very practical interests; the practical interests being that a number of international organizations—in fact, I dare say almost every one of them—all simultaneously discovered the environment. All decided that they in turn want to be the sole organization or the principal organization dealing with it. We are members of most of these organizations and have felt that at least with four organizations we had a real self-interest to participate to the fullest and to provide such leadership as we could.

I will mention them briefly, but I would like—simply because it may help your committee to visualize this—to create a mental image, and that is of a series of concentric circles at the center of which one might put in our bilateral arrangements with a number of countries concerning the environment.

The longest-standing, perhaps the most conspicuous of the moment, is that with Canada, where since the year 1911 we have had a continuous review—a joint cooperative venture, if you would like—in the terms of the International Joint Commission with Canada, which started out primarily concerned with the navigation problems of the boundary waters, including the Great Lakes, but recently has moved heavily into pollution problems. We are working now, in I believe a very effective way, with Canada with respect to actually doing something about the Great Lakes—the source of the greatest pollution.

Also, as you are well aware, the Japanese Government is sending a high-level representation at the beginning of this coming month to work closely with the Council on Environmental Quality in the Department of State with respect to bilateral matters and the exchange of technical expertise. We already have bilateral arrangements with Germany, France, and with a number of other countries. So, the bilaterals are a place to begin internationally.

Then, if we take the first of the concentric circles, we might look at the Committee on the Challenges of Modern Society of NATO, being the smallest organization of 15 members. This is the result of Presidential initiative of a year and a half ago. It is an organization concerned not with research, but with trying to do something on a basis of the knowledge that exists now. They have been remarkably effective in this area.

It has been focusing on specific problems, some of which go well beyond the environment as we customarily know it. If you talk about experimental safety vehicles, this kind of thing, we are talking about challenging modern society rather than a specific environmental problem. Nonetheless, this particular organization does act as the catalyst, not as the competitor to other organizations, and you may recall, Mr. Chairman, that last fall the first really international agreement on oil pollution was arrived at in Brussels and subsequently ratified by the NATO Council.

So, we start with NATO, an organization of 15 countries. I would say next in size probably is the Organization for Economic Cooperation and Development, an association of what you would call free market westernized industrialized countries that meets in Paris, and in this situation the focus of the effort is on the economic side: Who pays for pollution? How should it be paid for? On whom should the costs be assessed? What are the international trade implications from such assessment of costs? These are enormously difficult and tricky problems.

The OECD itself has an excellent staff for this purpose, and we as the executive branch view the OECD as the forum primarily concerned with this series of problems as having the expertise, and we feel very strongly that some of these economic problems and their resolution—or at least normalization—is of vital importance.

We have also started in the OECD something that we think may be precedent setting, which is what you would call an early warning consultation and confrontation arrangement, at this point confined to chemical compounds. But the purpose of this is to provide to one's allies or to other countries with which one carries on extensive trade as much warning as possible with respect to administrative actions or legislative actions that are taking place so all of a sudden the world isn't confronted with a decision, let's say, by the United States that they knew nothing about and they have to respond in a completely uninformed manner.

Already we have had some difficulties in this, but we are trying now to develop this early warning system and hope that in due course this can be expanded to more problems of the environment generally.

Next, I would mention the Economic Commission for Europe, which is a U.N. body that has come to take a life of its own pretty much, and which involves some 30 industrialized countries from both Eastern and Western Europe.

As you know, there has taken place a meeting at Prague which was to have been the Prague Environmental Conference, the major contribution of the ECE. For a number of political reasons that I don't think need to be dwelled on at the moment, this was reduced in stature from a conference to a symposium.

But the symposium took place, and having participated in it, I am very glad it did take place, because I think it certainly augurs well for perhaps a successful meeting in Stockholm. And we ended up on a note of harmony rather than one of confrontation which had taken place the week before.

Lastly, I would mention the obvious and biggest of the organizations within which we are taking a part, which is the United Nations and the United Nations conference scheduled at Stockholm a year from June, about a year from now. We have all heard from Maurice Strong, who has given this conference enormous leadership, and I might say most of the countries that have been concerned have felt if it hadn't been for his leadership they simply do not know what would have happened at the Stockholm conference.

I do ask you to visualize 120 countries meeting in Stockholm over a period of 2 weeks trying to decide the environmental fate of the world. This is going to be some undertaking. As far as the Swedish are concerned, it is the biggest international conference they have ever had.

I would once again review, just for the record: we start in terms of our international undertakings with the bilaterals and in enlarging circles, NATO, OECD, the Economic Commission for Europe, and the United Nations itself.

Now, with respect to the United Nations conference, as Chairman Train has pointed out, the United States is preparing a series of basic papers, which they are called in the UN terminology, and which essentially represent our position.

I might say this isn't just the executive branch all by itself. We have established—there has been established, let me put it this way, the Secretary of State has done so—under the chairmanship of Senator Baker of Tennessee—a Secretary's advisory committee, primarily a group of some 30 people. This is not necessarily limited to 30 but that is the size of it at the moment, and it represents various sectors within the United States, such as the conservation people, industry people, foundations, labor, universities, various groups within our society—a whole variety—all of whom have expressed a considerable interest in the Stockholm conference or who would like to make a contribution, and who would like to have their ideas brought into the conference. This group has been established for precisely this purpose.

We are working with them now, and they in turn have taken up the various substantive initiatives, examining them, and will make a definite substantive contribution.

Very briefly, Mr. Chairman, before completing, I might run down for you, simply by topic, the number of initiatives on which at the present time, as Chairman Train described, various agency task forces are developing basic papers. These basic papers will constitute in the first instance the United States' contribution to the Stockholm conference.[4]

We hope some of the things we have submitted will turn up on the agenda. There is a long process before this becomes true. But at least we are working on the following topics:

Marine pollution, which most countries from the various conferences I have attended feel is perhaps the most important of all the subjects currently facing the world;

[4] See Appendix V p. 217 Fact Sheet on the 1972 United Nations Conference on the Human Environment.

Environmental criteria for international development agencies, and I might revert a moment to marine pollution only to point out that there is an international working group meeting in London in mid-June at which Dr. MacDonald of the Environmental Council of the United States will be a part, to design or start drafting a convention at least in the area of ocean dumping;

Environmental criteria for international development agencies;

A world heritage foundation for the preservation of areas, whether they be cultural sites, landsites, monuments of historical interest;

Regional environmental centers. This is something on which we are laying enormous stress, Mr. Chairman, because we feel that with many of the countries of the world, particularly the developing countries, their problems—their exceptional problems involving urbanization, water, soil, forestry management, where you have similarities of geography, topography, et cetera, can perhaps be handled better on a regional basis than on an international basis;

Animal, plant, and micro-organism gene pools;

Maintenance and restoration of soils. There is an international working group preparing for Stockholm that will meet in Rome under the auspices of the Food and Agricultural Organization in late June;

Monitoring and surveillance. An international working group will meet in Geneva. This is an absolutely key item;

International education and training;

Rational management of human settlements;

Limiting the release of pollutants into the environment;

Research, development, and analysis;

Information exchange—a key matter of concern that one might conceive of as operating at three different levels. Certainly for the developing countries, informational exchange is useful only in terms of the problems with which they are confronted.

Again, we would visualize this perhaps at this point as operating through regional centers.

Then you have the highly sophisticated information that is required for any kind of monitoring. The results, data collection, processing, and an in-between area—in some ways the most important of all—is a mechanism for information exchange on the experience countries have had with certain problems.

There is no way now, no institutional way, of finding out except by accident, or except through bilateral discussions, what research has been conducted in other countries: what is the nature of it; what experience they have had with specific problems; how they are dealing with their solid waste disposal; whatever it may be.

Finally, Mr. Chairman, and I will conclude, our last item is perhaps the most difficult of all. We are devoting a considerable amount of attention to it, including Senator Magnuson's full exploration and review of your particular proposal, the problem of institutional arrangements following Stockholm. This is absolutely a key and, as you know, it is a sensitive area and a difficult area. A great deal of work inside and outside of the Government is going on with respect to this whole topic, and we hope to be prepared soon to formulate a U.S. Government position.

Thank you very much.

Senator MAGNUSON. Mr. Chairman, may I ask Mr. Herter a question, because I understand he has to leave. There are a series of questions which we want to ask of you, and we can submit those and put them in the record later on. I am sorry I couldn't be here for most of your statement, but I do understand by it that the State Department fully endorses the objective of what we are trying to do.

Mr. HERTER. There is no question about this, sir. They do fully endorse it.

Senator MAGNUSON. Despite the fact that we have some of the problems that you have mentioned.

Secondly, you don't have to answer this if you don't want to, do you think we should include Mainland China in these discussions?

Mr. HERTER. I, sir, would prefer——

Senator MAGNUSON. It has one-sixth of the world's population.

Mr. HERTER. I think that matter will be discussed fully at the Geneva Assembly this fall, and I think it is probably better——

Senator MAGNUSON. And by 1972, before we go to Stockholm, maybe some of these things will be resolved.

Mr. HERTER. I would hope so.

Senator MAGNUSON. Thank you.

Before you proceed, we are honored by the distinguished Senator from Tennessee, Senator Baker, who is here, and who has had a longtime interest in the objectives of this conference.

Senator BAKER. Mr. Chairman, thank you very much. Senator Magnuson, I thank you. I apologize to each of you and the witnesses and the participants of this panel for not having arrived at the appointed hour, but having discovered some time ago that the hallmark of senatorial service is never being on time, I can only apologize and say it worked again today.

Mr. MILLER. With your permission, I would like to recognize the presence of Dr. Philip Handler, the president of the National Academy of Sciences, who is here, and Dr. Samuel Leonard, who is one of the advisers to our committee since it was first established.

Dr. MALONE. Our concluding speaker this morning is a scholar who takes very seriously the responsibilities of a scholar to societal needs. He studied in Italy, Canada, and Chile. He is Professor of Ecology at the Austral University of Chile, and last fall when the International Council of Scientific Unions established a Scientific Committee on Problems of the Environment, he was the natural choice for vice president of that scientific committee.

STATEMENT OF DR. FRANCESCO DI CASTRI, VICE PRESIDENT, SCIENTIFIC COMMITTEE ON PROBLEMS OF THE ENVIRONMENT, INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

Dr. DI CASTRI. Thank you, Mr. Chairman. I am very honored and very grateful to the members here for this invitation, giving me this opportunity to express my viewpoints and the feeling of the scientific community from the less developed countries about the environment's use.

During these last months several programs on a worldwide scale have been launched or are in a planning phase, both from govern-

mental and nongovernmental organizations, in order to face with a global approach the problems derived from the deterioration of the environment.

From the elaboration and the execution of environmental programs, not just global in the intentions or in the formal aspects, but also receiving an active and sincere input from the scientists and the decisionmakers all around the world, it must be borne in mind with great realism that in spite of the intrinsic commonness of all the environmental problems there are clear differences between the developed countries and the less developed ones. These differences might be of a diverse type and based on:

The nature of the problems, such as the fact that the structure of the tropical ecosystems, not generally present in the developed countries, requires a quite peculiar and in general very badly known kind of agricultural and forestry management;

The origin of the problems, and in this respect it must be pointed out that the environmental degradations may be a consequence of the subdevelopment as well as of the development;

The different priority level of the problems, the priority not only depending on the intensity of the phenomenon, but also and mainly on its relative seriousness when compared with other problems;

The different perception of these problems by the governments and the public opinion, being this perception lowered by cultural and social situations, by the dominant impact of other problems and sometimes by simple semantic difficulties;

The type of strategies that should be adopted for the solution of these problems, according to diverse historical roots, local idiosyncrasies, economic and human availabilities, et cetera.

There is no doubt that besides these divergent perspectives there are many common issues based on the following three main considerations:

The linkages of an ecological type that join all the phenomena until hurting in a short or deferred term the integrity of all the biosphere, being every time more vague the delimitations of the nations, regional and global scales;

The linkages of a sociological type that may finally affect the global stability of the sociosphere;

The similarity in the scientific approach for the solution of environmental problems, being most of them of an intrinsically common nature, even when they are in a different intensity or shift in time in the diverse regions of the world.

The environmental problems of the less developed world to be discussed in this report can be used as examples because they could be classified according to the convergency and divergency criteria previously pointed out when compared with those of the developed countries.

After this introduction, necessary for avoiding any semantic misunderstandings, it must be remarked that there are in this report two completely different parts.

In the first part, some results of a preliminary survey to detect the viewpoints of environmental scientists from the less developed world will be summarized. I will try to show as objectively as possible

which is their general feeling upon their own problems, making only few personal comments.

In the second part, on the contrary, I will give my own opinion about which should be the main goals and strategies of action to encounter the environmental crisis in the less developed countries.

1. SURVEY OF THE OPINION OF SCIENTISTS FROM LESS DEVELOPED COUNTRIES

After the first meeting of SCOPE in Madrid in September of 1970, with the aim of knowing in a more direct way the environmental priorities and the major difficulties for their solution according to the viewpoint of the involved scientists themselves, I wrote to over 100 colleagues of Africa, Asia, and Latin America including in each letter an ad hoc questionnaire in order to standardize the answers.

The first general results of these questionnaires were presented at the second meeting of SCOPE in London in January of 1971. The attention was specially put on the large coincidences in the opinions of the scientists of these three regions and therefore on the possibility of a plan of action common to all of them.

As a consequence of this report, a special working group was created by SCOPE with the purpose of studying how to obtain the maximum of participation of the less developed countries for the achievement of the global programs of SCOPE.

After the meeting in London the work on this subject was followed and answers of other questionnaires were obtained in such a way that by this time I have reliable information about the general feeling of the environmental scientists of at least 24 countries; nine of Africa, seven of Asia, and eight of Latin America. There are more fragmentary data about several other less developed countries.

In the present report I will restrain myself to discuss the most general aspects of these results because they represent a too large amount of information, to be analyzed with more detail in a later paper.

First of all, I will refer to the environmental priorities and then to the major difficulties for the solution of these problems.

1.1. Priorities on environmental problems

In the questionnaire, 19 environmental problems have been listed, most of them subdivided in items and subitems. It was suggested to the scientists that they add other problems, and in fact this was done. In front of each problem they could designate three priority levels, first, second, or third.

For the purpose of giving a first general interpretation of these results it was considered convenient to group the different environmental problems in three big categories, even though I am aware that it is a rather artificial procedure.

These three categories are the following.

Management of ecosystems, in a very broad sense including both aquatic and terrestrial ecosystems, and in reference to these last ones also the problems of erosion, the use of the water resources, the plagues of cultivations, et cetera.

It would have been much easier to use the designation "Natural Resources Management," but the necessity of adopting the conceptual and methodological approach of the ecological system was wanted to be emphasized.

Control of human population, corresponding to both main aspects of the overall population growth and of the rate of urbanization.

Pollution, taking into consideration the polluted environments—air, inland waters, coastal and oceanic waters, soil, and the different types of pollutants.

In figure 1 the proportional priority of these three groups of problems is sketched with reference to the questionnaires of Latin America, Africa, and Asia, and above to the total of the three regions.

The data were conventionally weighed, giving a coefficient 3 to the first priorities, 2 to the second ones and 1 to the third ones.

The rational management of the ecosystems is far and away the first priority in the three regions. Then comes the control of the human population, with very similar percentages but showing a decreasing order of importance from Asia to Africa and Latin America.

The last relative priority is given to the problem of pollutions, mainly neglected by most of the African scientists while, on the contrary, the Latin American ones grant to it an importance even slightly higher than to the control of human population.

These trends are exaggerated in figure 2, drawn similarly to figure 1, but taking into account only the first priorities pointed out by the inquested scientists.

By keeping the proportion of the control of human population almost unchanged, the priority of the management of ecosystems increases strongly, while the relative importance of the problem of pollution decreases even more.

As a personal opinion, it is not to wonder at the strong priority given to the management of ecosystems when it is viewed at the incredible rate of destruction of natural resources, mainly of the terrestrial ones, which is taking place in this part of the world with generally irreversible consequences. Maybe the problem of control of human population has been somewhat underestimated.

1.1.1. Management of ecosystems

The point of the questionnaire did not exclude the aquatic ecosystems, but most of the inquested scientists referred themselves mainly to the terrestrial ones.

Four items, each of them subdivided in subitems, concerned this problem: Degradation of ecosystems, soil destruction, limitation of water resources (including the bad use of water resources) and a last one somewhat heterogeneous that could be defined as "unbalance in nature" (effect of introduced species, insect peaks and plagues, et cetera).

I am aware these divisions are artificial because of the interaction of all these problems.

The degradation of ecosystems reached with great advantage the first priority (90 percent of the answers give it the first priority), then with 70 percent comes soil destruction (mainly by erosion and

very far apart by salinization, laterization, and formation of sand dunes), the use of water resources and the biocenotic unbalances.

In this last item the phenomena mentioned with greater frequency have been the plagues of insects in arid and semiarid zones, the exceptional proliferation of some hydrophyta in many African inland waters, the danger of extinction of rare species mainly by overhunting and overfishing, and the extreme lack of biocenotic equilibrium of some island ecosystems due to the introduction of allochthonous species.

At a so general level of this report I think that only the problem of degradation of ecosystems must be more deeply analyzed.

The main causes of degradation of terrestrial ecosystems in decreasing order according to the frequency of mentions are:

The inappropriate agricultural management, having been pointed out with great insistence the poor results of the passive transfer of the agricultural technology from the developed countries of the northern hemisphere towards the humid tropics and the austral regions.

As bad management were frequently mentioned the overgrazing, the monocultivation, the lack of recycling organic substances to the soil and then its biological impoverishment (especially by the Latin American scientists) and the shifting agriculture.

The deforestation, a priority very near to the previous one in the whole and stressed as the most important factor of degradation of the natural resources according to the Latin American and Asian scientists. It also embraces the inadequacy of the reforestation from a qualitative and quantitative viewpoint.

The effects of fire, or at least the bad management of fire, was an item very much emphasized by the Latin American scientists as one of the main causes accelerating the soil erosion.

The bad management of the domestic and wildlife, insistently pointed out by nearly all the African scientists, with special reference to the large mammals.

In what concerns marine ecosystems, the bad organization of the industrial fishing and the overfishing were shown as the first priority for action by several Latin American scientists.

Finally, when taking into consideration the future of the global stability of the biosphere, my personal viewpoint is that the most serious problem and upon which we should be most worried about is the general decrease of biotic diversity, not as much by the extinction of species, but by the oversimplification of ecosystems in so wide a scale, not even leaving any space for the preservation of more complex nuclei.

Furthermore, it seems evident that this reduction of biotic diversity goes together with a similar decrease of the cultural and social diversity at a worldwide extension.

1.1.2. Control of human population

In relation to the two main aspects of the questionnaire the increase of urban agglomeration has taken priority over the absolute increase of human population. This is mainly due to the influence of the answers of the Latin American scientists, 73 percent of them consider-

ing that the first aspect has greater importance when compared with the second one at the level of first priorities.

On the other hand, in the answers from the African and Asian countries, there was an almost complete balance between these two problems.

I think that a slight interpretation should be given to these data. No one doubts that the control of the human world population is the major problem of mankind in an absolute sense when realizing that the global resources have finite limits. But the urban populations are increasing at about twice the rate of overall population growth, thus justifying the shifting of the primary urgency toward the control of the rate of urbanization and the planning of the urban environment and of the urban society in more general terms of the urban ecosystem.

Furthermore, even now, at least in Latin America, a very high proportion of the population lives in the cities, in most of which the problem of habitability has already reached unbearable extremes.

1.1.3. Pollution

As already pointed out, the group of pollutants have been considered in the last place within the environmental priorities according to the inquested scientists. Nevertheless, this fact must not lead us to an underestimation of the intensity of the pollution phenomena even in the less developed countries and of the undeniable increase in tendency.

When compared, this situation with respect to industrialized countries, most of the time it refers to relative differences, those I have defined in the "semantic" introduction of this report as differences of priority and differences of degree of perception.

In fact, in spite of the intensity of pollutions in many zones, there are several other environmental problems, without taking into consideration the social and economic ones, that represent a more clear priority for the less-developed countries.

On the other hand, a citizen facing immediate and elementary problems of survival due to large deficiencies in nourishment or in housing is scarcely able to perceive the nuisance of air pollution or to understand the seriousness of its future consequences.

Coming back to the results of the questionnaire and considering the total of the three regions, the pollution of inland waters received the first relative priority, mainly by effect of the answers of the African and Asian scientists.

For this pollution there are clear differences in relation to its origin: besides the pollution by industrial and mine wastes, by pesticides and detergents, there are other pollutants of the inland waters, pointed out with even greater frequency, such as the products carried away by erosion or the microbial contaminations due to deficiencies in the sanitary treatment of the wastes of cities and villages.

In a second place soil pollution is found (mainly due to the frequent mentioning as second and third priority), and finally air pollution and the pollution of coastal waters.

Here we can see the most controversial aspect: air and coastal water pollution were the two first relative priorities among the Latin American answers, while they occupied the last two places in the answers from Africa and Asia.

No doubt the Latin American scientists have been influenced first by the already stressed intensity of urbanization and the enormous accumulation of smog in cities where the greatest part of the population of the country is concentrated and, second, by the importance that many coastal countries are giving to industrial fishing as an economical issue and therefore to the factors negatively affecting it.

Finally, ocean and higher atmosphere pollution, that is to say the two phenomena with the greatest global effects, have almost not been considered in the answers.

I would dare to interpret this fact as the feeling that the less developed countries are judging themselves only in a very small measure responsible for the occurrence of these pollutions and that therefore the solutions should also be undertaken by the industrialized countries.

1.2. Major difficulties for the solution of environmental problems

In the second part of the questionnaire the inquested scientists were asked for their opinion about the most important difficulties that would be found to solve the environmental problems. Each difficulty could be chosen from three categories: Big, medium, and small.

I believe that this aspect of the questionnaire is one of the main ones because, in fact, any global program should be elaborated after knowing the feeling of the scientists that afterward would be called to set this program in action.

Furthermore, the comments of the scientists about this part of the questionnaire were much more numerous, in general very congruent and sometimes fairly polemic.

According to the answers to the questionnaire, the following difficulties in decreasing order are shown. The figures in brackets are quite conventional and they represent only a comparative value.

The figures were calculated as weighed data, giving a different coefficient to the three categories of importance in the same way to what was already explained in the previous part of this report. Unfortunately, it will not be possible to include in each point but only some of the most interesting comments of the inquested scientists.

Few specialists in environmental science (96). In the total sum of the three regions this turns out to be the major difficulty, confirming the generalized opinion that the educational problem is the first priority for the less developed countries and the only one that could break up many vicious circles.

Furthermore, many doubts were stated about how many of the few existing scientists have a solid training in modern ecology, how many of them are willing or able to face realistically and with originality local problems, and in general if the present policy for the formation of new generations of environmental scientists is the most suitable from the viewpoint of the less developed countries.

Lack of economic backing (91). Besides this aspect, almost obvious in countries just classified for their poor economic development, some inquested scientists pointed out that it deals furthermore with the bad distribution of the existing funds due to the lack of a policy at a government and university level in what concerns the environmental problems and the research for facing them.

Lack of background information about natural resources (87). In this respect it was stressed furthermore that the system for coordinating existing information is very deficient and doubt was expressed about to what extent the data that are being collected in the present time could really be used as a basis for later studies at the ecosystems level.

Little sensitiveness of public opinion (84). The lack of awareness about the seriousness and the urgency of environmental problems has been one of the most divergent aspects in the answers to the questionnaire. Clearly the most serious difficulty according to the Latin American scientists, and the one before the last in what concerns the African and Asian ones.

It is true that public opinion of Latin America is in general very little informed or maybe somewhat indifferent about the dramatic destruction of the natural resources of this region, having this attitude to be explained mainly by historical, cultural and social reasons.

Problems of interdisciplinary organization (83). This aspect has been emphasized with special insistence by many scientists, considering that if working groups of this nature are not created environmental problems will never be solved in a responsible way. In most of the less developed countries nearly always it had failed up to this time in the constitution of interdisciplinary groups.

As main causes of this unfavorable situation, the deplorable situation of the national system of the universities in many countries and numerous group psychology problems (individualism, overspecialization, political division, et cetera) have been quoted.

Problems in international collaboration (61). Even though this point received the lowest priority, the great number of remarks the inquested scientists did, is showing their sensitivity on these aspects.

Their comments range from very definite obstacles such as war—in a few countries—up to a heterogeneous series of diverse difficulties, deriving mostly from reticence, suspicion, and competition for prestige among countries.

Two points have been insistently quoted. First, the feeling of the scientific community of many less developed countries of being absent in the effective phase of planning and in the real spheres of decisions of the so-called global programs, both of governmental or nongovernmental nature; and the second, the confusion and the germ of competition arising from the proliferation of programs whose purposes are overlapping and whose coordination is bad or just formal.

A last factor about difficulties was not included in the questionnaire so as not to hurt eventual susceptibilities and not to start with polemics. Nevertheless, this factor was mentioned by most of the scientists in such a way that it could have reached a weight of about 85–90. This refers to a series of interconnected problems that could be grouped in only one item called "problems in the relationships between the scientists and their governmental spheres."

I will write down almost textually the most repeated remarks: lack of environmental policy in the governments and even lack of awareness and knowledge of the administrators to understand these problems, absence of environmental scientists in the bodies created for promoting the scientific policy of the country and in the institu-

tions for the planning of the agricultural, urban, and industrial development.

Furthermore, the fact that in the meeting for organizing intergovernment global programs, many less developed countries would be represented by politicians and diplomats, without any input by their most competent scientists in the matters to be dealt with.

2. ENVIRONMENTAL GOALS AND STRATEGIES FOR THE LESS DEVELOPED WORLD

All these aspects will be presented in the most schematic way, with the purpose of sketching possible actions. This must not make us assume that they are of easy or general application. On the contrary, the strategies are very complicated and have to be adapted each time according to local situations.

First of all I am going to summarize my viewpoints about the main characteristics of the situation today in the less developed countries and about the most frequent mistakes.

The main aspects of the environmental crisis existing in major or minor degree in nearly all the less developed countries are the following:

The incredible rate of degradation and destruction of natural resources;

The resistance against establishing controls that could limit in any way the rate or the cost of industrialization;

This point and the previous one are due to the fact that governments are acting under pressure trying to bridge many gaps—the economic gap between developed countries and the less developed ones—the gap between the expectations of their populations and the concrete possibilities, et cetera;

The scarce interest for participating in environmental projects of a global nature because of lack of conscience about the degree in which these countries are also involved and for the very concentrated attention upon the local problems;

The lack in public opinion of a true and deep comprehension about the reality of these problems and a reticence in accepting information and initiative in this respect that are most exclusively coming from the developed countries. In these attitudes there is the influence of ancient historical and cultural roots, as well as of more recent experiences;

The impossibility of solving these problems at a simply national scale for the lack of economic backing, the scarcity of competent people and many times the lack of originality in their planning.

Concerning the most common conceptual mistakes about ecology in the less developed countries, I want to point out the following:

That ecology would be an essentially negative discipline, a science restrained to emphasize "what has not to be done," all this representing a brake for many countries and establishing a conflict between development and environment. Really it deals with a nonexistent conflict or at least with an antithesis expressed in artificial terms. The optimization of the environment by the ecological approach embraces in fact two aspects: Besides the minimization of the negative effects of industrialization, the maximization of positive effects, even from a short-term economic viewpoint, of a good management of natural and agricultural ecosytems;

That ecology would be involved mainly in protecting rare species in danger of extinction or in prospecting peculiar environments as far away as possible from man's influence. To this it must be opposed the comprehensive concept of the ecological systems where man is an essential part.

That it would not be necessary to develop a background of ecological research in each region because solutions could be "imported" from the most advanced countries. In fact, in the present it is not even known if or at least how far ecology is a predictive science.

Finally, another mistake is almost being reached because of the determinant impact of the press news coming from the developed countries that the ecology would simply be the antipollution science. Thus it would inevitably be deducted that if pollution is not yet too high or clearly perceived in the less developed countries the ecology itself would not have but a very reduced importance for the country.

As last considerations before the following brief enumeration of the main goals and strategies, it must be stressed once again, both the great complexity and the interaction of the suggested solutions.

Furthermore, it would be naive to pretend that they could solve these environmental problems from their roots.

For this a series of changes should be produced, implying a time scale of at least one or two generations: Changes in the present policies and commercial relationships between the countries; changes in many of their internal social structures; changes in the kind of formation and in the attitudes of the scientists; changes in many national idiosyncrasies. Nevertheless, some critical decisions must be adopted immediately.

FIRST GOAL

Make governments aware about the suitability of the ecological approach to rationalize and even accelerate economic and social development of their country.

STRATEGIES

Produce consistent statements of the scientific community itself of the less developed countries about the environmental situation of its own country or region.

Introduce the ecological input in all of the development agencies and ask for the ecological expertise in specific projects of development.

Create or enlarge the environmental departments in the intergovernmental organizations.

SECOND GOAL

Increase the sensitivity of public opinion about the seriousness and the urgency of the environmental problems of a national, regional, and global character.

STRATEGIES

Publish pamphlets and information booklets with examples taken specifically from local situations.

Promote scientific journalism more in contact with the active scientists of the own country than with the news received from the foreign press agencies.

Introduce ecological education from the elementary schools without neglecting even simple experimental and naturalistic approaches.

Support improvement and up-to-date courses for teachers of both elementary and high schools.

THIRD GOAL

Strengthen the education of specialists in environmental sciences, tending to the selection of persons with a solid modern training, but at the same time able to plan and act with creative originality, attached to regional problems and willing to accept the interdisciplinary job, including sociological and economical approaches.

STRATEGIES

Establish regional centers of environmental sciences and aid the existing institutions so that the major part of the basic activity and training could be carried out in the region itself by specialists that really know the problems of the region.

Provide that all of the stations of a planned global environment monitoring system be used at the same time as training centers.

Introduce university courses of ecology even in the technological facilities—engineering, architecture, et cetera—in the schools of social sciences and economy, in medicine, et cetera.

FOURTH GOAL

Start with integrated, multinational and multidisciplinary research on the structure, function and management by man of the typical ecosystems of these regions.

STRATEGIES

Make easier and support selectively the initiatives of an interdisciplinary character within every university or scientific institution, among universities of a same country and among neighboring countries having similar problems.

Obtain for this pilot research an economic and human input from the developed countries, even when many times it refers to types of ecosystems not present in them.

Test through parallel investigations with a similar methodological approach to what extent the transfer of environmental technology is possible.

Establish a better system for worldwide or regional codification of information about environmental aspects.

FIFTH GOAL

Coordinate with realism and with sincerity the environmental programs that are arising at different levels and by diverse organizations, avoiding duplication, friction, competition or antagonism.

STRATEGIES

Promote the holding of joint technical meetings at governmental and nongovernmental levels.

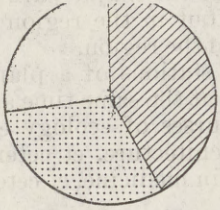
Concentrate in only one national committee the coordination of the environmental programs, even if they are of different origin.

Assure the input of the scientific community in all intergovernmental meetings on environmental problems.

Favor communication between the environmental scientists of the less developed countries of Africa, Asia, and Latin America, because it is among these regions that the major overlapping of similar ecological, social, and economic problems exists as do the major commonness of strategies. In other words, to increase in these countries scientific communications in a west-to-east sense, as opposed to the present almost exclusively north to south sense. This strategy would also be of great importance for reaching the third and fourth goal.

Thank you.

(Figures 1 and 2 follow.)



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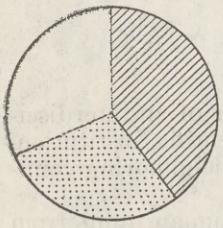
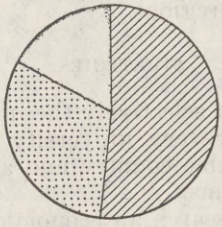
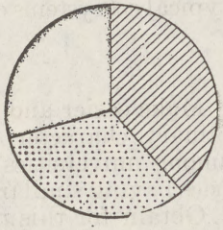


LATIN AMERICA



AFRICA



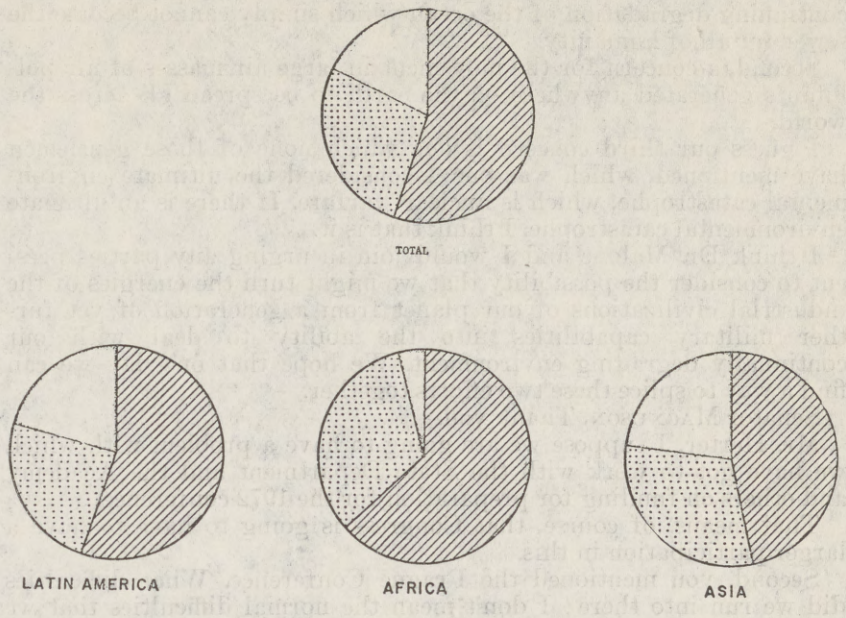
ASIA

Management of ecosystems

Control of human population

Pollution

Weighed Data



Dr. MALONE. Thank you, Professor di Castri.

In the true spirit of the colloquium, we will now have a discussion period which will terminate promptly at 12:30.

I think it is only proper that the first chance at questions go to our two distinguished cochairmen, Senator Magnuson and Congressman Miller.

DISCUSSION

Senator MAGNUSON. Dr. Handler, could I ask you if you could tell this group what is the position of the National Academy of Sciences on this matter?

Dr. HANDLER. As point of fact, the gentleman twice removed from you on our left is our principal exponent of these matters.

We in the Academy have deep concern for the continuing deterioration of the environment. We are particularly concerned in the international sense with a series of developments, one of those mentioned very clearly by Mr. Herter, namely, the consequences of

continuing degradation of the ocean which simply cannot become the sewer for all of humanity.

Second, a concern for the movement in large air masses of air pollutants generated anywhere on the earth to be spread all across the world.

I guess our third concern is one which none of these gentlemen have mentioned, which was one I considered the ultimate environmental catastrophe, which is nuclear warfare. If there is an ultimate environmental catastrophe, I think that is it.

I think Dr. Malone and I would join in urging any parties present to consider the possibility that we might turn the energies of the industrial civilizations of our planet from a generation of yet further military capabilities into the ability to deal with our continually degrading environment. We hope that one day we can find a way to splice these two efforts together.

Senator MAGNUSON. Thank you.

Mr. Herter, I suppose we are going to have a problem with which we have got to work with the State Department and the Academy and others on funding for preparation for the 1972 conference.

That means, of course, that Congress is going to have to have a larger participation in this.

Second, you mentioned the Prague Conference. What difficulties did we run into there? I don't mean the normal difficulties that we anticipated.

Mr. HERTER. If I may try to answer your two questions, Senator Magnuson.

First, with respect to the funding, in connection with our preparations for basic papers, we are asking the interagency groups to estimate the funding that would be required to actually carry out a program. This financial exercise, which is part of the preparatory process, is being reviewed with the Bureau of Management and Budget. So, we would hope, sir, within the next month to have a fair idea of what we think at least the U.S. contribution is going to cost. This, of course, we will discuss immediately with Members of Congress. But the figures are not yet fully developed, because in some cases the programs still have some work to be done on them.

Now, with respect to Prague, all I can say is that as you well know, and this is just a matter of history, the Prague Conference was reduced to a symposium over the issue of the participation of the German Democratic Republic. We don't know what effect this continuing effort to give international status to the German Democratic Republic will have with respect to Stockholm. I think the most hopeful thing I can say is we pray that this matter will be resolved between West Germany and East Germany in terms of their own policies by the time of Stockholm, so we are not faced with this problem that is the central issue, and very nearly wrecked the Prague Conference. It was resuscitated, and, as I mentioned earlier, Senator Magnuson, after 5 days of discussion, was not terribly profitable from a substantive point of view, but extremely useful from a political point of view.

Everything seemed to go well and there seemed to be real harmony and a desire to proceed.

Senator MAGNUSON. I have one quick comment that relates to Mr. Walker's testimony. We are embarked in this country, as you know, on a pretty stringent program on the biggest air polluter there is, the automobile, and we are hopeful that England and the other places in the world can achieve some standards that are basically similar to ours.

It has been a difficult job for us to do it. In this country, conservatively 63 percent of the air pollution around the United States is from the automobile. I think we are making some progress, but it will be good looking at this whole world environmental situation if we could have some basic international guidelines on exhaust from automobiles.

This is one of the things that we have got to overcome and convince people.

Mr. Walker's statement is in the record, and I don't know that England is doing as much as it should along these lines yet, but they will.

Dr. di Castri made an excellent statement, and I think that a major problem in the South American countries has been the use of pesticides. This is something we have got to take a good long look at when we get to these meetings. I think your statement is excellent.

I thank you.

Mr. MILLER. I only have a question for Secretary Herter.

The press reports indicate that the recent NATO meeting failed to reach agreement on ocean dumping. To what extent is the lack of scientific information a barrier to making these political decisions?

Mr. HERTER. I think I can reply as follows, Congressman Miller. They did reach agreement in NATO. It was not the agreement that was originally contemplated, which set a firm deadline for 1975 on the prohibition of all oil spills intentionally—oil spills and oily waste.

Through the pressure and the negotiations that inevitably take place in an international group of this kind, it was finally agreed that it would be by 1975, if possible, at the latest 1980. But it seems to me, Congressman, you put your finger on a very important point here, which is that it is very difficult to persuade a number of countries that normal spillage—cleaning of tanks, this kind of thing—in the ocean produced a very serious threat in terms of the total ocean. And at that particular meeting, which I didn't personally attend, I am told a certain amount of scientific information was produced by experts pointing out the hazards to marine life of oil pollution. But it was perfectly clear that more scientific information and research on this subject was required, and the lack of it made the political process the more difficult.

Mr. MILLER. Isn't it true that a lack of this information and the necessity for it is one of the great handicaps that we have in not only getting international cooperation but getting cooperation within our own country on these problems, that a lot of people do not quite comprehend or understand?

I remember some years ago when the AEC issued a statement and a program as to the dumping of atomic waste into the Atlantic Ocean. I held very extensive hearings on this. They never issued a

program for dumping of waste in the Pacific Ocean because by that time the people were pretty well alerted to the situation and they decided that they would not go ahead with this dumping. This is a very serious problem.

Talking about dumping some of this waste, the Japanese did not have the facilities, but they contracted an organization to make some studies for them, and they found in the areas of water in which they were going to dump this waste, it would bring the pollutants right to the surface.

Mr. HERTER. This is a very serious problem—the question of the disposal of radioactive waste. Even though the United States prohibits the disposal of these wastes at sea, it is not as easy a solution for other countries as it is for us in that we have certain areas in the Kansas salt mines where radioactive wastes can be disposed of with very little risk of danger.

The British and the Japanese really have no alternative at this point except to use the sea, and they haven't found a suitable alternative. There isn't land space enough for them to dispose of these wastes on land. This is a problem that is being worked on scientifically, but it is a very tough one.

Mr. MILLER. It is a very rough program. I have always been concerned with perhaps the dumping of atomic waste in the North Sea, because the Gulf Stream heats up the North Sea and makes it possible for the people who live in the northern climates on the eastern seaboard to exist. But there is a countercurrent that comes back under the Gulf Stream, and could it not carry the atomic wastes up into the northern part of the Atlantic and carry them back?

Mr. HERTER. I don't know the answer to this. Perhaps Mr. Strong does. I don't know enough about the physical setup of the North Sea to know how this would work out. As you know, a group of Nordic countries recently passed a resolution prohibiting the dumping of certain chemical compounds, radioactive wastes, and other harmful substances anywhere, in any sea whatsoever, but it focused heavily on the North Sea, and this is the beginning of what you might call a regional regime on the North Sea.

Mr. MILLER. I think this is highly desirable. My own knowledge is quite limited, but I have had some very excellent tutors.

When you dump anyplace in the ocean, it may seem remote, but eventually it is very close; the current that runs counter to the surface current in the Pacific comes back. So I think we have to do a lot of work, and I hope that we can get on with it internationally, eventually finding some of the answers, so that in our effort to sometimes help our neighbors we won't be hurting them.

Mr. HERTER. Perhaps Dr. Malone could comment intelligently on this particular problem.

Dr. MALONE. This is a very important problem, of course.

Senator MAGNUSON. Mr. Strong, one more question.

I understand that Dr. Dubos has been selected to gather a lot of data for the conference; is that correct?

Mr. STRONG. Dr. Dubos has agreed to help in the task of assembling a group of some 100, more or less, of the world's leading scientific and intellectual people who will in turn assist in presenting a

report on the state of the world's environment to the peoples and the governments of the world to provide a conceptual basis within which they can look at and better understand the particular problems that we will be dealing with at Stockholm.

Senator MAGNUSON. And possibly sort out, which I am sure exists, a great number of areas of agreement rather than focus on the areas of disagreement?

Mr. STRONG. I think this is the important thing, Senator, that we need to understand those areas in which there exists a sufficient degree of consensus in the scientific community to permit us to act, and it is equally important that we understand those areas in which such consensus does not exist.

Senator MAGNUSON. And we have to see that he has sufficient help and funding to do it.

Dr. MALONE. I wonder if we might take advantage of Mr. Strong's presence to see what might come out of this potentially very important declaration on the environment.

In our country, section 102 of our National Environmental Policy Act says that large-scale undertakings shall be assessed for their environmental impact before they are initiated has had a profound influence. Do you envision agreement in principle on this kind of thing possibly being included in the declaration, or is that going too far?

Mr. STRONG. Mr. Chairman, I think we are confronted here obviously with the rather new situation in which we need new principles of law and new principles of behavior in the conduct of international affairs, and I hope that the declaration will permit us to at least try some of these important principles. Governments are now working on this through the intergovernmental working group that has been established, and it would be premature for me to say what will be in it. But I do think if I read correctly, that the trend that seems to be developing in that work is certainly going to consider the very important and basic question of recognizing that no state should take actions even within its jurisdiction which materially impair the environment and the welfare of other states. That itself is a very, very important principle which has to provide us with one of the basic building blocks on which a new system of international environmental law can then follow.

There are a number of other principles. For example, I hope that consideration will be given to the possibility of recognizing that some 70 percent of the world's biosphere is in fact beyond the jurisdiction of any nation, and therefore must be accepted as a common global responsibility and principles and mechanisms must be established to provide for collective international management of that part of the biosphere.

I think there are many other principles, and I hope we will move a substantial degree towards the international recognition of those principles in the declaration.

Dr. MALONE. Could I ask one more question, Mr. Strong, since you are close to these things.

We heard eloquent testimony from Professor di Castri of the interest of the scientific community in the developing countries in this

problem and of their keen appreciation. One hears on the other hand we want a little bit of pollution because it is a sign of economic development. What is your sense of the possibility that this Conference might fall short of its full potential because of apathy or indifference on the part of the developing countries?

Are you concerned or reassured on this score? You speak with reassurance, but it is a rather important issue it seems to me how the 70 or 80 countries that fall into the less-developed-countries class will respond to this particular conference.

Would you feel free to comment?

Mr. STRONG. Certainly a good deal of my work in the last number of years before I undertook this thing was, of course, related to direct and intimate cooperation with the developing world. In fact, a good deal of my time since taking on this job has been spent in traveling through the developing world, in trying to understand in each of the regions the ways in which they perceive their concerns, and the kind of interest that they have in the Stockholm Conference. It is true that the word "environment," which after all is a pretty new word in our own sphere of public affairs and public attention—that the word "environment" doesn't really carry a great deal of magic. But when you get to the levels of the issues—when you get to the levels of the problems of managing human set limits—the problems of managing their basic environmental resources which constitute the natural capital basis from which their whole development process has to flow—even when you talk about pollutants, nobody wants pollutants. Obviously, when they are faced with a choice of industry with pollution versus no industry, they would make the same choices that we would make and have made under those conditions.

It isn't true that the developing countries want pollution. It is true that it is only one of many problems that they have. Their basic problems are problems of underdevelopment. But I do think that there is a deep interest on the part of the developing countries in the actual issues themselves, and I think that there is no question that as a result of these regional meetings where they will be talking about their issues, they will be talking about the particular parts of our Stockholm agenda that most interest them on a regional basis, and they will be bringing their regional views to bear on the global problems.

I don't think there is any question they are going to be there at Stockholm, they are going to be interested, and I really believe frankly that the developing countries are going to be far less of a problem in many ways than the industrialized countries.

After all, the really hard choices have to be made by the industrialized countries. They are the people that have got to change some of their attitudes, change some of their priorities. I think it is too easy to fall into the habit of believing that all the problems are with the developing countries. The real hard adjustments are going to have to be made in the industrialized countries.

Mr. MILLER. Doctor, as a matter of fact, you are just starting; this can go on and grow with time; but we have to start someplace, isn't this true? We can't expect perfection overnight.

Mr. STRONG. Absolutely. There is no question that Stockholm is simply a beginning of the global process of determining what we

need to do and setting into motion the first steps in actually dealing with the problem.

In the developing world, development is the problem, and environment has to be seen in that context.

Senator MAGNUSON. Mr. Chairman, may I interrupt just a minute? I have two distinguished Americans here who have been on the floor of the Senate voting about every 20 minutes, but they were both cosponsors of this concept of a World Environmental Institute, and I just wanted to introduce them to you.

Senator Humphrey and Senator Scott.

They have been long advocates of doing something about world environment. On the way over, they promised me, Mr. Secretary, they would give us great support on this matter. We have here some distinguished scientists from all over the world, and we are making some progress.

I know they are glad to join with us in this effort. Do you have anything to say about it?

Senator HUMPHREY. Senator Magnuson and Congressman Miller, may I first of all congratulate the Senate and the House, the House Science and Astronautics Committee and the Senate Commerce Committee, on this colloquium that you are having.

I think it is a splendid development and surely to be commended.

Last evening we gathered at the Smithsonian Institution for a meeting under the sponsorship of the Woodrow Wilson International Center for Scholars. Senator Scott and I were the co-hosts and we were privileged to have some of you there.

Dr. Rene Dubos was with us, Maurice Strong was with us, and we had a splendid visit and talk there last evening. I will just say the whole work of the Woodrow Wilson International Center for Scholars is centered around two areas of endeavor in scholarship: One, a study of the oceans, of which Senator Magnuson was the leader in the Senate on the whole subject of marine sciences, and which I took up at his command when I was Vice President, to be Chairman of the Marine Sciences Council. The second area is in the environment. Because of those two areas, we are in close cooperation with these committees of the Congress and indeed with the United Nations activity, with Mr. Strong, and others.

I likewise suggested in a resolution recently that we needed a preparatory conference in the United States to prepare ourselves for the kind of participation that we ought to make at Stockholm in June 1972, and I would hope that we might have such a conference.

Of course, this is a preliminary one in a very real sense, but a total national conference is needed to get our house in order, because of the great impact that our country has upon the environment.

Other than that, I just want to commend you and say how pleased we are that you are here. Thank you for your guidance. We always get a transcript, not of these remarks of mine—that is unimportant—but of the important things that important people say about these subject matters.

Senator SCOTT. Congressman Miller, Senator Magnuson, ladies and gentlemen.

As usual, Senator Humphrey has said everything. But I do feel, in succeeding Senator McCarthy and returning to the Senate, where

we are so pleased to have him, he has improved the environment by his presence.

We are delighted to see your efforts, and I was most interested to hear Secretary-General Maurice Strong last night and Rene Dubos. I know your work is desirable, and I hope it would receive very widespread attention. We are delighted to be here.

Dr. MALONE. Mr. Congressman, I think we should open this up to the audience, in case there are some questions that some of the audience would like to put.

Mr. PLANET. With the increasing population that we are looking forward to and also the increasing per capita energy consumption, we are going to run into a problem of energy supply and demand.

What thought has been given to the ever-increasing amounts of energy that will be needed?

Dr. MALONE. Who wants to take the question of how we are going to generate the energy needed and still preserve the quality of the environment?

What is your name?

Mr. PLANET. My name is Walter Planet. I am with the Senate Public Works Committee.

Mr. HERTER. Mr. Chairman, I can try to answer that. There is a great deal of thought being given to the energy problem. It is on the agenda at Stockholm. It is obviously a very severe problem, and, as you know, even in the United States our energy requirements are doubling every 10 years. We have seen already in such places as New York and elsewhere the conflict between the necessity or the desire of the public to have energy in whatever form it takes to improve the standard of living, and the desire of the environmentalists not to have the countryside despoiled and degraded by major plants, be they fossil fuel, atomic energy, or whatever.

There is a particularly acute problem of this kind in the so-called Four Corners of New Mexico, Arizona, Utah, and Colorado at the present time. I don't know that there is any ready answer except to hope that those scientists—and this is an international pursuit—that are trying to develop controlled fusion are successful as soon as possible.

It still would be the end of the century, I guess, Dr. Malone, but if we can get controlled fusion, it will be a source of energy of almost unlimited nature with virtually no environmental consequences whatsoever.

Is that correct?

Dr. MALONE. Yes, and the implications, of course, are very profound. Are there other questions that you would like to put to the panelists?

SUMMARY REMARKS

Dr. MALONE. If not, we are approaching the hour of closing, and these impressions remain with me: First, the Stockholm Conference is a highlight rather than end in itself, as Mr. Strong pointed out.

Second, we share with Mr. Strong and Mr. Herter the responsibility to see that this activity succeeds. We have Senator Baker's advisory committee to the Secretary of State for the citizens. We have a

group in the National Academy for the scientists. We have the intergovernmental working groups for the government people. We all must participate.

Third, we must all be persuaded of the importance of the flow of information across geographical boundaries, across sectoral boundaries, nongovernmental and intergovernment—points that Mr. Train stressed so strongly. The need for this to take place freely, so that we do not run the risk of wasteful duplication, is very important.

Fourth, I concluded that the point had been made very clearly that the environment is much more than pollution. It is resource utilization, it is human settlements—that brings a whole new dimension to the interest of the developing countries in this matter.

Fifth, listening to these experts, I would conclude that the prerequisites for coming to grips with the environmental issue are three: (*a*) Knowledge, (*b*) attitudes or human values, if we will, and we didn't talk too much about human values, and (*c*) institutions. These are the things we have to put in place if we are really going to do something about it.

Sixth, that out of the——

Senator MAGNUSON. Dr. Malone, could I interrupt again?

I want to present to this distinguished group the chairman of the Foreign Relations Committee of the Senate, Senator Fulbright, who has a lot to do with what the future is going to be with respect to what we are talking about.

He wanted to come in and reiterate what he told a lot of you, I understand, last night at the Woodrow Wilson Center dinner.

Senator FULBRIGHT. I am very pleased to be here.

Senator Magnuson said you were having a meeting. We had a meeting and heard Dr. Dubos and Mr. Strong speak last night at the Woodrow Wilson Center, and a number of others were there who were interested in this matter.

I don't think there is any question about the need for much greater attention to our environment. That is not the controversy. The controversy is how to get it done, if we can possibly stop destroying it as we are in Asia, in order to give this kind of an activity an opportunity to be funded—that is one of our pressing problems.

I know that you have a great many interesting views, and we will be very glad to hear what you have to say when this comes before the Foreign Relations Committee.

Dr. MALONE. In concluding, I would simply say that the impression remains with me that the Stockholm Conference can be a turning point in the affairs of mankind: that a meaningful change can be developed there; if an environmental monitoring system is put in place—at least in rudimentary fashion; if there is a policymaking mechanism established in the United Nations free from the kind of operational responsibility that Mr. Strong warned about in his list of guiding principles; if there is an array of knowledge—generating mechanisms established, both regional and perhaps of a kind that Senator Magnuson has been talking about; if a kind of world heritage foundation is established; if the issues of economic development and environmental quality are met head on; if agreement is reached that this is so important that we need to designate an interval of time

down in the future when we replicate the galvanizing effect of the International Geophysical Year and set aside an interval during which we bring to bear on the problems of the human environment, the new institutions, the new knowledge, and the new tools that we now have within reach.

Finally, I would say that there was an expression of optimism. It was very encouraging to hear that from Mr. Walker. I would try and capture the sense of his statement by citing the opening lines in Pierre Teilhard de Chardin's book, "Building the Earth." He said, "There is now incontrovertible evidence that mankind is just entering upon the greatest period of change the world has ever known," and he went on to recite the response that we should make to this great change. He concluded with these words: "No matter what reaction we may have to current events, we ought, first, to reaffirm a robust faith in the destiny of man."

And that is precisely what we are about. We will reconvene tomorrow morning at 10 o'clock.

Congress Miller, do you have any closing words?

Mr. MILLER. No, other than I want to thank you all, and tell you you have lived up to our finest expectations, and we hope that this is merely the beginning of a series of these meetings so that we can keep this matter before the public.

Senator MAGNUSON. May I present the Senator from Massachusetts, who was one of the cosponsors of the resolution and strongly supported it. He hopes that we can make any move we can toward doing what we hope to do, and which Mr. Herter has told us we are going to do that.

I want to introduce the distinguished Senator from Massachusetts, Senator Kennedy.

Senator KENNEDY. You are very kind.

I just received a short time ago the notice of this meeting, and I, of course, as Senator Magnuson has pointed out, have been a strong believer and a firm supporter of what is the purpose of this kind of meeting. I think it is of great urgency and great importance.

All of you who represent so many different countries I know speak for your constituents, but I can just say, as I know Mr. Herter has, that there is just a tremendous interest in the kinds of efforts that are being made by this group and tremendous hope of its promise. I just want to enter my voice as a very strong supporter. I know there are still many difficult problems to overcome.

You are looking forward to meetings at Stockholm later—a year from now—and I want to offer any support I can give as you approach this terribly urgent work for all the nations of the world.

I want to pay my respects and applaud these efforts and let you know that I hope you are able to work under the distinguished chairman's leadership.

Senator Magnuson has been interested for so many years and has guided us so many years on these matters, and many others, the SST and other things. [Laughter.]

Senator MAGNUSON. I can't win them all.

Mr. MILLER. I hope we can adjourn.

(Whereupon, at 12:40 p.m., the hearing was adjourned, to reconvene at 10 a.m., Wednesday, May 26, 1971.)

JOINT COLLOQUIUM ON INTERNATIONAL ENVIRONMENTAL SCIENCE

WEDNESDAY, MAY 26, 1971

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

The joint committee reconvened at 10:10 a.m., in room S-228, the Old Supreme Court Chamber, U.S. Capitol.

Present: Senator Magnuson (chairman, Committee on Commerce); and Representative George Miller (chairman, Committee on Science and Astronautics), Hechler, John Davis, Fuqua, James Fulton, Camp, Gude, and Hungate.

Mr. MILLER. The meeting will be in order.

Senator Magnuson will be here shortly, he is detained. The Senate is very busy these days, but he will be in any minute. In the meantime in the interest of time I will call the session to order.

I want to congratulate you on the very fine papers read yesterday. I think we got off to a very good start.

We will now turn the meeting back to Dr. Malone.

STATEMENT OF DR. THOMAS F. MALONE, VICE PRESIDENT, INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS, RAPPORTEUR FOR THE COLLOQUIUM

Dr. MALONE. I believe it is fair to say that our panelists yesterday sketched in bold strokes the framework within which concern about the world-over environmental issue is mounting and some of the measures that are underway to meet those issues.

In keeping with the international theme of this colloquium, we have speakers from four different countries this morning. They are going to probe deeper into the several aspects of this overall issue that we were exploring yesterday.

Last August I had the opportunity to visit Singapore, and I was told if I really wanted to know what was going on in the environmental area there, there was one man to see, and that was the Permanent Secretary of the Ministry of Education. I did have the pleasure of visiting with him, and the opportunity to see the splendid overall total program that Singapore has developed. I can say without qualification that it is probably one of the most advanced anywhere in the world. It is a model that any country might well emulate.

This morning we are going to have the privilege of listening to the Permanent Secretary of the Ministry of Education, Mr. Kwan Sai Kheong, describe something about what is going on in Singapore.

I say welcome, Mr. Kwan, and please proceed.

STATEMENT OF KWAN SAI KHEONG, PERMANENT SECRETARY, MINISTRY OF EDUCATION, REPUBLIC OF SINGAPORE

Mr. KWAN. Senator Magnuson, Congressman Miller, Dr. Malone, distinguished participants.

I deem it a great privilege to have been invited to address this distinguished forum, particularly as I possess no credentials whatsoever as an environmental scientist. My involvement in environmental matters is, at best, a peripheral one, and what little contribution I can make to this colloquium consists mainly of data gathered by my colleagues back home who are specialists in various related fields. I shall try to piece the information together to give you a brief account of what we are doing and planning to do to protect our environment. I shall also report briefly on my Government's proposal to create a regional body to solve environmental problems on a regional basis in Southeast Asia.

For a better understanding of our problems, I shall first present some vital statistics of Singapore. We are a nation of 2.1 million people living on an island of 225 square miles situated 85 miles north of the Equator at the tip of the Malay Peninusla. We have no natural resources of any kind, except perhaps our geographical location which has made our city a great port and a center of trade and communications. We have for a long time depended on entrepôt trade for a living, but in recent years we have begun to industrialize on a modest scale, and with modest success. Our economy has a large service sector providing banking, transportation, and communication services. We are a multiracial and multilingual society. About 75 percent of the population are Singapore-born and 50 percent are under 20 years of age. We have enjoyed political stability over a long period and this has been the major factor contributing to our economic growth and social progress.

Singapore's main environmental problems arise from the scarcity of land, incompatible land use, and serious overcrowding in the city center. Whilst other cities can expand into the suburbs, Singapore can grow only by reclaiming land from the sea. We have been doing this for several years now, and to date we have added some 1,500 acres of reclaimed land, mainly on the east coast of the island. When completed, the reclamation scheme will yield another 1,200 acres for development.

Incompatible land use and the consequential difficulties in waste disposal are the result of inadequate town planning which was not given proper attention until the late fifties. Even today we can find iron foundries, metal workshops, sawmills, and warehouses side by side with residential and commercial premises. The problem is aggravated by pockets of slums on the island, which developed mainly after the Second World War. In the city center there are also many

dilapidated houses over 100 years old which are still used for living accommodations under extremely congested conditions, with inadequate facilities for cooking, cleaning and waste disposal, lack of ventilation, lack of privacy, and lack of social amenities. These slums constitute a health hazard and a pollution problem of no mean proportions.

We have tried to solve these problems by a massive program of urban renewal and the building of low-cost housing. Under the urban renewal program, bold measures have been taken during the past 6 years to improve an area of approximately 1,700 acres in the heart of the city. Old buildings have been demolished, and small plots of land have been combined into larger plots for comprehensive development, including the provision of new roads, car-parking stations, pedestrian promenades, and other essential amenities. The urban renewal program forms part of the master plan for Singapore under the planning ordinance which came into force in February 1960. In 1967, a state and city planning office was set up in the Ministry of National Development with the responsibility for comprehensive, long-term metropolitan planning, with assistance from UNDP, a 4-year project costing the United States $5 million was undertaken to develop alternative long-range comprehensive concept plans for selection by the Government. These plans, which cover the physical development of Singapore up to the turn of the 21st century, are sufficiently detailed to enable short-term investment decisions to be made.

Some features of this SCP plan which have a bearing on improving and protecting the environment include a comprehensive road system and transportation policy; the provision of a mass rapid transit system fully related to the type and intensity of land use to achieve a more balanced distribution and freer flow of traffic; the conservation of a recently extended water-catchment area to prevent contamination through urban development; the grouping of industrial development, particularly heavy industry, well far away from residential areas; and the construction of a second international airport on the eastern tip of the island, where aircraft would take off and land over the sea, thus minimizing the noise problem. The SCP plan was completed only a few months ago and is currently being studied by the Singapore Government.

Our urban renewal program could not have been implemented without a public housing program to provide alternative accommodations for people evicted from substandard housing in areas designated for urban renewal. When the present government took office in 1959, a new housing and development board was established to replace the former Singapore Improvement Trust, with considerably more funds and legal powers to deal with public housing on a massive scale. When the board began its task in 1960, it was estimated that one-quarter million people were living in slums and another one-third million were squattters who urgently needed rehousing.

By June 1970, the board had built a total of 110,719 flats and shops, housing approximately one-third of the entire population of Singapore. A third 5-year program has now been launched, calling for the construction of another 102,000 flats by 1975. Eventually it is

estimated that up to 50 percent of the population will be living in public housing.

Early this year, my Government passed legislation to curb pollution of Singapore's limited water resources. The law prohibits the discharge of any trade effluent into a watercourse without prior treatment to the satisfaction of the Commissioner of Public Health. Similar legislation is being drafted to prevent pollution of the air.

In waste disposal, the Government has spent some $80 million over the past 10 years in expanding the island's sewerage system, which at present caters to about 63 percent of the population. By spending another $10 million a year for the next 10 years, Singapore will have extended the sewerage to cover the whole island. For the disposal of solid waste, the Government is actively studying incineration as an alternative to the present system of tipping refuse into swampland. As for pollution of the sea, various preventive measures have been introduced but the threat remains of a massive oil spill resulting from the collision or stranding of large tankers in the narrow waters of the Singapore-Malacca Straits. This problem would require solution at regional or international level.

Of all the measures which will contribute to a better environment in Singapore, perhaps the most important of all, from a long-term point of view, is our family planning program. Like most developing countries after the Second World War, Singapore experienced a very high natural rate of population increase, averaging 3.5 percent between 1947 and 1957. However, since 1957 there has been an accelerated decline of the birth rate from 42.7 to 20.5 in 1970. Simultaneously, the death rate has declined from 7.4 in 1957 to 5.0 in 1970. The net result is that the natural population growth rate has declined by 60 percent within a period of 13 years, from 3.5 in 1957 to 1.5 in 1970.

This achievement was mainly the work of the Singapore Family Planning and Population Board which was established at the end of 1965 with a 5-year program aimed at reaching 180,000 or 60 percent of the eligible married women in the age group 15–44, so as to lower the crude birth rate of 32 in 1964 to 20 in 1970. Both these targets have now been achieved.

Besides the provision of family planning services in a large number of Government clinics, certain changes in social policy have contributed to the success of the family planning program.

The Employment Act provides that women employees will not be entitled to maternity leave for more than 3 pregnancies. Hospital charges for the fourth and subsequent pregnancies have been increased fivefold to discourage couples from having large families. Instead of giving priority to large families in the allocation of public housing, the Housing Board now considers young married couples without children as equally eligible tenants.

Finally, let me turn to a proposal initiated by my Government to set up a regional body to deal with environmental problems in Southeast Asia on a regional basis. This body, which may be named the Environmental Control Organization (ECO) or the Regional Environmental Protection Agency (REPA) is to be established as an independent, autonomous regional organization in Singapore by

an act of Parliament or under some appropriate existing legislation with the objective of mobilizing the resources of countries in Southeast Asia and seeking the cooperation and assistance of other countries, international agencies, industrial undertakings, and commercial enterprises in a concerted effort to safeguard and improve the quality of the environment in member countries of the organization and in the region as a whole.

The policy of the organization will, of course, be determined by a governing board with regional representation, but it is envisaged that the functions of the organization will include the monitoring of indices of environmental quality in the region, the identification of major problems calling for regional action, the provision of resources and manpower to plan and operate regional programs to protect the environment, and the promotion of national and regional facilities to train personnel for environmental management.

This proposal can be implemented only if countries in Southeast Asia are prepared to join the organization and if other countries and international agencies are prepared to give the organization their support and assistance.

In response to Singapore's preliminary sounding of prospective member countries, so far only one Southeast Asian country has expressed positive and enthusiastic support. We are hopeful, however, that when the objectives of the organization are more widely known further support will be forthcoming. I personally have no doubt that the proposed organizations will be an effective agency for insuring that Southeast Asia shall be fit for man to live and work in.

Thank you, sir.

Dr. MALONE. Thank you very much, Mr. Kwan, for the very exciting account of the progress that has been made in the Republic of Singapore.

Our next speaker is well known throughout the world and is prominent in the United Nations as chairman of the U.S. National Committee for the International Biological Program; enducated at the University of Michigan where he spent several years of his early professional career. He is now at the University of Texas and is probably the best informed ecologist-biologist in Latin America and the United States.

This morning we are going to hear something from Dr. W. Frank Blair, who is going to transcend our national boundaries and embrace a large part of the Western Hemisphere.

Senator MAGNUSON. Before Dr. Blair begins, could I ask one quick question of the Secretary?

Dr. MALONE. Certainly.

Senator MAGNUSON. What is the main source of your energy in Singapore—Oil?

Mr. KWAN. We use oil.

Senator MAGNUSON. Does that pose any air problem to you?

Mr. KWAN. Not too much at present, sir, but we are an island and we have the sea breeze.

Senator MAGNUSON. And do you have oil around the area?

Mr. KWAN. We don't have oil around the area, but we have many refineries and storage tanks. We have many big oil companies having their oil refined there and in the surrounding islands.

Senator MAGNUSON. You must have some new ideas and innovations in relation to one of the serious problems in all of Asia, sewage and sanitation. We hope later on you might make a contribution to this record by telling us what you are doing in a new area where you can start fresh. I think this is vitally important. We don't have so many new areas left where we can do that, but many other countries, particularly yours, do.

Mr. FULTON. Mr. Chairman, I have a question, too. When I was in Singapore some time ago, I noticed the polluted waters surrounding Singapore because of the concentration of shipping. What have you done on water pollution due to discharges from ships and the ordinary boats of which there seemed to be a large volume?

Mr. KWAN. Sir, that responsibility lies with the Port of Singapore Authority. They have their own little antipollution unit.

Mr. FULTON. The question is what results have you obtained?

Mr. KWAN. I think by and large we have managed to keep the sea fairly clean. I don't think pollution of the seas immediately surrounding Singapore is a major problem.

Mr. FULTON. As clean as the Potomac River, which it is not?

Mr. KWAN. I am afraid I am not very familiar with the Potomac River.

Senator MAGNUSON. It seems to me that the whole world is going to be short on energy sources within the next 5 to 10 years, and we are going to have to turn to atomic energy. I think one of the things that probably could be done at the meeting in Stockholm is to see if everyone couldn't arrive at some basic guidelines on the uses of atomic energy throughout the world for power purposes. It would seem to me that would be one subject we could pretty well get some areas of agreement on as to guidelines. That is the reason I asked the question.

Mr. FULTON. That is a very good point.

STATEMENT OF DR. W. FRANK BLAIR, CHAIRMAN, U.S. NATIONAL COMMITTEE, INTERNATIONAL BIOLOGICAL PROGRAM

Mr. BLAIR. Chairman Miller, Senator Magnuson, and honorable Members of the Congress, ladies and gentlemen. It gives me an enormous amount of pleasure to be here today to participate in this symposium. A further pleasure comes from participating with Chairman Miller, whom we regard as somewhat of a godfather along with his committee, for the International Biological Program efforts in the United States.

I think that the efforts they made to bring this program to the attention of the Congress and the public a few years ago were very instrumental in the success that we have had in the International Biological Program. So, I particularly enjoy participating here with the chairman.

I would like to put my remarks this morning in the context of the spaceship concept of the world which now is a pretty well-accepted concept, and I would like to point out two aspects of this spacecraft we are riding that I think are pertinent to the following discussion.

One, of course, is the enormous complexity of the interrela-

tionships of the functions and events that take place on this spaceship. We have come to recognize the fact that perturbations of this system have effects in fantastically distant parts of the system.

Second, in keeping with this concept of the spaceship earth, we must recognize the fact that the resources of this planet are absolutely finite. I think all of our considerations must take into account these two facts: the interrelatedness of events and the finiteness of the world's resources.

This being the case, looking at the spaceship from the viewpoint of one of the so-called developed countries, we must consider that, as world leaders in the ecological science, we have an obligation not only to the other parts of this planet, but to ourselves to do all we can to promote development of competence in environmental science in other countries, in the lesser developed countries. This is not solely in their interest, but also in our own interest, because we are a part of a complex system and one part of the system affects other parts of the system.

Now, I would like to address my remarks, largely, this morning to the part of this planet outside of the United States that I know best. This is Latin America, particularly South America. Perhaps, when one says South America, if you have not been there, you tend to think of a uniform area. Such is far from the case.

Now I would like to emphasize the ecological diversity that must be taken into account when one starts thinking about the rational development and management of the resources of this vast continent to the south of us.

I do feel that I have some competence to speak in terms of the needs and in terms of the present competence of the Latin American countries to solve their own problems without assistance from others. It may be presumptive to say this with my good friend, Dr. di Castri, across the way from me, but since he and I have worked very closely together, I think he will probably agree with most of what I say, and if he doesn't, I am sure he will say so.

Actually, if we think in terms of trying to manage the environment in South America, we have to think in terms of three huge ecological divisions. There are subdivisions of these, but basically we think in terms of three huge regions. One of these is the tremendous area of tropical forest in the basin of the Amazon and Orinoco, with patches elsewhere. This is the largest area of tropical forest in the world. It has probably felt less of man's impact so far than any other comparable area of the world.

Because of this and because of its lushness in terms of production of organic materials, the tropical forest, and especially the neotropical forest, is the continual target of schemes for exploitation. Yet, it is one of the ecological systems of the world about which we know probably the least. There is not time to go into the details, but there are peculiar features of the tropical forest such as its enormous biological diversity and its complexity as an ecological system.

What we do know is that if you destroy the tropical forest you have upset a very complex ecological system that does not quickly recover. Consequently, many efforts to develop agriculture in the tropical forest lands have been failures. Yet we have very little sci-

entific knowledge of the tropical forest as a system. In fact, one quotation that I picked up points out that there are 10 experiment stations in all of the Amazon tropical forest area, and these have each essentially one scientist with at least a high school education.

This is the kind of competence we have in managing this huge forest. I think one of the greatest challenges to the ecologists of the New World is the development of the knowledge, the know-how to develop the tropical forest without destroying it.

The second area is the Andean Highlands. It is an area which in pre-Columbian days supported more of the indigenous population than all the remaining area of South America combined. It is a very harsh area. We know how man uses the environment there. It would be a logical place in which social scientists and hard scientists could get together to look at man interacting with his environment and to produce knowledge for the better use of that system.

The third area is the very large area of drylands in southern and eastern South America, the "monte" and "chaco" of Argentina, the "cerrado" and "caatinga" in Brazil. Rainfall is deficient. There are great pressures, particularly in Argentina, to develop this land to take care of the needs of their growing population. Here man has interacted greatly with the environment, particularly through using goats as a domesticated animal, and there are tremendous effects.

These are the three major areas that need to be looked at in terms of how they can be best managed and best developed without making the mistakes that most of the developed countries have made in their past history. I think it is an obligation of the developed countries to point out their own mistakes as exemplary of what not to do and to interact with these countries as they develop.

Now, what are the capabilities of the South American countries to solve their own problems? I should expand here a bit on what I mean by capabilities. I am thinking in terms of the kind of sophisticated, multidisciplinary studies that we have found successful in the International Biological Program, particularly here in the United States, where we look at the whole ecological system, with many participants, and with the ultimate objective of a predictive model of that system so it can be used by our decisionmakers in the management process. This is our aim and objective. This is what I mean when I say ecological capabilities.

As Dr. di Castri well knows, we have in Latin America, many scientists who can fit into such a pattern. What we do not find there in very many places is the ability to put all of this together into a sophisticated ecosystem-type study such as we have developed in the International Biological Program.

Actually, there are probably five countries in Latin America that have something on which to build now and which with the proper input from the countries where this kind of technology has developed, where this expertise now exists, could develop their own expertise.

Now, what are we really talking about? What do the less developed countries need, and again I am focusing on the Latin American countries?

I would like to identify quickly five major categories of what I see that needs to be done in the Latin American countries.

First, they need urgently to get the scientific facts about these ecological systems we are talking about in preparation for planning their own resource development and environmental management. In my own opinion, especially in the tropical forest and the drylands, the need is urgent. It is not tomorrow, it was yesterday that we needed this information.

Second, they need to train their own scientists in this kind of ecological science.

They need to disseminate the information to the decisionmakers and to the general public. This is something that Dr. di Castri touched on. I think it is one of the most important items that we can bring into the discussion. The politician, the man who makes the decision in terms of environmental development, in terms of development of the whole social system, must get an interface with the scientists who are generating the information. If this interface cannot be established, the research is really a useless exercise.

There needs to be a much greater communication developed among the Latin scientists and communication between the scientists and the public. One of the enormous needs of the Latin American countries is for something like a Scientific American, just to use an example. There is not the kind of communication of science to the general public that we take for granted here in the United States.

There is a need for communication among scientists, but probably the greatest need is for the translation of science for the general public, particularly environmental science.

Finally, there is need just for an assessment of the biological diversity of Latin America. There are many species of large organisms that are not even known to science. These are important components of ecological systems. Intellectually, to me, it is criminal that these things may become extinct without ever having been described by science.

On the more practical side, these species are components of ecological systems which must be considered in management of the systems.

What are the possible courses of action? My feeling is—and I have spent most of my time preaching this feeling—that taken in the broader context of the world environment, we absolutely must come to some kind of an international arrangement. In the scientific community we have talked about the ICE—"International Center for the Environment," as Tom Malone mentioned yesterday. There is a remarkable parallelism between what the scientists are talking about and the Senate resolution calling for a World Environmental Institute. The two are the same. Whichever acronym you want to use would depend on your preference. They are the same thing.

In my opinion, we have got to come to it. One thing we are shooting for is to have this proposal on the agenda in Stockholm next year, and personally I feel that this might be the most important thing that could conceivably come out of the Stockholm Conference: Actual agreements on an international center. I visualize such a center as built around regional centers; that is, you cannot study the tropical forest in Sweden or you cannot study the Arctic tundra in Argentina. We are going to have to have regional centers, and we need world agreements on how we do this job. My personal feeling

is that it should be done on the basis of a nongovernmental entity, I think blessed by the United Nations. I think this is absolutely necessary, that there be a strong tie to the United Nations. However, for reasons I won't go into here, I think the scientific community of the world should organize and operate ICE as a nongovernmental foundation. I believe that ICE will have to be funded by endowments from member Governments of the United Nations, but I think that it should be a body of the world scientific community. I feel that the patterns that we have developed in the International Biological Program are patterns that may serve as a prototype for this.

I will use only one example, because I am running out of time. In the International Biological Program, I think we have established two things. One, we have shown that you can bring multidisciplinary groups of scientists to work on these major ecological problems. Second, we have demonstrated and are demonstrating that scientists of different countries can work together.

We have a project—or a pair of projects actually—in the IBP involving U.S. scientists and involving Latin American scientists, to see how ecological systems are put together. We call it Origin and Structure of Ecosystems. This was planned jointly by Argentine, Chilean, and North American scientists working together. We all sat down and started planning from the beginning. We have worked together. We haven't produced something in North America and exported it to Latin America. We have done it together, and we have a very viable program going involving Argentine, Chilean, and U.S. scientists.

I will mention one example of the kind of diplomacy this sort of effort can produce. We had in March a meeting in Chile to plan where we would go next in the research involving the Chileans and U.S. people. Our group was welcomed to Chile by the President of the Republic of Chile, which I think is the kind of diplomacy that I like to see—scientist-to-scientist—scientists working together. We feel as though we are partners in the undertaking. It is not just U.S. people going to work in Chile; it is Chileans coming up to the United States, and vice versa, and we work together in the field. It is the kind of thing that can be developed. It is the kind of thing that could be sponsored by a World Environmental Institute, and should be.

I have used all my time, sir. I think I will close with that remark.

(The statement follows:)

STATEMENT OF W. FRANK BLAIR ON INTERNATIONAL ENVIRONMENTAL SCIENCE, WITH SPECIAL REFERENCE TO SOUTH AMERICA

INTRODUCTION

Honorable menbers of the Congress, ladies and gentlemen, it gives me much pleasure to participate in this colloquium on International Environmental Science. I have great personal interest in the subject because the environmental problems of this miserably abused planet have come to occupy seemingly more and more in excess of 100% of my time in the past few years. I welcome the opportunity to participate with this distinguished group in discussing this subject. I am well aware of the keen concern of many members of both houses of Congress for the environmental problems of our own country and of those of the whole of this space-ship earth. I hope that this colloquim can not only identify the major problems of international science, but can also produce concrete plans for positive action.

In this presentation, I will review certain background information and then make some positive suggestions toward a course of action.

It hardly seems necessary to review in detail the events that have led to this and to other public dialogues and colloquia on environmental problems. The late Adlai Stevenson phrased the problem as succinctly as is possible in a statement to the United Nations in which he said: "We all travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work, and the love we give our fragile craft."

The *world is indeed a vast and complex ecological system.* Neither this system nor its subsystems, the world's major ecosystems, recognize political boundaries. We have come to recognize the fact that perturbations of this system do have effects in fantastically distant parts of the system. Pesticides from the agricultural lands of the world travel through the air, water, and biological food chains to contaminate antarctic seals and penguins and potentially upset the ecological balance in that remote continent. Dust from abused agricultural lands of southern Asia affects the climate over the United States. Burning of fossil fuels in the industrial capitals of Europe affects the carbon dioxide content of the air over Australia and Greenland and may have effects on future world climates. But, even more importantly, there is the inescapable fact that the *resources of this global system are finite.* Consequently, we here in the United States need feel concern for the orderly utilization and management of natural resources in all corners of this planet. This is true because of the direct effects I have just mentioned. It is also true because the orderly development and management of natural resources versus unthinking exploitation of those resources will bear directly on the social and economic health and stability of the other nations with which we share this planet and with which we must live in everyday commerce and communication.

I believe that it is in *our own national self interest,* as the world's scientific leader in the field of ecological science, to look toward the development of cooperative international programs that will *assist the lesser developed countries* (LDC's) to achieve their own capabilities in this field. Also, I might add parenthetically that our own environmental mistakes have been so huge that we have the opportunity to point out to the LDC's, chapter and verse, the consequences of following our own past courses of action.

In this context, I will address myself mainly to the area of the world which I know best beyond the limits of the United States. This is the large, biologically diverse, and generally underdeveloped continent *of South America.* During the past 5 years, and largely in the interests of the International Biological Program, I have travelled extensively in South America and have talked there with scientists and with governmental officials concerned with environmental problems. I have also been involved there in efforts to mount international cooperative research efforts in the field of ecological science.

Consequently, I believe that I can speak with some assurance about the needs, about the state of the art in Latin America, and about the potential for developing an indigenous capacity to deal with problems of environmental biology as the countries of that continent continue to develop their own natural resources. I suspect that what I will say has much broader implications with respect to the LDC's generally, but I can speak with a high degree of certainty about only Latin America.

ENVIRONMENTS OF LATIN AMERICA

The problems of resource development and management vary from one major ecosystem to another. Thus, to understand the environmental problems of Latin America one must have a basic understanding of the biological diversity, i.e. of the broad ecological subdivisions, of that continent.

Basically, South America divides into *three major ecological areas* and a few of lesser importance. In fact, 2 lines can be used to divide South America into 3 ecologically fairly uniform areas (Fig. 1) each with its own peculiar set of problems with respect to man's impact on the natural environment.

The tropical forest and bordering tropical savannas occupy a large fraction of the South American continent, including particularly the huge Amazon and Orinoco basins and such disjunct areas as the Choco forest of northwestern Colombia. This huge area has felt less impact of man's exploitation than any

major ecological area of the New World. Consequently, it is the continual target of schemes to exploit and utilize its presumably vast resources. Ecologists know less about the ecological dynamics of tropical forests than they do about almost any major ecosystem. However, we do know certain things that are of compelling significance with respect to any plans for increased exploitation of this vast forest.

One main feature, by contrast with a forest in the middle latitudes, is the great diversity of species of plants and animals. For example, individuals of a particular species of tree will be widely scattered; a sample plot will contain trees of many species, but few individuals of any one species. This kind of pattern, so different from the pure stands of oaks and other trees we are familiar with in the middle latitudes, has been interpreted as providing relief for the species from its numerous tropical parasites and predators. A seed that is disseminated far away from the parent tree has a better chance to germinate and grow than one that simply drops to the ground and becomes subject to attack by the predators associated with the parent tree. Attempts to develop monoculture agriculture in the topics have resulted in spectacular failures (e.g., rubber plantations in Brasil) probably for these same reasons.

A second major feature of the tropical forest is its great complexity as a functional ecological system. There is high productivity of organic matter as seen in the lush vegetation and abundant animal life. Nutrients are cycled rapidly through this complex system. As one of the few ecologists who have worked extensively in the neo-tropical forests puts it: "The Amazonian forest lives *on* the soil more than *out* of the soil; the role of the soil is that of a mechanical substrate rather than a provider of nutrients."

Removal of the forest results in the destruction of this complex system. Nutrients are removed with the forest or are lost through leaching and erosion. The soils of the cleared tropical forest thus are generally poor agricultural soils. The survival of human populations in the tropical forest is also beset by many difficulties including a variety of tropical diseases, nutritional problems and meager levels of subsistence, in many cases, based on inappropriate agricultural practices.

In my opinion, the greatest challenge to New World ecologists is the acquisition of sufficient knowledge and the application of that knowledge toward the utilization of the Amazon forest for man's long-term benefit. Such efforts would necessarily look toward utilization of the forest in ways that would not lead to its destruction or to the development of new human problems related to a lack of ecological knowledge. This might be the time to mention that a program jointly sponsored by the U.S., Brasilian, and Venezuelan IBP committees is concerned with some aspects of these problems in studying the health and genetics of primitive Indian tribes living in the tropical forest along the Orinoco River. This study should help gain insight into their relation to the *land* surrounding them.

The Andean Highlands and the cold southern tip of South America have long felt the heavy impact of human agricultural effort. Fly across the Peruvian Andes and you see that every mountain slope that is not too utterly steep has stone fences and other evidence of agricultural use. These highlands provide a harsh and limiting environment for human life, and the indigenous peoples show major adaptations to their harsh existence. Ecologically, this area is even more poorly known than the tropical forest, yet it is a system in which rapid progress toward an understanding of ecosystem function and of human impact on the system could be expected if the effort were made. The system is a relatively simple one, especially by comparison with the tropical forest. Also, there is a fair fund of knowledge about the activities of prehistoric man in this ecosystem. Furthermore, there is already under way under the IBP a cooperative U.S.-Latin American anthropological study in one country (Peru) that could be melded with primarily ecological investigations. Here, an Indian population that was in ecological balance with its ecosystem high in the Andes is being examined in relation to migration and changing environments. Over the centuries, the Indians have evolved adaptive features in their bodies to give them maximum efficiency in an atmosphere of lowered oxygen content and cold temperatures. But now with society encroaching in on them, they are moving down from the mountains to other environments and the adaptations that their bodies have made are no longer useful—in fact, they may be harmful in many cases. As you can see from just this small example, the relation between man and environment is a delicate and complex one that is easily

upset and in need of much integrated research not only on man himself but also on the environment in which he lives and functions.

This Andean environment can also be seen to include the Mediterranean Scrub vegetation that occurs on the lower slopes of the Andes in Chile and recurs in California, Australia, South Africa and in the Mediterranean region. While covering only a minor part of the earth's land surface, this ecological type occurs in places that have felt (and continue to feel) heavy impact of human population. In Chile, a major destructive pressure on this ecosystem has been exploitation of the scrub vegetation to produce charcoal.

The arid and semi-arid lands of southern and eastern South America provide the third major ecological component of that continent. Included are the "cerrado" and "caatinga" of Brasil, the "chaco" and "monte" of Argentina and adjacent countries. Much of this great area is marginal agricultural land because of water deficiencies yet pressures are increasing for the development of these drylands to accommodate increasing human populations. These arid and semi-arid lands have already suffered severely from human activities, especially from the introduction and heavy dependence on the goat as the principal domesticated livestock species over huge areas. Here, an important ecological problem is the one of finding alternatives to present modes of use of these xeric environments.

ENVIRONMENTAL BIOLOGY AS A SCIENCE IN LATIN AMERICA

I have attempted to make the point that there are many ecological problems confronting the countries of South America and that the nature of the problems varies from one major ecological region to another. The social, political and economic health of these countries depends on the finding of satisfactory solutions to these problems. Therefore, it is pertinent to examine the state of the art in environmental biology in South America.

The picture is not exactly an encouraging one, yet it is one that leaves us with the hope that with assistance from the countries (e.g., the United States) that are developing competence in the new kinds of environmental biology, at least some of the South American countries can develop the local talent to deal with their ecological problems.

My first extensive exposure to the state of ecological science in South America came in early 1967, when I visited scientists at institutions in 17 cities in Venezuela, Brasil, Uruguay, Argentina, Chile, Peru and Colombia to encourage cooperative inter-American research under the International Biological Program. Since then, I have travelled numerous times in South America and feel that I know fairly accurately the ecological capabilities and limitations in the various countries.

I believe that it is necessary here to say a few words about what I mean by ecological capabilities. Before the public press essentially destroyed the professional meaning of the word, ecology still had reference to a wide diversity of approaches to the interactions of organisms and environment: physiological ecology, population ecology, ecosystem ecology. The last of these has undergone major development under the IBP, especially in the United States' program. It is this ecosystem approach that holds promise of providing predictive models for guidance in the management of the world's environments, but this approach must depend on the contribution of ecologists working with the physiology of species, with population dynamics and on the contribution of many other specialists. Taxonomists must identify the organisms that occur in the ecosystem. Specialists of many types must measure the biological processes that take place there. Soil scientists, hydrologists, meteorologists and others have their input. Computer storage and retrieval of data and the people to carry out these tasks are essential in such a large undertaking. Finally, there must be theoretical ecologists to produce models and submodels of the system.

If man is involved in the ecosystem, numerous complications occur at which time anthropologists and social scientists must work to help integrate man's role and impact on the environment and vice versa into the system.

Capabilities for doing this kind of ecosystem research are at present virtually non-existent in South America. Some of the specialists who could contribute to such a project exist in some places in South America, but even here the picture is very spotty. Even at the very basic level of taxonomy there are great gaps, especially when one considers the tropical forest. Many species, of even such large animals as vertebrates, remain unknown to science. For example, in all of Peru there is no active student of mammals, a group that is of

major importance in ecosystems, as vectors of human disease, and sometimes as agricultural pests.

My thumbnail impressions of the capabilities of the countries I know best in South America are as follows:

Argentina.—Overall, Argentina probably has the best prospects for advancement in ecological science. The Instituto Nacional de Tecnologia Agropecuaria (INTA) has one of the two best and most active groups of ecologists in all of Latin America. This group is cooperating with the U.S./IBP in a project of which I will say more later. The Argentines have an active and well equipt and housed Instituto de Limnologia at Sante Fe on the Rio Parana. The Fundacion Bariloche (which I visited in April) has a biological field station on Isla Victoria in Lake Nahuel Haupi with an ecological program and is in the process of setting up an ecological institute. An ecological institute has been approved at the University of Cordoba, which has contributed a number of students to the cooperative IBP project with the U.S.A.

Brasil.—Prospects are rather dim for any immediate progress toward capabilities in ecosystem ecology in this largest Latin American country. The best ecological work is probably that at the University of Sao Paulo, but it is limited in being principally plant ecology.

Chile.—One of the two best and most active ecological groups in Latin America is located at the Universidad Austral at Valdivia. This group as well as scientists from several other Chilean universities is cooperating in the joint U.S./IBP project which I will mention later.

Colombia.—An effort is being made to organize an ecological study of the tropical forest centering on the University of Antioquia at Medellin. The campus is new. The biology faculty is mostly young and enthusiastic. This could be the best place in which to develop an international center for study of this important ecosystem.

Venezuela.—This is the fifth South American country with a base on which strength in ecological science might be built. The strength is to be found in Caracas at the Universidad Central de Venezuela.

Other countries.—From what I know of other South American countries they are simply without a present base on which to build ecological competence.

WHAT DO THE LDC'S NEED?

Basing again on my experiences in Latin America, I would like to identify a few major categories of needs that the LDC's have with respect to environmental science:

(1) There is immediate and urgent need for ecological facts on which to base resource development and environmental management. I will repeat again here my own concern about the need for a scientific base for management of the tropical forest rather than thoughtless exploitation of it. Human pressures increase daily on the remaining undestroyed environments of Latin America, yet the scientific facts on which to base rational management of these environments are largely lacking.

(2) There is urgent need for the training of national scientists in the LDC's in the concepts and technologies of modern ecological science. The urgency of the needs can be illustrated by reference once again to the tropical forest and by quoting from an article by H. D. Thurston in "Population and Food" (A.I.B.S. Foundations for Today, Vol. 1, 1971): "In the entire Amazon Basin (half the size of the U.S.A.) there are only 10 experiment stations, some with only one researcher with the equivalent of a high school education."

(3) There is equally urgent need for dissemination of information about the world environmental crisis and about the needs for environmental management on a sound scientific basis. Such information must reach the general public and it must eventually influence the activities of the decision makers at all levels. Otherwise the acquisition of the information is a useless exercise. One of the needs frequently cited by my Latin American colleagues is that for one or more Latin American journals of the type of Scientific American, to use an obvious example, that would disseminate scientific information to the reasonably educated non-scientist. A Spanish-language and/or Portuguese-language publication aimed at a wide audience in Latin America would seem to me to be a worthwhile undertaking for private enterprise or possibly with initial financial backing from one of the private foundations.

(4) There is need for a quantum increase in the amount of communication among Latin American scientists. I am thinking here of communication of two

principal sorts. One is through the medium of scientific meetings. Probably because of the numerous national boundaries, there are no Spanish-language biological journals that have really general circulation in Latin America. I have found my Latin American colleagues generally hungry for scientific information from the technically advanced countries and often even more poorly informed about scientific activities in their own fields in other Latin American countries than about those in the United States or western Europe. In my experience, the United States has not performed very well in exporting its technical literature to Latin America. Some 3 years ago, I browsed through a book exhibit at the annual meeting of the Brazilian Biological Society in Rio de Janeiro. Amidst a profusion of Portuguese-language versions of Japanese and Russian scientific texts I was able to find one U.S.-produced, not-very-distinguished, paperback.

Although some national scientific meetings do occur in Latin America and some meetings labelled as Latin American Congresses also occur, there is not the same tradition about such meetings that we have in North America and Europe. As some of my Latin American colleagues put it, "travel to a scientific meeting is regarded as a request for a paid vacation rather than as a request for support of a legitimate and essential activity in the scientific process of accumulation, divulgence and assimilation of scientific fact and theory.

One of the most satisfying experiences I have had during my involvement in the IBP was the response of the Latin American biologists to the first planning conference for cooperative inter-American research under the IBP. This conference was held in Caracas, Venezuela, and involved biologists of many specialities from the United States and from various Latin American countries. For many of the Latin American participants, this was their first multinational scientific meeting, and for many it was their first meeting with scientists other than the specialists in their own narrow discipline. I still continue to see new evidence of the new trans-national scientist-to-scientist lines of communication that were opened up by this single meeting to plan a cooperative research program.

(5) Finally, there is need for much increased effort just at the level of learning and cataloguing the biological diversity of the neotropics. Many tropical species are not even known to science in almost any major group of plants or animals one could name. Yet, in addition to the basic intellectual need to know the diversity of organisms that exist with us on this planet, there is the practical, managerial need. Biological diversity and stability of ecosystems are closely interrelated. We need to monitor diversity of life in the world's ecosystems, but in order to monitor we need baselines.

POSSIBLE COURSES OF ACTION

In my own opinion, the one real hope for coping with global environmental problems and of meeting the needs of the LDC's as I have just identified them rests on the establishment of an International Environmental Center. In our discussions in the world scientific community, i.e., International Council for Scientific Unions (ICSU) and its committees, Special Committee on Problems of the Environment (SCOPE) and the Special Committee for the International Biological Program (SCIBP), we have talked of an "International Center for the Environment" (ICE). The concept does not differ significantly from that of the "World Environmental Institute" proposed in the Magnuson resolution (S. Res. 399).

My own thoughts about an ICE are presented in outline form in a paper prepared earlier for use in the U.S. National Committee for the IBP and attached as appendix A to this document.

One responsibility of ICE would be the monitoring of the quality of the world's environments. Another would be the coordination and management of Regional Centers for research on the structure and function of the world's major ecosystems. Along with these there would be functions of data collection and storage and of dissemination of information concerning world environments.

Regional Centers are an important part of this whole proposal. I envision them as being established in specific major ecosystems for study of the functioning of their respective ecosystems and for study and forecasting of the impact of human development on these systems. In South America, for example, there should be at least one center for study of the tropical forest, one for the Andean Highlands, one for the drylands, and probably another for the tropical savanna.

I believe that we have seen evolving in the IBP the kind of centers and study programs that I would envision for the world's major ecosystems. Important among the projects of the U.S. participation in the IBP are five biome studies, of the grassland, desert, deciduous forest, coniferous forest, and arctic tundra. Each has the objective of an understanding of the ecosystem as a highly complex ecological system and the production of mathematical models and submodels for the ecosystem. Large numbers of scientists, with a wide diversity of specialities, participate in each biome study.

We have been attempting to develop a sixth biome study, a study of the tropical forest. If this develops (and I feel that it must) it will necessarily be a more international effort than the five biome studies we have under way in the United States. I am making a distinction here between projects that are internationally coordinated sets of primarily national efforts, as particularly the tundra, grasslands and desert biome studies, and subjects that will require multinational teams comingling at the same site. I intend to imply no preference between the two. Both approaches are going to be necessary toward solution of global environmental problems. However, the latter approach seems clearly indicated in the case of the neotropical forest. Such a study of the tropical forest could provide a prototype of the kind of multinational centers that might develop under the aegis of ICE, especially in the LDC's. Actually, we in the U.S. part of the IBP have under way two cooperative ecosystem projects that may well serve as such prototypes. These are two parallel comparisons of the structure of ecological systems that have evolved under similar physical environments of the southern and northern hemispheres. One of these comparisons is between the "monte" (desert scrub) of Argentina and the Sonoran Desert of North America. The other is between similar "Mediterranean Scrub" ecosystems as they exist near Santiago, Chile, and San Diego, California.

In these projects, scientists and graduate students from several U.S. and several South American universities and institutions (e.g., in Argentina, Universidad de Buenos Aires, Universidad de Córdoba, Instituto Miguel Lillo and Instituto Nacional de Tecnologia Agropecuaria (INTA)) are working together on the common goal of understanding the ecological structure of the ecosystem. In this kind of arrangement the value of the projects in advancing environmental science training in South American countries may well equal the value of the information generated.

POSSIBLE INTERNATIONAL INSTITUTIONAL ARRANGEMENTS

Through the IBP activities, I have had first hand introduction to the problems, the difficulties, and the frustrations that go with planning and attempting to implement multinational programs. There has been the opportunity to observe the strengths and the weaknesses of intergovernmental institutional arrangements for such programs and the strengths and weaknesses of non-governmental arrangements.

The IBP is an undertaking of the world scientific community with sponsorship by the International Council of Scientific Unions, and its experiences point up the realities of non-governmental arrangements. The greatest argument for this non-governmental approach is the relative facility with which scientists representing their respective national scientific communities can communicate and can plan and manage international efforts. The greatest weakness of this approach is the difficulty in finding adequate financial support for non-governmental activities. The IBP has suffered throughout its history from inadequate financing of its central secretariat as well as from inadequate financing of most of its research activities.

Intergovernmental agencies are more certain of financial support, but they tend to get bogged down in bureaucracy and international and interagency politics. Several of the existing specialized agencies of the UN have responsibilities for some aspects of world environments. However, the specific missions of these agencies and the aggressiveness with which they guard their spheres of activity, make it unlikely, in my opinion, that any one of them could successfully take on the whole packet of developing ICE, Global Monitoring, and world biome research. One agency at least (UNESCO) has such ambitions, with its "Man and the Biosphere" (MAB) program, copied from the IBP and advertised worldwide by UNESCO as the successor to the IBP. For the reasons I have mentioned, and others, I question the ability of UNESCO to assume the major role that the program I have outlined would require.

Instead, I would commend for the U.S. consideration and support a plan that seems to combine some of the best aspects of governmental and non-governmental international institutions. Some aspects of this plan have evolved in domestic meetings and some in international meetings of scientists. The plan is outlined on page 4 of the appendix to this document and a functional flow diagram is shown on page 5. Essential features of the plan are:

(1) Creation of a new UN body cognate to ECOSOC and designated as the "Environmental Monitoring and Assessment Commission" (EMAC). The specialized UN agencies (FAO, WHO, etc.) would have input into EMAC on environmental matters that fall within their respective purviews.

(2) EMAC would commission SCOPE to develop and manage ICE as a non-governmental activity or if SCOPE were unwilling to accept this role some other non-governmental agency representing world science would have to be found. A non-governmental international foundation established through endowments by member governments and hopefully from private sources would provide the financial base for the establishment and operation of ICE and its various activities.

The ways in which the activities of the governmental and non-governmental bodies would intermesh (as diagrammed on page 4 of the appendix) hardly need elaboration at this point.

POSSIBILE INTER-AMERICAN INSTITUTIONAL ARRANGEMENTS

I firmly believe that we must work toward the establishment of an ICE that has the functions of environmental monitoring, research management, and data storage, retrieval and dissemination that we have discussed. In the meantime, however, the environmental problems related to resource development and exploitation in the Latin American countries are so urgent that it seems imperative that a hemispheric effort toward monitoring, ecosystem research and centralization of environmental data be mounted as quickly as possible. These hemispheric efforts could be incorporated into an ICE at the appropriate later time.

A newly existent entity which might easily provide the institutional mechanism for initiation of such a hemispheric program is the recently incorporated and organized Inter-American Institute of Ecology (IAIE). This institute is the result of several years of planning by the Ecological Society of America and its founding institutions represent an array of the most prestigious U.S. universities in the area of environmental science. Furthermore, some of the Latin American institutions with the most promise in this field either are founding institutions or are expected to become such in the very near future.

Excerpts from the stated objectives of the IAIE are attached as Appendix B of this document. With an adequate funding base the IAIE could, in my opinion, move rapidly to develop on a hemispheric basis the kind of environmental program I have been discussing in this document. I commend this idea to your serious consideration.

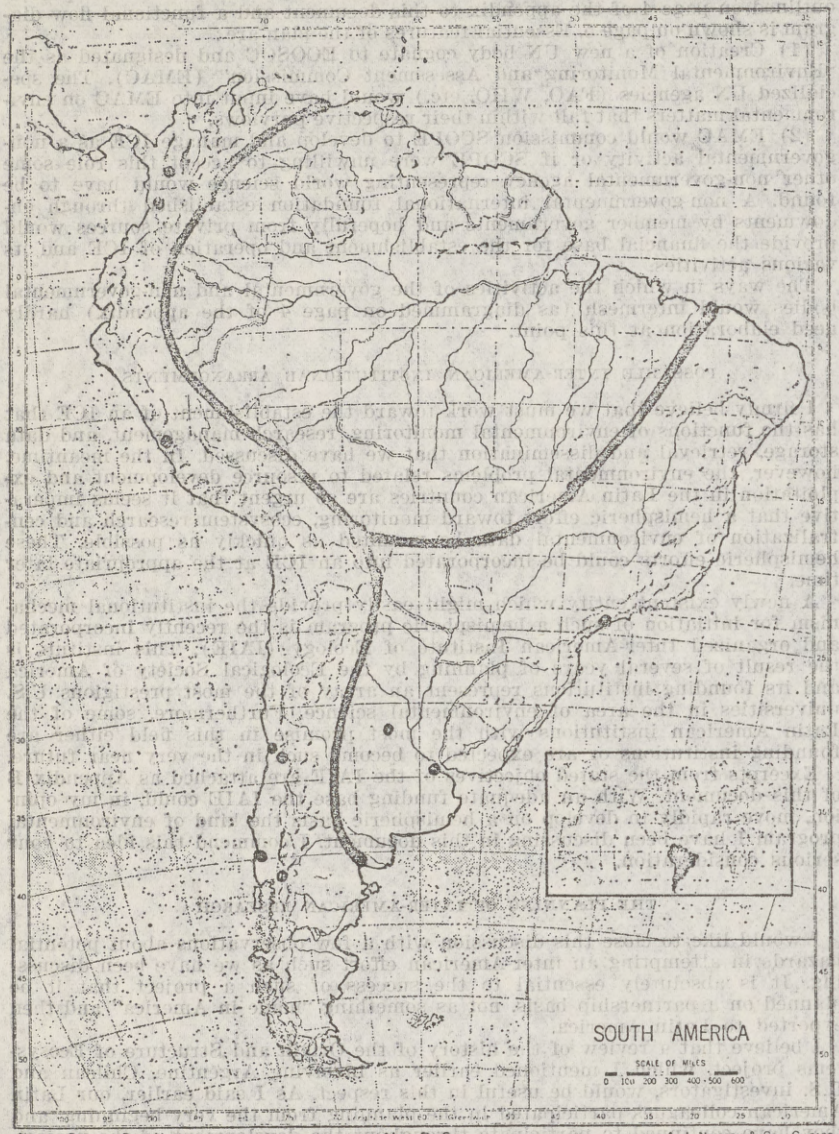
THE PLANNING OF INTER-AMERICAN RESEARCH

I would like to close this discussion with a few observations about potential hazards in attempting an inter-American effort such as we have been discussing. It is absolutely essential to the success of such a project that it be planned on a partnership basis, not as something "made in America" and then exported to Latin America.

I believe that a review of the history of the Origin and Structure of Ecosystems project, which I mentioned earlier as involving Argentine, Chilean and U.S. investigators, would be useful in this respect. As I said earlier, our Latin American colleagues participated in the planning from the very beginning, and they have continued to participate throughout the development of the project. I believe that some of their enthusiasm for the project results from the fact that they were involved in planning components of the project that were to be done in the United States as well as those that were to be done in Argentina and Chile. The managerial arrangements for the two subprojects are also bilateral with an Argentine and a U.S. scientist co-directing one and a Chilean and a U.S. scientist co-directing the other.

The degree of acceptance of this kind of cooperative undertaking in at least one Latin American country is illustrated by the reception the U.S. participants received when they arrived in Santiago in March for a research-planning conference with their Chilean colleagues. The group was met and personally welcomed by President Allende.

I really believe that the pattern of inter-American cooperation we have seen developing in this instance can become a pattern for future cooperation toward solving the hemisphere's and the world's environmental problems.



Appendix A

Prepared for the U.S. Committee for the International Biological Program

International Center for the Environment (ICE)

(By W. Frank Blair)

The basic premise is that the United Nations establish a separate body cognate to ECOSOC which might be called the Environmental Monitoring and Assessment Council (EMAC). SCOPE*, as representative of the international scientific community, would serve as scientific adviser to EMAC.

I. FUNCTIONS OF ICE

A. Monitoring

1. Supervise operation of global network of baseline monitoring stations. Receive data from same.
2. Receive, screen and store data from national monitoring networks.
3. Receive and store data from remote sensing activities.
4. Receive and store data from special international nets (e.g., WHO, WMO, GARP, etc.)
5. Receive and store data from special "impact stations."

B. Research

1. Depository for data and coordination of research on biological diversity of the biosphere.
2. Structure and function of world's ecosystems; coordinate and where necessary, support research on structure and functions of world ecosystems.
3. Impact of technology and urbanization on ecosystems and on biosphere.

C. Snythesis and Evaluation

Maintain ongoing assessment of the"health of the biosphere" based on input from all available sources.

D. Information

1. Collation of pertinent world literature.
2. Publication of research results.
3. Publication of monitoring data.
4. Responsibility for education regarding environment of biosphere.

II. INSTITUTIONAL ORGANIZATION

A. ICE must be a bricks-and-mortar institution with a strong staff.
B. It must be staffed from the international scientific community.
C. There should be sections corresponding to the 4 main functions, with such subsections as might prove necessary.
D. ICE should have a *funding* function with respect to activities in LDC's at least.
E. ICE would report through EMAC to the UN.
F. SCOPE would serve as scientific watch dot over ICE and report its observations and recommendations to EMAC.

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* Special Committee on Problems of the Environment of the International Congress of Scientific Unions (ICSU).

III. RELATION TO OTHER INTERGOVERNMENT AGENCIES

A. ICE would collate data from activities of presently existing agencies rather than complete with them. It would fill in gaps that presently exist between activities of specialized UN agencies. It would provide a synthetic function, using data from all possible sources.

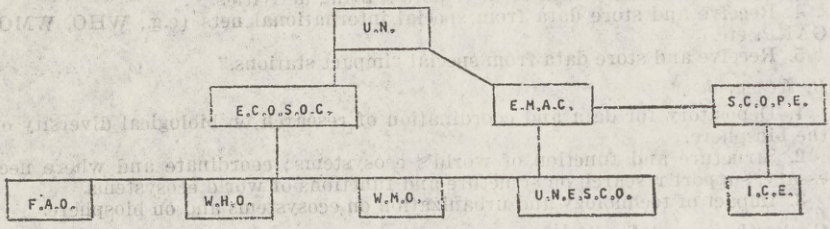
B. Specialized UN agencies should be directed to make their data available to EMAC through ICE.

IV. RECOMMENDATION FOR ACTIVATION

A. The plan for ICE and its activities should be placed on the agenda for the 1972 UN Conference on the Human Environment.

B. Support of member states should be sought prior to 1972.

ROBERT WHITE PROPOSAL



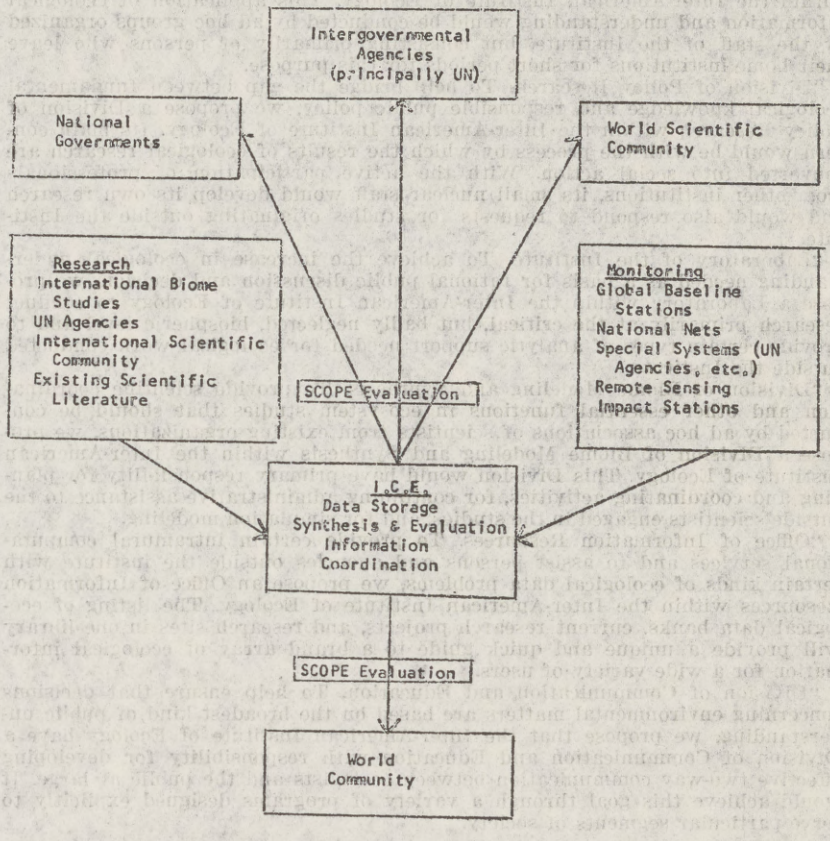
Environmental Monitoring and Assessment Council

Composition: Representatives, member nations

Functions: (1) Policy on international environmental matters
(2) Coordination
(3) Review

Organization: With small executive body

V. Input - Output for I.C.E.



Appendix B

Excerpts from the brochure describing the Inter-American Institute of Ecology, prepared by the Ecological Society of America and Peat, Marwick, Mitchell and Company.

The six proposed major components of the institute are briefly described by the following quotes:

"Office of Forecasting and Planning. To assist other agencies, public and private, in utilizing existing ecological knowledge to predict and thus to plan how to avoid ecological problems, we propose an Office of Forecasting and Planning within the Inter-American Institute of Ecology. This application of ecological information and understanding would be conducted by ad hoc groups organized by the staff of the Institute, but consisting primarily of persons who leave their home institutions for short periods for this purpose.

"Division of Policy Research. To help bridge the gap between fundamental ecological knowledge and responsible public policy, we propose a Division of Policy Research within the Inter-American Institute of Ecology. Its main concern would be with the process by which the results of ecological research are converted into social action. With the active participation of professionals from other institutions, its small nuclear staff would develop its own research and would also respond to requests for studies originating outside the Institute.

"Laboratory of the Institute. To achieve the increase in ecological understanding needed as a basis for rational public discussion and decision, we propose a Laboratory within the Inter-American Institute of Ecology to conduct research primarily at the critical, but badly neglected, biospheric level and to provide certain types of analytic support needed for ecological work conducted outside the Institute.

"Division of Biome Modeling and Synthesis. To provide scientific coordination and other essential functions in ecosystem studies that should be conducted by ad hoc associations of scientists from existing organizations, we propose a Division of Biome Modeling and Synthesis within the Inter-American Institute of Ecology. This Division would have primary responsibility for planning and coordinating activities, for continuing administrative assistance to the outside scientists engaged in the studies, and for simulation modeling.

"Office of Information Resources. To provide certain intramural computational services and to assist persons and agencies outside the institute with certain kinds of ecological data problems, we propose an Office of Information Resources within the Inter-American Institute of Ecology. The listing of ecological data banks, current research projects, and research sites in one library will provide a unique and quick guide to a brand array of ecological information for a wide variety of users.

"Division of Communication and Education. To help ensure that decisions concerning environmental matters are based on the broadest kind of public understanding, we propose that the Inter-American Institute of Ecology have a Division of Communication and Education with responsibility for developing effective two-way communication between ecologists and the public at large. It would achieve this goal through a variety of programs designed explicitly to serve particular segments of society."

FOUNDING INSTITUTIONS OF INTER-AMERICAN INSTITUTE OF ECOLOGY
(AS OF MAY 13, 1971)

HAVE SIGNED FORMAL AGREEMENT

Academy of Natural Sciences; Arizona State University; Colorado State University; Conservation Foundation; Dalhousie University; Duke University; Harvard University; Indiana University; Instituto Nacional de Limnologia (Argentina); MIT; McGill University; Michigan State Universtiy; Oceanic Institute; Rutgers-The State University; Texas A&M University; University of British Columbia; University of California; University of Colorado; University of Connecticut; University of Georgia; University of Houston; University of Idaho; University of Illinois; University of Mexico; University of Michigan; University of Minnesota; University of Montana; University of North Carolina; University of Sao Paulo; University of Texas at Austin; University

of Virginia; University of Washington; University of Wisconsin; Utah State University; Washington State University; Woods Hole Oceanographic Institution; Yale University.

HAVE WRITTEN LETTERS OF COMMITMENT; AGREEMENTS WILL BE FORTHCOMING AFTER THE INSTITUTIONS' LAWYERS HAVE APPROVED DOCUMENTS

American Museum of Natural History; New York University; Oak Ridge National Laboratory; San Diego State College; Smithsonian Institution; University of Manitoba; University of Toronto; West Virginia University.

AGREEMENTS UNDER CONSIDERATION PRESENTLY BY INSTITUTIONS

Austral University of Chile; Columbia University; Desert Research Institute; Universidad de Antioquia, Colombia; University of Buenos Aires; University of Cordoba, Argentina; Universidad Central de Venezuela; University of Littoral, Argentina.

Dr. MALONE. Thank you very much.

Senator MAGNUSON. Dr. Blair, I am just thinking out loud here. When we talk about funding in this field, which necessarily we are going to have to face up to, why wouldn't the National Science Foundation be a good channel through which to fund, or are there some problems?

Dr. BLAIR. I would hate to answer for the National Science Foundation.

Senator MAGNUSON. When we wrote the bill, this is the sort of thing it was set up for. We have our problems, but it seems to me that we will have to explore that up here. It might be the logical place to fund some of these things we are talking about, through the Science Foundation.

Mr. MILLER. I agree with you. On the other hand, I think we have some work to do in the Science Foundation to make sure that we don't duplicate what has happened in the past.

Senator MAGNUSON. Yes. We could do it through our contribution through the United Nations. There are two avenues there, or it could be joint for some specific things you have been talking about in Latin America.

I just wanted that in the record, because you have got to have a channel through which to fund this matter, as far as I am concerned. The other countries have their own administrative setups that probably go a different way.

Dr. BLAIR. I might point out also for the record that the National Science Foundation has been the lead Federal agency in supporting the IBP effort in the United States. The IBP is supported primarily, but not entirely by the National Science Foundation.

Senator MAGNUSON. We will take a look at it because we want to get busy on it in next year's budget which we will start to take a look at in about 3 or 4 months. That is a problem which the House and Senate are going to handle.

Mr. MILLER. Doctor, you mentioned this great basin of the Amazon—the forest which no one has succeeded in getting cleared. I know very little about it, but I was in Manaus once, and there was a great failure down there in trying to introduce rubber. Is that part of the problem—that they didn't know too much about the country before they went into it?

Dr. BLAIR. Exactly. Speaking as an ecologist, the tropical forest is really a unique ecological system. Basically, the high productivity that comes from high rainfall and high temperatures throughout the year tends to get tied up in the forest itself, so it is a very deceptive sort of thing. When you look at the soil profile, you see it is pretty miserable soil. This is one aspect of it. If you take off the forest, you have taken out a whole lot of the system.

Secondly, the major feature is the enormous diversity of species, and my friends who have really worked there and tried to explain the reasons for this diversity theorize like this: You find a tree here and you may have to go another mile before you find another tree of this same species. With the enormous variety of parasites and animals that are eating one another, if you are a seedling from a tree, that little seedling has a better chance of getting started a mile from the parasites who are eating on that tree than if it germinates near the parent tree.

This great diversity is the protective mechanism in the ecological system. When you put in a field of corn down there—or a rubber plantation—you are just putting a great, tempting morsel there for all the parasites and predators which are around there and which can then run wild in this particular system.

We have to look at development of the tropical forest in a different way from the way we look at middle-latitude agriculture, is what I am saying, and we really need desperately the experts working there right now, finding out how this forest works.

Mr. MILLER. In Venezuela they have a rather sophisticated organization that is working down there, IVIC. Venezuela is one of the five countries I would put my bets on as being able, with a cooperative effort, to develop their competence.

Mr. FULTON. Mr. Chairman, what is a xeric system? What do you mean by that and what are its limits?

Dr. BLAIR. Technically, my colleagues define it as an area where less than 10 inches of rainfall a year. There are many xeric areas of the world that are very critical as the result of improper development.

Mr. FULTON. Do you mean desert?

Dr. BLAIR. Semidesert, semiarid. It is very difficult to draw the line. We have huge areas in the Great Basin of North America, and there is a comparably huge area in South America which is now getting pressure for development.

Mr. FULTON. Are you recommending against developing with water these desertic systems?

Dr. BLAIR. When we get into water, we get into a really complicated problem and no one can speak more to the complication of this than someone from Texas.

Mr. FULTON. You see, you are not clear on what you would do as to the goals for such. Do you really say just leave them alone?

Dr. BLAIR. No. What I am saying is that in these, you might call them fragile systems, we have to look for all of the possible ways we can use them for the best interests of man without destroying the system.

Now, as an example, I was recently in Chile, as I mentioned earlier. I was impressed there by the enormous amount of just plain—

what we call in Texas—prickly pear, however without spines, being produced as an agricultural crop. This does not require irrigation. It is producing what I understand to be a highly nutritious organic material in a very dry environment. This is one alternative.

Mr. FULTON. I am going to ask you one question on the critical point of changeover. In the lesser developed countries, nature is supreme and man then must fit as he can into nature as an environment. In the more developed countries, man has changed the environment so that man is supreme and his environment, then, is a man-centered environment and nature is subservient to this particular type of environment?

Dr. BLAIR. I don't think it is quite that simple, speaking as a scientist.

Mr. FULTON. Do you believe, then, in the Thoreau concept? Is that what you are aiming for, that we all just fit back into nature, or are you willing to make this transposition in type of environment? It sounds to me as if you have got a foot in both camps.

Dr. BLAIR. I think I have my foot in between.

Mr. FULTON. What do you mean as a goal? It is not clear from your paper.

Dr. BLAIR. My goal is to take care of man's needs without fouling up the system so badly that man's needs will no longer be pertinent. I would absolutely deny that I am any kind of an old-fashioned preservationist, because I think this attitude is impossible. I have talked to young students who say, "Let's get rid of the automobiles, telephones, and this sort of thing." This, we are not going to do. On the other hand, I think that we have to look at the characteristics of each major ecological system as we make major modifications in that system. Otherwise, we are going to repeat some of the disasters—the Dust Bowl in Oklahoma is a good example of an ecological disaster which should never have happened.

Mr. FULTON. Thank you very much.

Mr. HECHLER. Dr. Blair, you are aware of the potential of the earth resource satellites that we have under development. I wonder what your reaction would be to the use of these satellites and the type of interaction we would have to carry on with the peoples and governments of South America to make sure that these are used in a constructive way and not to make these people apprehensive about the nature and the contribution these satellites could make in identifying and developing their resources and improving their environment.

Dr. BLAIR. You are probably asking a scientist a political question, but I will try to answer it. We have some interaction with NASA in the IBP. NASA has flown a mission for us in Argentina in connection with our work there, and we are in contact with the ERTS program. I think generally, as long as you are talking scientist to scientist, there is no great problem. When you go to other groups that are more concerned with national affairs, more than scientists are, there may be problems. But so far, I think the interest in the ERTS program in the IBP has been enormous. At our general assembly in Rome last fall, NASA provided us with their very nice little publication they have concerning their satellite program, their remote sensing program. We got a hundred copies over to Rome and

we had to fight the people off who wanted them from the other countries. The response was tremendously good, I would say, to this program.

Mr. HECHLER. That is very encouraging. Thank you.

Dr. MALONE. Our next speaker brings all the way from India an extraordinarily rich and varied background of teaching, research and science policy study. As the head of the Department of Zoology at Delhi University, his teaching record is outstanding.

As the author of 100 scientific papers, his scholarship is evident.[1]

As the president of the Indian National Science Academy, president of the Indian ICP Committee, he certainly has his hands full with policy problems.

We are delighted, Dr. Seshachar, that you have come all the way to share with us your views on the international aspects of the environmental science.

STATEMENT OF DR. B. P. SESHACHAR, PRESIDENT, INDIAN NATIONAL SCIENCE ACADEMY

Dr. SESHACHAR. Thank you, Mr. Chairman.

Senator Magnuson, Chairman Miller, distinguished Members of the Senate and House, ladies and gentlemen.

I am not being merely formal when I say I deem it a singular privilege that I am asked to present to this gathering of Members of the U.S. Congress and others some problems of the environment that a developing country like India is facing. It is, it seems to me, at once interesting and characteristic that the United States has taken the initiative in calling this colloquium. This to my mind is indicative of the leadership of the United States in this field, as in several other fields. It is also indicative, Mr. Chairman, of the desire of Members of Congress to understand and help solve not only your own environment problems, which, by any understanding, are complex enough, but what, to my thinking is even more important, is a desire on your part, to interest yourselves in problems of countries other than your own, especially of developing countries.

It is clear that these problems are of two kinds, and perhaps we should seek solutions to them on two fronts. Some of the problems of the environment are global, affecting almost all denizens of the world—regardless of where they live and the state of society of which they are a part. Others are of special relevance to certain specific areas. Technological advance, population density, and even geographical location determine environmental quality in a highly specific way.

Information about the environment in advanced, industrialized countries is itself meager, but a recent awareness to obtain this information is evident. Information about the environment of developing countries is even more sketchy. And I cannot say even the awareneiss of the need for obtaining it is there in many of them. Under the auspices of the International Biological Program and other similar programs in the past, some efforts are being made and it is to be hoped these efforts will bear fruit and we shall soon have

[1] See Appendix VI p. 222 Problems of Environment in India, by B. R. Seshachar.

enough material for study. In this connection, I wish to say that in India we have recently set up a committee on human environment. It has about 17 members belonging to different disciplines—biologists, meteorologists, economists, public health specialists, agricultural scientists, et cetera—and it is this committee that is preparing the material for the Stockholm conference in 1972.

The problems of environment of a country like India are not only different from those of highly developed countries but some of them are peculiar to it.

India has an area of a little more than a million square miles. It's population, according to the latest census which came through only a few weeks ago is 550 million—a seventh of the world's population. Eighty percent of these people live in small settlements called villages which number 600,000. Some of the largest urban centers of the world are in India—Calcutta with 7.5 million people, Bombay with 6 million, Delhi with 3.7 million.

With a history, culture, and civilization which are among the oldest, India is one of the world's great human centers and stands as a mighty challenge not only to the ingenuity of man but also to his dignity. In fact, it is this ancient civilization that has acted as a social and cultural deterrent to economic development. That is the problem of India. But the compulsive needs of science and technology cannot be ignored and India should prepare and is preparing for them.

Mr. Chairman, in the little time that I have at my disposal, I can do little more than briefly touch on some aspects of India's environmental problems which might be of interest to this group, and which, hopefully, would constitute areas for further study.

The first problem is our population. I don't have to make an apology for it because among the first remarks that were made in this room yesterday by Senator Magnuson there was a reference to population. When one talks of the population increase, he asks four or five questions:

First, has it threatened total food production and its distribution in a damaging way?

Two, has it thrown pressures on resources and services and caused disruption of these resources?

Three, has it impeded, retarded, or arrested economic growth?

Four, has it led to an unrelievable pollution problem?

And, finally, has it led to a sharp disproportion of working and dependent population?

Population is not merely India's problem. It is a problem of many parts of the world. It is a question of how many of these criteria are met. In several countries, some one or the other of these criteria are relevant. In India, all of them are relevant. So I need not, to a highly informed group such as this, emphasize the highly intimate relationship that exists between population increases and its effects on environment, that this relationship is even more complex, and poverty accompanies population increase is nowhere clearer than in India. But there are other features of the Indian situation which are of great interest.

The disparities between urban and rural settlements are sharper and more acute. The cities of India approach, and in some ways

surpass, the conditions obtaining in some of your urban complexes in the deterioration of their environment, while our 600,000 villages are so primitive that some of them have not changed over centuries. You have an urbanization of your villages—if you have villages at all. We have a ruralization of our cities. In fact, the term village cannot be applied any more to your smaller settlements except perhaps euphemistically. Extensive industrialization and effective communication have led to the disappearance of the village of the American landscape and it is only a matter of time before it disappears from the American dictionary.

The worst of both the worlds is therefore characteristic of the urban and rural settlements of a developing country like India. Overcrowding, pressures on services, problems of waste disposal, pollution—all are on an intensified scale in the city. Primitive conditions of living, poverty, absence of protected water supply, lack of essentials for healthful living—these are the problems of our rural areas.

All pollution that you have in New York or Chicago or Los Angeles is present in Bombay, Calcutta, or Delhi. We have some more, caused by accumulation of refuse, lack of adequate water supply, and breakdown of services. I happened to be in Calcutta last week and was worried that the gas fumes I was inhaling came from some kind of a leak in the car I was traveling in, but soon discovered that the air was polluted to an extent I did not imagine was possible in that city.

The problems of the environment in India are therefore problems of the relationship between not merely population and environment, but of the dual effects of population and poverty on environment. We do not know what these effects are. I quote from the annual report of your Council on Environmental Quality:

> We do not know * * * how people react to changes in their environment * * * What do crowding, urban noise and automation do to man?

Again the effects of an altered environment caused by overpopulation of man himself in a kind of feedback relationship, have hardly been considered. People and their environment constitute a single interacting system and it is impossible that changes can occur in the one without attendant changes in the other, moving in both directions. We do not know what these effects are—probably on the lines of what Dr. Blair said about the regional institution.

Sociological studies everywhere have suffered neglect, more so in underdeveloped countries. We have been so engrossed with the problem of wresting advantages from our environment that we have never given serious thought to the likely effects of the altered environment on man himself. It is my plea that we should strive for a new sociology which meets the challenges of new situations which have arisen for the first time in the history of this earth. We need a sociology which keeps constantly in touch with the new environmental changes occurring around man—pollution, noise, overcrowding, automation, boredom, living in a confined space, and so on.

What are the measures we should adopt in this regard?

It is clear that the first step is to set up a machinery for the study of our environment. This is important. This should be not only global but should take into consideration the special problems of cer-

tain areas, particularly of underdeveloped, less industralized, populous areas. It is obvious therefore, that it calls for an international effort and hopefully the Special Committee on Pollution of the Environment and the Stockholm Conference will evolve some strategy in this direction.

Underdevelopment, population pressures, poverty, biological and other pollution, are relative terms. We need, therefore, to choose representative areas in the world for this study, for the two parameters—population and environmental quality—are constantly changing. not only in different places in the world, but they are different at different times in the same place. We therefore should set up a machinery by which these studies are continually made over a period of time in different and representative parts of the world.

One was speaking yesterday that environment is not all pollution. It is not. Felling a forest in the Western Ghats, in India, has an effect different from cutting down a forest in California or Sweden or for that matter, in another part of India, in Assam. Having cut the trees, planting tea or coffee, building a city, laying an airport, have again different effects. No one has studied them, certainly not in India.

And we have this new specter of radiation pollution to which yesterday mention was made by President Handler and this morning by Senator Magnuson. We in India have embarked on a vigorous program of nuclear power production, not anywhere like what you have done, but nevertheless quite substantial. Conflicting accounts are put out about the amount of radiation released into the atmosphere. Our scientists say this radiation is negligible; but in your country, you have a vigorous, sometimes acrimonious, debate about the danger. These often tend unfortunately to become politicalized, and even scientists take temporary leave of truth and embrace emotion when pet views are assailed. Especially, seeing that atomic energy and nuclear power are often in the hands of prestigious pressure groups in any country—because of the sophisticated technology involved, some of the most influential men of science can be vigorous protagonists—it becomes difficult first to obtain a true picture and, when one is obtained, more difficult to get it accepted as true.

There is one other problem, special—almost unique—to India. That is the problem of her cattle. Cattle, especially the cow, bear a special relationship to man in India. There are around 180 million cows and bullocks in India, around 50 million buffaloes. The economy of the cow and the bullock is unique here. It is not only the provender of milk, it provides fuel, fertilizer, and it is also a draft animal. But one thing it does not provide, and that is meat. In effect, it is a competitor to man in the absorption of resources, while its yields are pitifully small. For instance, only about 20 million cows are milk producers and the production per cow is about a tenth of what it is in Europe or the United States—400 pounds per cow in India as against 5.000 pounds per cow in Europe or the United States.

The reason why I make a special mention of the cow is that any aspect of human environment in India is closely bound with the life and death of the cow. I might also mention here, there does not seem to be any possibility of the cow being used in India for anything other than the purposes mentioned above, certainly not for meat, in

the near or even distant future, and to that extent the cow should be regarded as an adjunct of man.

Having mentioned some interesting aspects of man and his environment in India, you might ask what are we doing in India? Our awakening is recent but hopefully real. We have formed a committee on human environment consisting of 17 people from different disciplines. It is this group that is writing up material for the Stockholm Conference in 1962.

We have inscribed in our fourth plan document a vigorous plea for paying urgent attention to the examination of our environment. We are making an intensive study of our urban populations; we are studying our rural settlements, our farming methods, our arid zones, our monsoons. We are developing some ideas in regard to a rational use of our resources. We are asking our economists and planners to assess the situation arising our of rapid but haphazard industrialization, pollution of our environment; we are asking our ecologists to survey our river valley biology, our high altitude biology and our forest biology. We have a vigorous meteorological department which is engaged in the collection of data. We have in our atomic energy establishment machinery for the detection and determination of radiation in the atmosphere. We have in Nagpur, a Central Public Health Engineering Institute whose recent and important concern is the problem of pollution of our air and waters. But it is my belief that we do not have strong bases for our environment studies, either in the universities or research institutes in our country. We recently had, under the auspices of our science academy a binational conference on ecology. I have often been asked if I would advise starting an ecological institute, but I am appalled at the prospect of looking and not finding adequately trained personnel to man it.

One of the most extraordinary features of population distribution is that the city always attracts—never releases. The movement is always towards the city, almost never away from it. In India, the migration of people from rural to urban areas during the decade, 1951–60, was 35.2 percent, while in the reverse direction, from urban to rural areas was only 5.2 percent. During the period new cities have come into being, old cities have become larger, more disorderly, and grown in a fungal manner. The localization of many industries in some of these cities has brought a great number of rural people in search of employment. Nowhere, in no city, old or new, has the growth of the services kept pace with the growth of population. The unimaginable crowding, the enormous and intolerable pressures of the population on education, housing, sanitation and transportation, have brought almost all of these services to a standard breaking point, and one wonders how anything works at all. We are concerned with all this and we are making studies of it.

But there are some interesting problems here, of special relevance to any developing society and not merely ours. Environmental degradation, so often evident in highly industrialized countries, has often been cited as the villain who is corrupting developing societies, and warnings are issued against industrialization. Pollution or environmental degradation should not be used as a threat to developing societies. In fact, if I may submit, it is extremely important that the developing countries do not obtain the impression that advanced

countries are attempting to thwart development by using pollution as a means by which industrialization is either halted or slowed down. I may refer to the plea by India's representative at the United Nations who, recently protesting against the imposition of processing plants on industries in developing countries, said that by doing this, the industry would become nonviable owing to increased cost, and pleaded for special tariffs for developing countries to counter this.

A sidelight is provided by DDT. It is now well known that DDT has been found in the bodies of animals far away from the areas where it is applied. It is also well known, though some intensive work is going on, that DDT has some adverse effects on the organism. It has been noticed that in spiders, webbuilding becomes defective over certain concentrations in their bodies of DDT. Mice do not care for their young as well as normal mice do with certain concentrations of DDT. But consequent to this, do we ban DDT in underdeveloped countries? Having done this in an experimental manner and for a short time, malaria has made its reappearance in Ceylon. The program was abandoned in 1965, as you know. By 1968, 1 million cases of malaria were noticed and no part was free, and the Government asked for 10 million pounds of DDT to recover control. What is good for a technologically advanced country is not necessarily good for a developing one.

Mr. Chairman, answering specifically some of the questions posed in the communication from Senator Magnuson and Chairman Miller so far as India is concerned, I wish to say this:

We do know, reasonably accurately, what our population is today. We do not know what it is going to be in 1981.

We do know that population is our most urgent, important, and pressing problem. We are making valiant efforts to solve it but I am afraid we are hamstrung by constraints, both scientific and sociological. We are looking for breakthroughs in both areas. They have to be urgent and spectacular—particularly scientific ones. We need your help in making a scientific breakthrough.

We do know we shall be able to provide food for a few more people, but not many more—by means that we now have at our disposal or we might acquire in the very near future. But we shall never be able to give them the other things they need to have—shelter, clothing, health services, education, transportation—not for those we already have, not for any more we are almost certain to have.

We need to have more information on the relationship between man and his environment in a poor, populous country; we need to know the details of the interaction between one and the other in a constantly changing situation, where one is increasing all the time, the other deteriorating all the time. We need intensive sociological studies.

We need vigorous training programs, not only in basic environmental sciences, but in the related and highly relevant field of animal and human behavior.

We should be glad to cooperate in any international endeavor directed toward intensifying environmental research, monitoring, and data evaluation. On behalf of the Indian National Science Academy,

I would like to assure this group that we shall be happy to participate in any such global effort.

Information on the status and trends of environmental quality in developing countries is extremely meager. Also, it is complicated by the fact that the problems of environment in these countries are often linked with economic, sociological and political factors—even more than they are in developed ones. Hence it might be necessary to approach them with greater caution. But I am sure they will react positively to any international effort which is aimed at improving environmental quality in these countries, without impeding their development and progress.

This conference needs to express concern toward the special problems of environmental quality in developing countries. It is in these countries, where traditional societies are reaching out into modern scientific and technological living, that some of the great problems of environmental quality remain, and it is necessary not only to identify them but also attempt to solve them.

For today, environmental quality might appear to be a matter of local interest. It will not be too long before it becomes the oppressive concern of the whole of mankind.

Thank you, Mr. Chairman; my profound apologies for exceeding my time.

Senator MAGNUSON. Thank you.

I think we all know the burden of financing development in developing countries is heavy in this field, but also we know, too, that these countries have got to share some of that financial burden in developing their particular problems, such as in India.

I wonder if you would agree with me that not only should we discuss the financial assistance matters in the future in countries such as India and other developing countries, but also methods and ideas, through the exchange of ideas. I think the 1972 conference should give some sufficient attention to the economic impact of the measures designed to preserve the environmental quality, and they are different in different places. But they all work together, and I am hopeful that we can do what you suggest, that we not only be a global network in this matter but that all the things are involved.

In your statement you mention a great deal of conflicting accounts about radiation. Well, we in America can make a contribution in that field. I am hopeful that we will have Dr. Seaborg meeting with us, for whom I have great respect in this particular field, because you are going to be involved in nuclear power in any way you look at it in the future, whereas Chile might be thinking of more hydro development. They have the rivers, they have the streams, and these are two different things.

Hydro power isn't going to suffice for the world.

I think you have made a good contribution here, but these are the things we want to find out. In the meantime, you are working on them. I am greatly pleased with the amount of work that India itself is doing in all these fields. I think you pointed up here the tremendous problem.

Do the southeast Asians have scientific cooperation with mainland China? I am talking about weather reports, things of this kind. Do you have an exchange?

Dr. SESHACHAR. I wish I could say we have a vigorous exchange. I am hoping to be able to have some of this embark on a vigorous plane from now on. As Dr. Malone mentioned, I have just taken over as president of the academy, and one of the first things that I did was to impress upon my colleagues the need for not only developing cooperation with western countries, Europe and the United States, but to look at the other countries in that area.

Senator MAGNUSON. I think we can look in the future and find out that there will be more of that going on in these particular fields.

Just one other question that equally interests me. When you don't eat meat, you have got to have some source of protein, don't you, for good health?

Dr. SESHACHAR. This is——

Senator MAGNUSON. This is what people tell me.

Dr. SESHACHAR. This is a big problem. I did include a little bit of it in my original paper, but as a consequence of a lack of time I had to omit it.

One of the most important and unique features of the Indian situation is her cattle. We have an enormous number of cattle. They serve several purposes—milk to a small extent. I believe the milk yield from Indian cattle is a small fraction of what it is in Europe, in Switzerland, in Holland or in the United States. But the cow is the other thing. It is fuel. It yields skins and hides. It yields fertilizer. And any advocate of doing away with these cattle has therefore to be confronted with the problem of greatest urgency consequent on this change. Cattle is competitive with man in the scarce resources which already obtain in the country. But it never affords meat. I can't foresee in a reasonable time—when somebody asks me how soon do you think the people of India will be able to eat cow's meat, I say 1,000 years, and I am optimistic, because it was 2,000 years ago that it was banned, and I cut it into half. I may have easily said 2,000 years more.

This is a very big problem.

Senator MAGNUSON. We are embarking on some very exciting projects to get from the seas a simple, cheap source of protein. I don't know how many articles Dr. Spilhaus has written on this, but he has written plenty. It may be that someday you are going to look to the various sources of protein in the Indian Ocean which India hasn't done much about, have they? And there we can exchange ideas.

Dr. SESHACHAR. Sure.

Senator MAGNUSON. There is enough food in the seas if we practice conservation to take care of much of the world's needs for protein, if we use it right and don't just despoil it.

I appreciate your statement.

Mr. MILLER. I would like to congratulate the doctor on his very fine statement. I think he has given it a lot of thought and he is telling us something that we should follow, that we have got to go a little slow on this thing.

You speak of protein from the sea. All of a sudden we find all of the fish being taken in the sea are filled with mercury and we can't use them. So, let's take another look at this. I don't subscribe to this

theory nor do I subscribe to the theory that you can feed the world out of the sea.

I happened to be the executive officer of the California Fish and Game during the war, and as a matter of fact very good scientists who were agriculturalists criticized us because "look at the acres in the sea that are not producing." I don't know whether Dr. Spilhaus agrees with me or not; you can only catch fish where you have the food to grow these fish, and this isn't in every acre of the sea. These are the things we have got to look to.

Senator MAGNUSON. We have got some two, three, four or five other exciting programs going on in aquaculture, where an acre of water will produce much more of the protein type of food than an acre of land.

Dr. MALONE. In this period of New World environmentalists, it is good to find someone who has been doing this since 1967. He earned the Ph. D. at Uppsala University in zoology at that time, and he has been teaching in Sweden since that time. He is one of the most respected authorities on environmental monitoring. Dr. Bengt Lundholm, who is the secretary of the ecological research committee of the Swedish Natural Science Research Council, is here to speak to us.

STATEMENT OF DR. BENGT G. LUNDHOLM, SECRETARY, ECOLOGICAL RESEARCH COMMITTEE, SWEDISH NATURAL SCIENCE RESEARCH COUNCIL

Dr. LUNDHOLM. Thank you, Dr. Malone.

Senator Magnuson, Congressman Miller, honorable Members of the Congress, ladies and gentlemen, first, I want to express my gratitude to have this privilege to address this colloquium.

The environmental crisis is caused by a conflict between short-term interests and long-term damage. This depends partly on our ignorance of the laws governing nature. Natural laws might be defined, in contrast with civil laws, as the kind of laws you discover only after you have broken them. But the really difficult thing is that there might be a long time interval between the lawbreaking and the effects. When the law is established and the case is proven or the corpses are on the table the damage is done.

Another reason for this predicament is that we refuse to learn from earlier experience. To take one example. We have at least 2,000 years of experience of lead as poison and in spite of that we put it in the gasoline to be disseminated in the environment by the most efficient method. And what is more, many so-called experts are ready to assure that this use of lead is quite harmless. To take a more serious question: you do not have to be a biological genius to predict that the use of pesticides should give short-term profits, but that the end result might be very serious.

Earlier we also failed to recognize that the human environment is a unity and that you lose the necessary unitary overview when you deal only with isolated parts. This fragmentation of the environmental approach is one of the reasons why we have failed to handle the present situation with success. In exposing the present critical situa-

tion scientists have played an important role. It is, however, interesting to notice that the most important contributions have been made by scientists outside the critical problem areas. Very often specialists from a neighboring field have moved in. Instant ecologists are commoner and commoner, and we have to be very grateful for that. For this reason I think it is very important that the whole scientific community has access to all the relevant facts in relation to environmental problems. This is the only way to get an integrated view of these problems.

It is also important to keep in mind that the present crisis is caused by the established institutions and patterns of action in the field of economics and technology. These institutions and patterns have not considered the long-term ecological approach to environmental problems. To improve the situation, changes in the structure are necessary. But there is always a resistance against changes and the old structure will be defended by the experts who in many cases have a vested interest in the existing situation.

I have given this general introduction as a background to the question in my invitation letter regarding the available information and its use by law decisionmakers in parliaments and the United Nations. The lay decisionmakers are in a very difficult situation in relation to the experts. The politicians have to evaluate the experts, and must be aware of the fact that you can always obtain experts to defend any position. But the politician has also to realize that some so-called experts are, because of their position, hardly able to cut off the branch they are sitting on.

The remedy for this is of course to use independent experts. Here it is easy to refer to the scientific community as a source for independent experts. But the situation for the politician will probably not be much easier as science is to have a different opinion, and certainly even the so-called independent scientists will disagree. A good scientist should change his opinion depending on the facts, but good scientists are rare. Many studies have revealed that most scientists never change opinions; new opinions and new ideas are generated by the rising generation of new scientists.

For that reason I think it is very important for the politicians to listen to the young scientists. In Sweden the most important contributions to progress in the environmental field have been made by the "young, angry scientists."

But it is not only the decisionmaking politician who is confronted with the difficulties in choosing between contradictory pieces of evidence; the scientific adviser has the same problem. The difference is that the politician is not expected to be able to evaluate the situation which the adviser is. The politician can always be excused as having a bad adviser; the adviser can never be excused. The main thing, however, is not to protect the politician nor the adviser, but to make the right decisions.

I think the only way out of this dilemma is to try to deal with all the evidence and all the facts in relation to the environment in an open way. If all information is free and open the whole scientific community with its angry young men will have the situation under constant and critical surveillance. I think, however, that we have to

bear this burden in order to avoid mistakes. Even if only one "alarm" in 10 is correct, it is well worth it.

To sum up this point I think that it is essential that the environmental questions are handled in a very open way. And I may add here that in this case other countries have a lot to learn from the United States. The congressional records and hearings are particularly good examples of a correct handling of the problems and these records and hearings are very valuable to the rest of the world.

A further reason to have an open handling of the environmental problems is that it will be the basis for an international information exchange. As I have some personal experience in this area I will elaborate on that. First, I must stress that this information transfer is extremely important. We have the curious situation that information from outside—from foreign specialists—has greater impact than information from internal sources. I can give you one example. When the basic Swedish report on the environmental situation was published in 1967 there was a small notice about the DDT content in human milk. This caused no comments at all in Sweden but when these facts were told in the United States by a young Swedish scientist they were really noticed. And then Sweden got this alarming news from the United States. The impact has increased with the distance.

My personal opinion is that Sweden has gained enormously from the information flow from the United States in relation to environmental problems. I think also that this information flow is mostly based on a very personal basis. Sweden has a well-developed system of scientific attachés and these are doing a very good job, but if you really want to have critical information you have to go to the country to get it yourself through personal contracts and by mutual friendship. It is always very difficult to organize an information exchange in a formal way; it must be done in a more personal way.

I said that Sweden has gained quite a lot from the information flow from the United States of America. There are, however, reasons to believe that this information flow has been rather one-sided. As my own research committee in the Natural Science Research Council has been one of the main receivers of the information from the U.S., I have tried to analyze the situation. I think the main reason is the language barrier. The Swedish scientists have no time to publish the results in English. You get progress reports and they are always written in Swedish. Even if an American scientist is informed about research results, it is very difficult to digest them without any written records to fall back on.

We in Sweden now have a feeling, however, that we have to improve the situation and give more useful material in return for the very valuable information from the United States. The Ecological Research Committee has recently decided to have all progress reports in relation to ongoing projects written in English. Much has, however, still to be done. To give one example, half a year ago a summary report on mercury was published in Swedish. In this report the Swedish research during the last 3 years is reviewed. The report also contains a lot of information published for the first time. This report is not yet published in English but I hope it will be

very soon. My point here is that due to the language barrier this area has been almost closed to non-Swedish-speaking scientists for 3 years.

In your invitation letter you have the following question:

> How can the lag time between the appearance of environmental science data in the scientific literature and its digestion or interpretation for decisionmaking be shortened without degrading the reliability and validity of the knowledge?

First, I want to point out that in the environment field we have a very curious situation caused by both the urgency of and the special attention to these problems. The scientific results are in many cases going directly from the laboratories to the decisionmakers. The publication of the results is coming later and is of less importance. This has been the situation in relation to several contamination problems. The research results have been in the headlines of the newspapers. From many points of view this might be a dangerous situation as the decisionmakers may act too quickly on immature evidence. But in general from the scientific point of view it is better to have quick reactions than to have no reactions at all.

The general aim should, however, be to shorten the time for the transfer of the scientific results to the decisionmaker. This can be improved by an active gathering of information directly from the scientists. It is of importance that all relevant information is collected and I want to stress once more that also the results from a "lower scientific level," that is, from the young scientists, are used. The information flow from the young scientists to the establishment is often ignored.

I think it now should be possible to try to start such an active information gathering on the international level. It is an area where even moderate funding contributions will give a great payoff. The objective of such an information service could be twofold: To collect relevant information for the decisionmakers and to gather information to allow a better resource allocation and research planning for the environmental field in order to get the most needed information.

Such an active information system should use consultants to get an evaluation of the specific problems. This we have done in Sweden with quite good success on the national level. Young, bright scientists have been asked to review a specific problem and give their personal views.

Such an information-gathering system must be international and it could well be organized within the ICSU framework. The costs for such a system can be kept low and the annual budget could at the start be $2 million.

Environmental problems are often very complicated and the interrelationships difficult to understand. Because of this, it often happens that a statement or a conclusion based on what a scientist regards as very solid and clear facts means nothing to the decisionmaker. Here it is very easy to blame the politician and regard him as stupid, but I am not sure that this always is the case.

The problems may be very difficult to understand, especially as you in many situations have to visualize effects far ahead in the future. But I think the main reason for the lack of communication be-

tween the scientists and the politicians—and I will also add the public in general—is that most scientists are not used to expressing themselves in a way that the layman can understand. Especially when the scientist is trying to be very strict and objective, as when judging environmental problems, his statement may be both dull and meaningless. If, however, the statement from the scientist is transformed by the news media and transmitted to the general public—and voters—the message will get through to the politician very quickly.

I can hear the objections from the politicians and the officials. They have the opinion that the journalists always overstate—to use an understatement—the case, and that they are far away from the truth. I have heard these complaints against the journalists many times in Sweden, especially in relation to the very dramatic mercury situation. The role of the news media in relation to the mercury problem in Sweden has been investigated in a special study from the Institution for Political Science at the Stockholm University. I just want to quote the main conclusion regarding the objectivity of the journalists:

> The journalists have to be complimented for their aim to transmit the scientific results in a clear and easy understandable way without excluding any aspects.

I think we are very lucky in Sweden to have had very competent journalists and that the response toward environmental questions has been very positive from the big newspapers and from the Swedish radio and television. Thanks to that we have a public opinion which is very well aware of the environmental problems; more aware than the politicians, as the present battle over the elms in Stockholm shows. I would thus like to stress the vital role to be played by well-informed and technically expert science correspondents who can act as a kind of midwife in bringing often apparently unimpressive and obscure scientific information to life and relating it to the real world.

I thus think there are very good reasons to include the news media and the general public in the information dissemination. Ultimately environmental problems are the concern of all people and the information to everyone is very important. To sum up, active information gathering and an open and free information dissemination is essential.

The relation to international environmental research:

First, I want to point out that environmental problems might be divided into two main areas:

(1) The contamination area with all the pollution problems, which make the headlines in our newspapers; the decrease of environmental quality which is especially troubling and threatening the industrialized and rich countries;

(2) The resource management area which is based on the proper functioning of the world's ecosystems and which is vital to the future of the whole earth; in the rich countries we are not aware of this problem. If the Swedish farmlands are not producing crops we can always buy the necessities from some tropical country and probably also buy it cheaper. In the LDC's these problems are of vital urgency. The damage caused by mismanagement will have immediate effects, and pollution problems have here a much lower priority.

If we look at the international research activities within the field of pollution we find a multitude of organizations mostly of intergovernmental character. Substantial funding is needed to keep these organizations going. There is a great need for coordination but this is very difficult and we should not expect an easy way out of these problems in the international field when it is impossible to do such a coordination on the national level for most countries.

This international system is, however, of very great importance for information exchange and for the personal contacts. The actual research promoted by these international activities has generally a very small volume. The reason for this is that most of the international agreement on mutual research is very seldom carried out in an efficient way. This depends mostly on lack of time and lack of funding and I think also lack of real confidence in this type of research. These are, of course, very personal opinions, but I would like to suggest that independent investigations should be done to find out the concrete results of the present international activities. I have tried, however, to examine my own experience and I am inclined to regard the value of the information exchange and the personal contacts well worth all the costs, even if value of the actual research results is reported as nil.

The situation in the other area—resource management—is quite different. Within the applied field there are several U.N. agencies doing important work. The main problems of the functioning of the ecosystems have until very recently been a very neglected area. An attempt to cover these areas was done with the start of the International Biological Program, which is a nongovernmental program.

During the last 2 years remarkable things have happened within this program. It started with the biome studies in the U.S.A., which now have developed into a quite new type of international scientific cooperation. It is a cooperation directly between scientists and scientific institutions at the grassroots level in order to find out how the grassroots function. It is a cooperation and international planning in order to get results, which all the participating scientists regard as essential in order to understand the processes of the biosphere. The research is done without bureaucratic overhead. It is fundamental research which will be the base for the understanding of productivity of the earth. IBP will soon be completed, but the biome studies have just started. I think it is very important to keep this research intact and nurse the spirit of international cooperation without political interference.

I also think this is an area of importance both to the developed and the less developed countries, as Dr. di Castri will tell you. In order to avoid political disturbances it might be wise to use nongovernmental organization as a framework for this research.

At last I want to say a few words in relation to monitoring of the global environmental changes. The Secretary General for the UN Conference on the Human Environment in 1972 has asked SCOPE to design "a coherent global environmental monitoring system."

SCOPE has erected a special commission on monitoring to do this job. The international scientific community is thus already being used to prepare this report; at the same time there will be an intergovernmental working group on monitoring. A close cooperation between these two groups will take place.

If there will be agreement to set up a global system for monitoring, the hardware must be the responsibility of the national governments. A system must be based on an agreed coordination of national activities and at the same time a coordination of already existing international efforts. A high degree of coordination and intercalibration is needed to avoid fragmentation. In my opinion this must be an intergovernmental responsibility.

I think, however, that the international scientific community has to play an important role in the evaluation of the results from a global monitoring system.

During the 10 years when environmental problems have been my every day worry I have seen how so-called "alarms" have grown to be serious problems. The concern for these problems is now worldwide. Some regard the future now as rather bleak. A similar reaction occurred when a global nuclear war was a threat. Now, however, the situation is very different. In relation to nuclear war we feared that someone should press the button and cause a quick end. In the environmental crisis the buttons are already pressed and we are all pressing. The end may come, but we hope—or fear—that it will be in the next generation. This metaphor is probably exaggerated, but my point is that we are all involved as never before. This gives the present crisis quite new dimensions.

I have been able to follow rather closely the development of the environmental questions and the shaping of the environmental policy in the United States. I have also been able to compare with other countries. When I first visited your country in 1964 or 1965 I was struck by the dimensions of the problems and the power of the destructive forces.

At the same time your administrative system with its different levels—Federal, State, county, municipality—seemed to make integrated solutions very difficult. Looking at the United States today the situation has completely changed. You have tackled the problems in a very successful way and you are ahead of all other countries especially in the conceptual field. Why? Many reasons, of course, but one may be that my earlier conclusion regarding the negative effect of the many different levels was wrong.

Looking at the specific environmental problems and their solutions, one point is rather startling. A local problem is often for a lot of reasons very difficult to solve. Too many are involved and the approach is too limited. Looking at the same problems at a distance, the solutions are easy and obvious. A "federal level" may provide this useful distance and overview and is also backed up by a large majority. A powerful "federal level" may thus be a very useful tool to achieve rapid progress in the environmental field. In most countries this high level of overview and concentration of excellence is lacking and the progress is slow. We have again increased impact with increased distance.

Transferring these ideas to the global field an increased internationalism can be of great importance. Strong international bodies or bodies of good international expertise could get the overview and they could also get a very strong support by the public opinion of all countries. This support will be strengthened by the fact that we

all are concerned and by the fact that we all have a sense of common responsibility.

We are facing grave problems. The scientists have to find out how the biosphere is functioning, and the laws of nature. The technicians have to find a technology suited to the laws of nature. I think both the scientists and the technologists will succeed. I think, however, another task is even more difficult and important, and that is to create a political system—a democratic political system—to govern spaceship Earth. That is the task of the politicians. Your responsibility, gentlemen.

Thank you very much.

Senator MAGNUSON. Thank you, Doctor. We all appreciate that fine message.

Before we adjourn here today, I think I speak for everyone by saying I appreciate the extension of the hospitality of Sweden for the 1972 conference.

I don't think anyone has suggested yet for the record, but what is the date we are supposed to meet in Stockholm?

Dr. LUNDHOLM. The first half of June.

Senator MAGNUSON. Mr. Chairman, if I may be permitted, I would like to put in the record at this point a speech made by the Senator from Maine, Senator Muskie, last week at the United Nations. Mr. Strong was there, and others.

I notice that representatives of the Soviet Union and India were there, and many other nations, and specialized agencies of the United Nations.

He identified what he thought were four steps which deserve high priority, and if I may be permitted, I just want to read them, because Senator Muskie has been chairman of the Subcommittee on Air and Water Pollution in the Senate, which has been dealing with many pollution matters in this country.

He says, "We must more effectively coordinate current international policy toward environment." I think we are all in agreement on that.

"Two, we must set international standards and norms for environmental behavior where they are possible.

"Three, we must establish an international system for environmental control."

The last one is quite potent. He suggests that "the nations that have shared the financial benefits of environmental anarchy must now share the financial burden of environmental control."

I think part of that is what this is all about, too. So, I would like to put this in the record anyway, so it will be there.

(The statement follows:)

STATEMENT OF HON. EDMUND S. MUSKIE, U.S. SENATOR FROM MAINE

"AN ALLIANCE FOR SURVIVAL", CONFERENCE ON INTERNATIONAL ORGANIZATION AND THE HUMAN ENVIRONMENT, NEW YORK CITY

Today, we meet in the forum of man to discuss the survival of man.
In other times, people have come to the same place for the same purpose.
But today's crisis is different from most the United Nations has seen.
No ultimatum signaled its coming—and no bugles summoned its contestants. What is at stake is no one's security and everyone's life. Ally and adversary, we all share the pain and the danger of the environmental crisis.

A wall may keep freedom out and people in—but no wall could be high enough to keep the smog out of Potsdam or inside West Berlin.

Artillery and aircraft once turned the peaceful Ussuri River into a tense borderline—but bullets and bombs cannot deter the bacteria in the water that separates China from Russia.

The Israelis and the Arabs have fought over Sharm-El-Shiek—but war and the threat of war will not avert a disastrous oil spill in the Gulf of Aqaba.

Americans cannot travel to North Korea—but Americans breathe the same air the jet stream carries here from there.

The simple truth is that no place on our planet lives alone—and no place can deal alone with the pollution of the planet. We are far from one world politically—but, by necessity if not by choice, we are one world environmentally. And the crisis of the environment has made us common victims of a common adversity.

Together, we must create something better.

Together, we must build an alliance for survival—an alliance beyond our separate ambitions to serve our shared interests—an alliance that includes all nations and excludes no nation. That is our only decent chance—and our only real choice.

People are the issue. States have sovereign rights—but so do people. People have a right to clean air and clean water. They have a right to the international resource we call the ocean—which gives us food and even the atmosphere itself.

So much hangs in the balance. We cannot rely on the political habits of the past to save our environment for the future. We may be tied to habit when we take up the issue of war and peace. We must free ourselves from it when we turn to the problem of pollution. And I believe that now is the time to try.

Our best hope for initial success is the Stockholm conference next year. The composition of the conference should be equal to the scope of the conference. It should be as universal in 1972 as the United Nations should become in 1971. The General Assembly should ask every government in the world to a meeting called to consider pollution everywhere in the world. And the most essential addition to the conference is the Peoples' Republic of China.

China is too large and too populated to be left out. It has the world's greatest river system and one of the world's longest coastlines. It is a growing industrial power and a maturing consumer power. Its present and potential impact on our human and physical environment is comparable only to the number of its people. We simply cannot expect to create an environment that will work for man if our efforts ignore one-fifth of mankind.

And the General Assembly should not refuse China an invitation to Stockholm out of fear that China would reject it. That might happen—but it might not. A time of ping pong diplomacy holds out at least some hope for the success of environmental diplomacy. If China is willing to let its athletes compete with the rest of the world, China might also be willing to let its scientists help the whole world survive. It is worth finding out—and it is vital to find out.

If China will not participate in 1972, the United Nations should issue similar invitations in the years to come. I believe that, in the end, China must say yes to the invitations—and yes to a safe future for our fragile environment. An alliance for survival is in China's interest because it is in the human interest.

It may take time to convert that simple perception into international policy. But we cannot just sit back and wait. An alliance for survival incomplete at its inception would still be an infinite improvement over no alliance at all. And we must begin now. The crisis in the environment commands our immediate attention and our best efforts. In 1971, every concerned nation must become a partner for environmental protection. Every concerned nation must co-operate to create a multilateral attack on pollution.

If we can spend billions for our security from each other, then surely each of us can spend some of our wealth and some of our power on the common security of man.

Four specific steps deserve the highest priority.

First, *we must more effectively co-ordinate current international policy toward the environment.*

No one believes that present international arrangements can alone resolve the crisis. But we must make sure that we are doing as much as we can with what we already have. Co-ordination should be centralized at a high level in the United Nations to direct priorities, to avoid wasteful duplication, and to assure comprehensive action.

The exact design of a co-ordinating mechanism and the role of U.N. agencies, new or old, are matters for intensive study and prompt action. And the resulting structure must reach beyond the U.N.—to take advantage of the promising efforts of other multilateral and regional organizations.

Second, *we must set international standards and norms for environmental behavior.*

Some very serious offenses—like dumping certain toxic substances into the ocean—should be flatly prohibited. That is something the Stockholm conference should accomplish next year. In less troublesome areas, we may be able to rely on recommended uniform practices. But whether standards are mandatory or voluntary, we must speed up the process of setting them. We must assure that the best scientific opinions are taken into account as knowledge and circumstances change. And we must minimize the competitive disadvantages in world trade of acting responsibly toward the world environment.

Of course, setting standards as a national as well as an international duty. For example, the United States can—and should—move against American firms for the environmental excesses of their foreign subsidiaries. No company should ever be permitted to export its pollution.

Third, *we must establish an international system for environmental control.*

We do not know enough about the trouble the world is in—and consequently we cannot do enough about it. The remedy is to identify, analyze, and diseminate relevant information about the global environment. We have seen a hopeful beginning in limited sectors—the prime examples are the World Weather Watch and the reports on threatened animal and plant species by the International Union for the Conservation of Nature and Natural Resources.

But we cannot stop there—or even with an expanded version of monitoring physical data. Equally vital is the monitoring of national environmental policies. American law requires America's government agencies to submit detailed statements before they do anything that might impair the quality of the environment. I believe those statements should be passed on to the United Nations. I believe other countries should adopt a similar policy. And I be'ieve that the U.N. should apply the same standard to the conduct of its own agencies.

This system wou'd let every government review and comment on what every other government was doing. I doubt that any country is yet prepared to grant a veto over all its decisions about the environment. But every country should be prepared to consult in good faith—as a first step toward an institution with the power to prevent the pollution of resources which belong to people everywhere.

We must learn a hard and fundamental truth: The atmosphere—which is essential to life—and the ocean—which is the source of life itself and of the renewal of life—are in jeopardy because of man himself. We can save them from man and for man only if they are brought under international jurisdiction.

We have a treaty to protect the empty blackness of outer space. At the very least, we should agree to full disclosure and due process about what happens here on earth—to the air we breathe and the water we drink and the land that sustains us.

When some scientists tell us that five hundred SSTs could destroy the ozone in our atmosphere and leave us exposed to deadly radiation, we cannot afford to let one nation decide for all mankind. Every interested country's voice should be heard—and such voices should be heeded. The international community must determine the truth about its environmental dangers before the SST is allowed to fly.

And that principle must prevail across the sweep of the world environment. In the years just ahead. we will hear more and more about the harm one country has inflicted on the ecology of others. The construction of large dams may flood a nation upstream and dry up the irrigation system of a downstream neighbor. The disposal of wastes in rivers and estuaries can hit another country hard—and so can efforts at weather modification. In all these areas, men must find and face the facts together—and then men must decide together.

Fourth, *the nations that have shared the financial benefits of environmental anarchy must now share the financial burden of environmental control.*

We must beware of the voices that are urging the third world to settle for stunted development in the name of the environment. That advice is self-defeating—it will never be taken. And it is also wrong. We cannot sacrifice the human environment to the physical environment. We are against pollution—but we are not against people. We cannot begin an environmental crusade by telling primarily the poorest nations among us to ask what they can do for the world.

Before we who are lucky enough to live in a wealthy society start lecturing deprived societies, we should look to our own backyard. When I was a boy in Rumford, Maine, my friends and neighbors used to sniff the odor from the mill and say—"that's the smell of money." Why should we expect Asians and Africans to react differently?

What we should expect of them is what we expect of ourselves—a readiness to control the impact of industry and agriculture on the quality of life. But we cannot ask them to pay every cent of their own bill. They lack the profits we have already made from pollution. We must now use some of those profits to help them help the environment.

Economic aid should give the developing countries the chance to install anti-pollution devices at the outset of industrialization. We should be willing to pay more for less damage to the environment. We should also be willing to give international lending agencies the power to grant low interest development loans—loans that would prevent pollution now and would have to be repaid only in prosperity. If the advanced nations now believe that a product like DDT is a threat, they should provide the third world with any cost difference between it and a safer alternative.

It would be a crime to stop progress in the developing countries. And it would also be a crime to lose their unique opportunity for progress without pollution. Decent development and a decent environment are one and the same. That should be their goal—that should be our policy—and we should put our money where our advice is—and our interests are. After all, it is our environment as well as theirs.

All of this will require tough, tedious nuts and bolts work. But that is the only way to build an alliance for survival. That is the only way to succeed in the essential adventure of saving the earth God made—and the world man has remade.

But direct action to save the physical environment cannot be the sole aim of our alliance. There would be little consolation in saving every endangered species except people. And even in the best of all possible physical words, man could still disappear.

We could be engulfed by the weight of our own numbers—numbers too great for any miracle grain or any land use.

We could destroy ourselves in a quarrel over the vast gap between the majority that is poor and the minority that is well-off.

We could sacrifice everything for a border that is in doubt or a negotation that has been broken down.

So ultimately, an alliance for survival must move beyond the physical environment. It must encompass the total environment. And it must provide support for effective U.N. peacekeeping, enough population planning, more development capital, and real arms control. An alliance for survival will finally fail if our countries continue to stagger under an arms spending burden of $200 billion a year.

Let us begin to put the alliance together in the fight against pollution.

We can bring governments like China into the effort without pushing other differences into the foreground.

We can make ideological adversaries environmental allies.

We can make men and nations see their shared interest in defeating the shared danger.

And from there, with luck and commitment, we can turn to the other assorted agonies of the human condition. If we once learn to work together to reclaim our physical environment, perhaps we can then create the environment or tranquillity and justice.

Your conference can point the way—to Stockholm in 1972 nad to a more decent future in the twentieth century.

You can teach us to do the work of peace and avert the terror of war.

You can help us to realize the political renewal of the United Nations, which President Kennedy called "our last, best hope."

Then, some day, we will no longer have to come to the forum of man to struggle for the survival of man. We will instead debate and decide how to make the most progress for people.

That seems a distant dream—and it is. But I believe we can make it real in a universal United Nations committed to the total human environment.

Thank you for trying.

Senator MAGNUSON. The House Committee, as their mission, has the whole field of science, but the Commerce Committee has been quite active over the years in dealing with oceanography, which is one part of this.

I think we have come a long way in international cooperation in that field. There is an exchange of oceanographic information. On many of our research ships, we have aboard scientists from all nations dealing with that problem.

The people in the Senate that are involved—Senator Humphrey, when he was Vice President, did a great deal about this. So I think you will have the almost unanimous support of the United States Senate. I am going to let Congressman Miller speak for the House.

Mr. MILLER. I think it is a question with which the House is very much concerned. A while ago you met five members of the House over here, representative of different committees of different factions of it, which are greatly concerned with it. They are all alive to the situation.

I think a great deal of this started some years ago when the National Academy of Sciences filed its great report on oceanography, and that was one of the starts of it. It came out of the IGY and it was a follow on to that, and this has been a follow on of the IGY over the years. We are all concerned with it.

I want to congratulate Dr. Lundholm, and the others who are here today, who have made these great contributions to us. I do appreciate the privilege of being here.

Senator MAGNUSON. Also for the record, I think the people here involved would agree with me, there was some doubt about the International Geophysical Year when it was started, and we had some trouble in the Congress even getting a small amount of money to participate.

I don't think there is a person in the world involved in this whole field that would not say the International Geophysical Year was a success.

It was.

Mr. MILLER. The great success was the foundation it provided toward what we are doing today.

Dr. MALONE. Senator, I understand from Mr. Nichols that the colloquium record will be kept open until June 8, and that participants and those in the audience are invited to submit papers or additional statements relevant to international environmental science for possible inclusion in those printed proceedings. Just send them to Mr. Nicols, in care of the House Science Committee.

Senator MAGNUSON. We can keep the record open for a period of time in case you people want to read it and might want to make a few corrections. Sometimes we have to do that on figures and things of this kind.

Mr. MILLER. A couple of people who came into the audience are old friends of mine. I would like to direct your attention to them.

You remember Dr. Spilhaus, don't you?

Senator MAGNUSON. He has been in the field of oceanography for a long time, and we have an old friend of both of us, Dr. Revelle.

Dr. Spilhaus, do you have anything to add to this?

STATEMENT OF DR. ATHELSTAN SPILHAUS, WOODROW WILSON CENTER FOR INTERNATIONAL SCHOLARS

Dr. SPILHAUS. Yes, sir.

I wanted to add something to you on your remark on the question of the business of getting food from the sea.

There are a lot of scientists arguing as to how much food it is possible to get from the sea. These arguments, it seems to me, are pointless, even though they come from wonderful scientists who don't agree.

Why don't we have a massive program, the extension of that program which is being tried in your State, Senator? Why don't we have more money put into trying the experiment of getting food from the sea instead of studying it to death?

Why don't we take the step jump?

Why do we subsidize the prehistoric hunting in the sea—fishing they call it—instead of taking the step jump toward farming the sea?

The same thing in the shipping business. We are trying to compete, unsuccessfully, with old-fashioned ships instead of doing the kind of thing we could do, preeminently well, automating ships, taking factories to sea, doing the kind of step jump on the sea that we will need if we are going to farm the sea.

We have no national commitment in these great experiments, and let's quit just analyzing what might happen. Let's try it.

STATEMENT OF DR. ROGER REVELLE, DIRECTOR, CENTER FOR POPULATION STUDIES, HARVARD UNIVERSITY

Dr. REVELLE. I disagree rather violently with Dr. Spilhaus.

The problem of the ocean right now is the problem of pollution, and the inshore waters particularly are being devastated by many of the kinds of pollution, including just junk thrown into the ocean by all of our seagoing friends.

If you had heard Captain Cousteau on this subject, you would realize how much things have changed in his own vision as he has been diving over the past 20 years.

I think our real problem with the ocean right now is to preserve the oceanic biosphere, to learn how to manage it; to learn how not to overexploit it, but to use it as it can be used.

This does not mean, so far as I can make out, factory ships or modern equipment to scoop up every last fish in the sea.

It may very well mean some kind of farming in inshore waters, where we can take advantage of the currents which bring phytoplankton and small zooplankton past organisms which are fixed on the bottom.

I must say I am very worried about the overexploitation of the oceans at the same time that chlorinated hydrocarbons, oil, poisonous chemicals, overfertilization with phospates and underfertilization with nitrates, when many things seem to be conspiring in fact to reduce our ability to use the ocean rather than increase it.

Dr. SPILHAUS. Mr. Chairman, I do not disagree with Dr. Revelle. I am very well aware of the pollution problem. I do not think pollu-

tion and our preoccupation with pollution must stop us doing things at sea in ways we have learned and that will not pollute the ocean.

We cannot use pollution as a reason to, say, stop doing anything for people. This is what Mr. Revelle is saying, and I disagree violently.

Mr. MILLER. I started something.

Senator MAGNUSON. Here is our problem. I will say for the record that Dr. Revelle for a long time was the head of the Scripps Institute of Oceanography, and Dr. Spilhaus and I did a little bit about building the great Pacific Science Center in Seattle.

Mr. MILLER. Who got the money for you for the Pacific Science Center?

What committee did it come out of?

Senator MAGNUSON. It came out of the Appropriations Committee.

Mr. MILLER. It had to be authorized before it went to the Appropriations Committee.

Senator MAGNUSON. It had to be authorized. The House did a great deal, but it is still operating; it is still one of the fine things we have going in this country.

Mr. MILLER. Mr. Chairman, there is another gentleman here who has been very helpful to our committee in connection with this work and I think should be recognized, and that is Dr. Herman Pollack, the Assistant Secretary of State for Science and Technology.

STATEMENT OF HERMAN POLLACK, ASSISTANT SECRETARY OF STATE FOR SCIENCE AND TECHNOLOGY

Dr. POLLACK. Thank you, Mr. Miller.

I am not going to add to the dialog that has taken place the last few days. I am sorry I did not have the opportunity to listen in yesterday.

I want to compliment the two committees for their wisdom in providing a forum for this kind of a colloquium.

CLOSING REMARKS OF DR. THOMAS F. MALONE, VICE PRESIDENT, INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS, RAPPORTEUR FOR THE COLLOQUIUM

Dr. MALONE. The matter of institutional innovations are of more than casual interest because institutions constitute the framework within which international cooperation is achieved. At the outset it should be recognized that there are approximately two dozen intergovernmental organizations, most of which are in the U.N. system, currently engaged in activities and programs concerned with environmental problems. In addition, the International Council of Scientific Unions and the International Union for the Conservation of Nature carry on programs at the nongovernmental international level.

The importance of institutional innovation and renewal has been succinctly stated by Prof. Eugene Skolnikoff, chairman of the Department of Political Science, MIT in the Technology Review for June 1971:

The nature of the issues emerging from advancing technology and its side effects is such as to emphasize the connectedness of things. Increasingly, issues cannot be neatly divided into boxes labelled "oceans," "agriculture," "health," and so forth. This is no less true domestically than internationally, and again raises the problem of integration of policy and activity. In the future, this interconnectedness will make current problems of international jurisdiction and coordination appear relatively simple.

Another problem that complicates the issue of policy integration is the complexity and size of modern technological and organizational systems. This makes the task of innovation exceedingly difficult. The problems of innovation in existing international organizations and their activities are well known today. They can only be more difficult tomorrow. * * *

In fact, these new and intensified demands on international machinery will severely strain the international political system as we know it today. Serious questions arise as to the viability of existing patterns of intrenational relationships. Whether man and his political systems are capable of coming to grips with these prosaic but politically demanding requirements will go a long way to determining whether we ever have to worry seriously about global catastrophes. * * *

In a different vein, we can point to what may be the hopeful beginning of increased public interest, in some countries, in the substantive issues that have been raised in this analysis, particularly environmental control and pollution. It will surely take such public interest, expressed in political activity, to bring about the kind of controls on man and his works, whether national or international, that will be required for survival.

Accompanying this increased public interest in the protection of man's environment there seems to be, though much less clearly, a growing recognition that governments do not have the right to act unilaterally in technological areas when the effects may spread beyond national borders. It remains to be seen how this recognition will develop, but it would be a prerequisite for any substantial movement by governments in the direction of relying more heavily on international organizations in their own decision making. * * *

* * * whatever the political developments of the next two decades, technologically related developments that are in some sense "inevitable" will pose major new international requirements. What the preferred course of evolution of the international system should be to meet these new requirements must depend, in part, on an evaluation of existing international machinery. Clearly, as a minimum, a substantial amount of extremely difficult institution building and institution modification will be required internationally.

A logical starting point for a consideration of institutional arrangements is the kind of functions which these institutions might perform. In general, they are two: action functions and support functions.

Action functions would include: Articulation and adoption of multilateral policies; formulation and adoption of international standards; operation of monitoring systems and archiving of data; implementation of multilateral regulatory and trade agreements; execution of multinational action programs; funding environmental projects; and adjudicating disputes.

Supporting functions would include: Exchange of information; education and training; and analytical and research activities intended to develop the body of knowledge required for decisionmaking and to cast the results of these studies in a form that can be conveniently linked to the mechanism by which public policy decisions are made. An important attribute of this work is that it be completely objective and free from political influence yet readily accessible to the political instrumentalities concerned with decisionmaking.

It seems clear that the institutional arrangements would include the following:

Vigorous national efforts in both the support and operational categories.

Strengthened and augmented activities of a coordinating nature carried on by the specialized agencies of the U.N. system.

Coordinating activities carried on by the nongovernmental national institutions.

Responsiveness to the kinds of questions posed by Professor Skolnikoff would seem to require two major institutional innovations:

A small, high-level body within the United Nations, either within ECOSOC or at a level equivalent to ECOSOC. The functions of this instrumentality which might be called an Intergovernmental World Environmental Council would be of importance to provide coordination and cohesion to the diverse activities in the environmental arena within the U.N. System and among the U.N. Specialized Agencies.

A nongovernmental instrumentality capable of carrying on sustained analytical research and planning activities of use and interest to intergovernmental agencies and national governments. This kind of entity has been variously referred to as an International Center for the Environment (IC) and World Institution for the Environment (WEI).

The concept of a nongovernmental international capability for environmental areas is sufficiently important to merit further discussion.

Rationale

Although on purely intellectual grounds, a strong case could be made for an executive agency at the international level in order to develop and implement policies that would be universal around the world, it is highly unlikely that this will be possible within the foreseeable future. Public policy decisions will be for the most past decentralized among sovereign states, although international conventions and agreements will surely be made.

The most important step to be taken in the near future is to create an international mechanism for developing a body of knowledge which has universal credibility as well as constituencies of sufficient stature that their views are heeded in individual nations. This appears to be the most effective way of introducing rationality and coherence into a decentralized system of decisionmaking.

Character

It must be international in staff, governance and funding.

It must be nonpolitical, open to all the nations of the world, and carefully insulated from the political forces operative in intergovernmental organizations.

It must be advisory and analytical rather than possessing executive or administrative functions.

It must be in a position to cooperate closely with other nongovernmental institutions at the international and national levels, as well as with the intergovernmental organizations and national governments.

Its staff must be interdisciplinary.

It should have access to a large computer and be equipped with analytical laboratories and shops for instrumentation research and development.

It should be organically linked to several regional problem-solving institutes in areas where the environmental problems of developing countries can be vigorously addressed in situ.

It must possess first-rate research capability.

It must have a permanent as well as a visiting staff of the highest competence.

Functions

Comprehensive analysis of the impact of environment on man. This would include: (*a*) determination of levels of toxicity, (*b*) the psychosocial consequences of overcrowding, ugliness, frustration, and so forth, (*c*) the economic costs of environmental pollutants, and (*d*) offenses to human aesthetic sensibilities.

The impact of man on the environment. This would include the prediction of biome degradation or improvement through the use of biome modeling techniques, the management of tropical forests, determination of the progression of soil erosion. technology assessment (e.g., climatic consequences of an increase of CO_2 or the possible depletion of O_3 by supersonic transports), environmental implications of manmade lakes, large-scale river diversion, and ocean-to-ocean canals with special attention to the anticipation of the consequences of new technologies before they have started processes that will be difficult to reverse.

The analysis of the potential for ocean productivity of food and minerals with special attention to its measures which will preserve the integrity of international waters and optimize the food yield from the seas.

The formulation of options for global public policy in the field of energy conversion with special attention to the most efficacious use of fossil fuels are the energy requirements for recycling materials, as well as an assessment of the threshold at which world energy production becomes a significant factor in the environmental energy balance.

The analyses of the sources and uses of materials and the substitution of one material for another and the policy that will be required to insure an adequate supply of materials for centuries to come.

The application of systems analyses to an understanding of the global social systems with the development of an hierarchy of computerized, multiloop, feedback models that successively approximate the behavior of the real world.

Analysis of alternative processes for converting natural resources into goods and services and for disposing of the waste from consumers use with particular attention to technological controls that will minimize the deleterious effects of environmental pollutants and nuisances.

Goverance

It has been suggested that such a center be established within the International Council of Scientific Unions in a manner similar to that employed in establishing special and scientific committees. Goverance would be by a board on which would sit representatives of the adhering body (academies, research councils, royal societies) as well as governmental observers. A special advisory council would be made up of representatives of the U.N. System and U.N. Specialized Agencies.

Funding

To reach a critical size for effectiveness, the principle center should be staffed by about 300 physical scientists, life scientists, social scientists, engineers and humanists, and each of four regional institutions in the developing countries (South America, Africa, India, and Southeast Asia) would be staffed by about 100 scientists and professionals. An approximation to the total cost including support personnel and facilities could be reached by estimating $50,000 for each scientist or professional. Funds would be provided by national governments through the adhering bodies to the International Council of Scientific Unions.

Finally, it is important to stress the role of the regional institutions in the developing countries that would be organically linked to the international center. These would be problem oriented with particular attention to the matters of immediate practical and environmental interest in the countries (water supply and sewage disposal, ecosystem management, urbanization, soil erosion, agricultural productivity, etc.). They would serve as catalysts in developing indigenous environmental scientists and engineers and in fostering environmental literacy and public awareness that economical developing and environmental enhancement are not antithetical but really constitute a single concept.

SUMMARY AND CLOSING REMARKS

Mr. MILLER. Mr. Chairman, I have a short statement.

I don't think that it is hopeless. I would like to carry you back 10 years ago—10 years ago the day before yesterday—when President Kennedy announced we would go to the moon in the sixties.

Those of you who are sophisticated in this, like many of us, doubted that this could be done, but by a concentration of resources on the scientific community, we were able to do it.

I think if we make our minds up, we can, perhaps, bring out of Stockholm the sort of program that made it possible to get to the moon in a decade.

Dr. MALONE. Mr. Chairman, I was supposed to summarize, and it is rather difficult, and we do want to stop by 12:30. So, I will be quite brief.

Once in a great while in that flood of material that comes across one's desk, you find a little gem. I went back to tend the store last evening. I found such a gem which I think captures what we have been saying here, and I would like, Mr. Chairman, if I may, just share this with this group, because I think this is relevant. [Reads:]

"A lone planet
hurtling through space
encased in a narrow pocket of air
enriched with a few inches of fertile topsoil
endowed with a delicately cycled
flow of water * * *

"Precariously balanced
at just the right distance from
and angle to the sun
rotating harmoniously

to alternate periods of light
and darkness
in proper proportion * * *

"Such is the EARTH
with its marvelous conjunction
of intertwined elements
that make up
that incredible
combination of conditions
essential to human life.

"How fragile
unreal
impossible
it all seems
when viewed
from
the astronaut's perspective.

"The startling truth
is that this delicate globe
is manned!

"It has
the beautiful
complex equipment
necessary
for man
to live
breathe
work
love
and pray

"Today Earth is in trouble.
The splendid balance
is gravely threatened.

"All of man's intelligence
imagination
and dedication
will have
to be roused
and fused
into a massive emergency operation
if we are
to demonstrate
our gratitude to
the Creator,
our concern
for the work of His hands,
and our concrete practical love
for each other."

It seems to me those words capture the sense of commitment, the sense of concern, the sense of restrained alarm that characterized these hearings, gentlemen.

The crisis, we have agreed, I believe, is of a period of decades, not of years. We have a few tens of years, and mankind is sort of a warship in his progress in time.

The marvelous capacity we now have to convert natural resources into the goods and services that can be shared by everyone in the world also poses a threat. That capability, if not used wisely, threatens the balance on earth.

It is a paradox that this great opportunity to meet the primitive needs of food, clothing, shelter, and amenities which give meaning to

sheer existence, that splendid opportunity is accompanied by this grave tragedy.

I think we did agree that, if we are to meet the challenge, we are going to have to improve our knowledge, change our values, and be creative about establishing institutions.

I think we agreed that Stockholm would be a sort of point of departure for this effort, that we would there make a commitment—we and the other nations of the world; all nations of the world, hopefully—to do three things: To manage our equalization of matter and energy in a fashion that holds the discharge and waste down to a tolerable level; tolerable to health, tolerable to cost, and tolerable to our well-being.

Second, we would bring under search and scrutiny our policy and practices of land utilization, including the integrated analysis of the structure and manmade ecosystems, such as human substances.

We are all awed when we realize that in the developing countries an urban population which is now about 600 million will grow to about 2.1 billion by the year 2000. In the next 30 years, we are going to have to accommodate 3½ times the structures we built over the last thousand years.

Finally, commitment to bring in balance the world's population and the world's natural resources.

I think we want to see in that declaration, to be made in behalf of nations, a statement that technological innovations or large-scale tinkering with the earth will be assessed for their environmental impact before their admission.

I think we are beginning to realize that a special work is going to be required, probably, about the last half of this decade when many international programs are going to come into being—an international environmental period during which the world's intellectual and material resources will be focused on bringing man into harmony with his nature.

We will have to set up institutions, and we each have clearly our own idea of these institutions. But I think from the discussions there is emerging the conclusion that there is an array of institutions.

We need a small policy council at the U.N. level to review and to coordinate. We need national governments carrying on monitoring programs, coordinated by specialized agencies. We need regional organizations working together.

But the big need is the knowledge need, and as I sat and listened to these discussions, I became more and more convinced that we do need a World Environmental Institute, which can bring to bear on this problem these sophisticated techniques of multifeedbacks of systems, biosystem analysis, that will provide the list between informative environmental knowledge and public policy, even as this colloquium was an opportunity to bring together environmentalists and policymakers.

I think we are going to need, though, not just one joint think tank. We are going to need the regional institutes which are properly oriented and which are located in the continents inhabited by the developing countries, which dips right down to the nitty gritty

kinds of problems which confront these nations. I think you can take a leaf from our own experience in this country where we wrought a societal change over the last 100 years by linking institutions with the people.

We wrought an agricultural revolution, transformed this Nation into an industrial society by the combination of a Department of Agriculture, the Land Grant University, the Agricultural Experiment Station, and the Extension Agency.

I think in those regional institutes we need environmental extension workers who go out and are in contact with the people concerned and people who are daily forced to make decisions with environmental considerations.

I think this kind of corps, an environmental service corps, attached to these institutes might be a necessary part of the whole scheme. These things are all beginning, slowly, to come to mind, and as a closing thought, I can't help but go back to Dr. Handler's comment yesterday, when he talked about the ultimate environmental hazard. As I observe the mounting concern around the world, evidenced by the people who came here, for the deteriorating quality of the human environment and an increasing alarm over the prospects of developing successfully more sophisticated and powerful rudders for global conflict, my personal conviction is growing that a powerful case can be made for galvanizing world opinion and precipitating multilateral action by setting aside, say, 1975 to 1980, as the period when we do address the problems of the environment.

My concern is we will try to muddle through, that we will not put the resources into this issue, and when I envision the dimension of resources, and how we might cope with that ultimate environmental hazard, I think "wouldn't it be wonderful if, at Stockholm, all the nations would agree to make this massive effort and to finance it by, say, a 10-percent rollback in the $200 billion annual cost of preparing for conflict?"

Think what $20 billion a year deployed in this area might do for a generation yet unborn.

Gentlemen, I think you are to be congratulated on convening this colloquium. We are grateful to you for inviting us here. It has been stimulating for all of us.

I think we will all carry away a little deeper commitment and a little better understanding, and perhaps a little more hope.

Senator MAGNUSON. Thank you.

Mr. MILLER. Thank you, Dr. Malone.

Again, thank all of you for being here.

I am sorry, but Senator Magnuson was called to the floor. But, in his name and my own, I thank you. And without further ado, we will adjourn.

(Whereupon, at 12:35 p.m., the joint committee hearing was adjourned.)

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

Resources for the Future, inc.

1755 MASSACHUSETTS AVENUE, N.W. / WASHINGTON, D. C. 20036 / CABLE: RESOURCES / PHONE: 462-4400

June 1, 1971

Mr. K. Guild Nichols, Jr.
Staff Consultant
Committee on Science and Astronautics
House of Representatives
U.S. Congress
Washington, D.C.

Dear Mr. Nichols:

I am availing myself of Representative Miller's invitation to the participants of the recent Colloqium to send you a brief note, prompted by some remarks made during the proceedings.

I start from the assumption that the cutting edge of environmental problems in the international setting will be -- and, indeed, is already -- matters associated with international trade, investment, and development assistance.

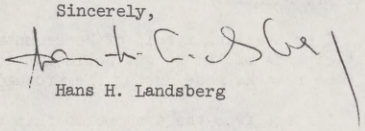
In making this assumption I wish in no way to diminish or belittle the importance of those truly global problems in which all mankind shares and which took up the major part of the Colloqium -- such as problems of the atmosphere, the ocean and natural systems generally. But these are less visible or tangible, especially to the less-developed countries than, say, a change in the procurement policies made by a former customer on the basis of environmental considerations (e.g. from high- to low-sulphur oil), or higher costs of a given import because it now incorporates new devices required by country of origin but perhaps not by that of the importer, or a delay or cost increase in a development project due to environmental concern of one kind or another.

There is good reason to be alert to these opportunities for conflict and to begin to look for ways of resolving it. But, fortunately, environmental concern on an international scale also provides opportunities for cooperation. These arise from a factor that figured in much of the discussion, i.e. diversity. I am not referring to diversity in ecosystems, in levels of awareness, in perception of priorities, in value systems, in degree of economic development, etc. These can engender conflict. But

there is one diversity that received little if any mention at the Colloqium, even though it is the one which can be the basis of cooperation, depending on the way in which it is approached. I am referring to the diversity in capacity to abate pollutants. Without going into detail I have no hesitation in asserting that, for a variety of reasons, in many of the less-developed countries the absorptive capacity of water, air or land is -- and will for some time remain -- much larger than it is in most developed countries. This suggests a new international "division of labor", or, if you will, the emergence of a new factor in cooperative international trade advantages. I suggest that this be given full opportunity to affect trade and investment flows rather than be reduced or wiped out by countervailing duties, rebates, subsidies, or other devices designed to offset these advantages in an effort to establish what at first blush appears as conditions of "fairness" in trade. This is not to deny that such an approach will create transition problems, but it will have the double advantage of (1) utilizing environmental resources most efficiently, and (2) enabling the less-developed countries to get more deeply involved in processing and manufacturing rather than just extracting of materials -- a long-standing aim of theirs.

To one concerned about possible divergences in the evaluation of environmental factors as they affect the process of development the opportunities for convergence in the issue described above should offer a welcome field for constructive action.

Sincerely,



Hans H. Landsberg

INTECOL
INTERNATIONAL ASSOCIATION FOR ECOLOGY
Международная Экологическая Ассоциация
ASSOCIATION INTERNATIONALE D'ECOLOGIE
INTERNATIONALE VEREINIGUNG FÜR ÖKOLOGIE

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13 May 1971

Honorable George P. Miller
House of Representatives
Committee on Science and Astronautics
Washington, DC 20515

Dear Congressman Miller:

Unfortunately, I will be unable to attend the Joint Senate-House Colloquium on International Environmental Science 25-26 May 1971. I am sending someone to represent me; Mr. Felix Rimberg will attend in my behalf.

I wish to assure you of the genuine interest of the International Association for Ecology in an effort to prevent further perturbations of the environment and to correct those that have already occurred. INTECOL represents the professional ecologists throughout the world and publishes a bulletin, sponsors symposia on matters of ecology, and is planning an International Congress of Ecology in 1974. We have representatives in nearly all countries of the world. Should you need advisors in any part of the world on biological aspects of the environment (ecology), we would be prepared to supply you with names of competent scientists.

We now have active study groups in the following subspecialities of ecology: National and International Affairs, Human Ecology, Communication & Education, Resources & Conservation, Pollution & Perturbations, Terrestrial Ecology, Aquatic Ecology, Physiological Ecology, Population Ecology, Soil Ecology, Tropical Ecology, Ecosystem Analysis, Industrial Ecology, (IOBC) Liaison Commission on Biological Control. These commissions could be called upon to participate in international studies which could improve the lot of humanity.

Attached is a copy of a presidential address which I gave to INTECOL in 1969. I quote here from page 12:

> "Our commissions should study the feasibility of founding an International Center for Ecology. Such a Center, if adequately financed by international and private funds, could undertake ecological studies for Developing Countries which do not have access to sufficiently large teams of specialists, but who will be in future generations vastly increasing the exploitation of their resources.

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Moreover, an educational aim of such a Center would be to receive and train young scientists for the Developing Countries. These commissions with old and new facts can help assure humanity a healthful and more aesthetic future.

"When activities arising from two or more nations affect the biota of a region or ocean, an unbiased evaluation could be initiated by this Center. A prime example is the trend toward river basin development in drainage systems that cover two or more nations. The scientific facts and projected effects on society would then be the basis for new international regulations or cooperation."

This address appeared in Intecol Bulletin Vol. 1 (1969):2-12.

Sincerely,

A D Hasler

Arthur D. Hasler
President

Enclosure

[Intecol Bull. vol. 1 (1969):2–12.]

Presidential address

Acting responsibly to our environment—a profoundly human issue*

ARTHUR DAVIS HASLER
University of Wisconsin

'. . . ecologists are very much concerned that the fundamental issues of population control and the need for stability in ecological systems and especially in the biosphere as a whole are being buried by the lesser problems of government, including the current problems of the cities, which are also important, but which will prove in the end to be trivial unless we can solve these far more fundamental issues.'

G.M. Woodwell, 1968

At present rates of increase our world population will double within 37 years. This projects to a population of 60 million billion people in 900 years, the ridiculously impossible number of 100 persons per square meter. An absurdity, of course, but how can the trend be slowed?

The quality of the environment is inextricably linked to increasing numbers of people and the attendant requirements of people for a good life with the need to dispose of their wastes. We cannot lose sight of this principal factor in future management of our environment. This very fact should give us the motivation to become involved in public issues. Ecologists can give impetus to family planning by explaining to individual citizens and officials what is at stake for their progeny in a limited environment constricted by alarming increases in population.

There are no shortcuts to the solution of the population problem. It begins with individuals. The individual must be convinced

*I am indebted to many fellow ecologists from whose conversations, committee reports and writings I have gleaned many of the recommendations and ideas expressed here.

that there is a problem. Then solutions must be made societal, then political, and then governmental.

Ecologists have been at times in the past branded as unrealistic and super-idealistic conservationists, opposing indiscriminately the consumption of wild landscapes for human use. These attitudes are changing because scholars of ecological history now have evidence that even primitive man changed his environment quite radically, in some instances beneficially, in others adversely. In historic times (ca. 1200 A.D.), the Maoris discovered the islands of New Zealand. They eradicated several species of giant flightless Moa birds from those islands within 300 years by using only primitive tools such as slingshots, arrows, and spears. Only the bones of those birds buried in Maori middens provide evidence of their magnificence and former abundance. In contrast, there are cases where primitive man improved his environment. There is good evidence that the fertile soils in the U.S. Middle West derive from practices of Indian culture. The Indians learned to drive their buffalo by burning the prairie which provided new grass for grazing the following summer. Without this practice vast areas would have grown up to oak forests, because the oak roots stayed alive in the soil in spite of persistent burning of the prairie. Instead of oak trees, an elegant species-rich community of tall grasses and brilliantly flowered plants developed and were maintained as flourishing vegetation. As a result of thousands of years of this kind of management, the prairie plants formed some of the deepest and grandest soils in North America, now the nation's breadbasket. Thus, we have received a rich agricultural legacy from the past, a gift from the American Indian. These examples illustrate a critical current issue. The long story of mankind is his adaptation to and with the environment. However, modern man with his technology and almost limitless power to make changes at an enormously increased rate often causes irreparable damage.

At the present frightening rate of population increase, it is clear that nearly every landscape will be needed by man for its 'most productive use.' Even with population controls, ecologists must be prepared to guide this use toward programs of least damage.

First, we should, without delay, place as many landscapes as possible on *deposit for the future* and recommend their use only when a well conceived and justifiable plan is formulated. At present we do not understand the ecosystems of our natural landscapes well enough to utilize them effectively. We can hope that research in the future will provide us with understandings of new uses to avoid irreparable damage.

New potentials for ecological research

If an ecosystem could be understood, ecologists would be well on the way toward predicting the tolerances of a landscape destined for development. We should be able to provide facts to economists and decision-makers as to the risks or failure of a novel plan, the effect of an industry with toxic fumes, or a developer whose buildings and roads would cover 75 per cent of the land surface. Predictive models could be made of the various alternatives.

The Freshwater and Terrestrial Sections of the International Biological Program in the U.S. have merged and focused their effort on the ecosystem analysis of drainage basins with the anticipation that modern ecology in a 'big science' cooperative undertaking might learn how stable or fragile ecosystems are. More governmental and private funds are needed for research in systems ecology.

The general problem of ecosystem analysis is the most difficult problem ever posed by man, with the exception of complex sociological problems, which are also ecological. Modern digital computers are now large or fast enough for truly realistic simulation of even simple ecosystems, but this is an area in which activity will increase tremendously as computers evolve. We must eventually account for such features as the vagaries of weather, which introduce very large uncertainties into any realistic analysis. These complexities are not insurmountable. The behavior of models will suggest new courses of analysis to add to our success with older analytical models.

Movement of matter and energy in food chains, from sun, air, water, and soil, to producers, herbivores, predators, and decomposers, is under intensive study in many places. Efficiencies and rates

of turnover are being studied. These studies are greatly aided by radioisotopes and other tracers, and we anticipate that new, rapid, and automatic methods of chemical analysis and calorimetry will lead to great advances. As the results of these studies accumulate we will face increasing problems of data and literature retrieval; we are already at the point where some sort of national or international ecological data bank is urgently needed.

Some of the most important questions about ecosystems involve their stability as related to their composition. We would like to be able to tell, for example, if a pollutant added to soil or water is causing its microbiota to deteriorate or become unstable. All such measurements are very sensitive to accuracy of taxonomy. But many soil organisms are undescribed and many others cannot readily be identified. This is a serious limitation because current theory holds that stability is best measured in terms of species diversity.

Soon man will be assembling synthetic ecosystems as life-support systems in space ships, for use under water, and for improved production of food and other commodities. Much remains to be learned before we can assure the efficiency and reliability of such systems. Engineers seek simple systems with few components. Ecological experience strongly suggests that simple life-support systems will prove highly unreliable. The biosphere as a whole is definitely not simple, but it has been remarkably reliable up to now. The objective of applied ecology is to keep it so.

Uses based on present knowledge

Already ecologists familiar with forestry and agricultural procedures have enough knowledge of landscapes to prevent management catastrophes.

I have in mind a recent catastrophe (1966) in northern Italy where flood waters of the Po and Arno Rivers inundated the city of Florence and wreaked havoc to collections of paintings and sculptures of past centuries and laid barren large areas of hillsides. For centuries the hills and valleys of these river basins have been overgrazed by goats and sheep. Insufficient vegetation is left to protect

the soil from erosion when torrential rains fall. Farmers in these areas might have been re-oriented in their farming practices by an ecologically trained clergy. Landscape management is usually controlled by local communities rather than by a central government, hence education of citizens locally is highly important.

What can you do?

'Human societies are now so large, so complex, and use resources so rapidly, that they are in danger of drowning in their garbage. The problem is inescapable; there is no rug under which it can be swept . . . Human ingenuity creates so many "new" resources and they become garbage so quickly, that old ways of handling garbage can no longer be counted on. Meanwhile, the old, familiar pollutants, – silt in our reservoirs, manure on our farms, carbon and sulfur compounds in the air – pile up on an unprecedented scale, and overflow the sinks that used to contain them.'

E.S. Deevey, 1968

Even the ocean cannot process all the garbage we produce, nor is it big enough to dilute the man-made poisons entering it – atmospheric transmission of DDT on dust particles is having far reaching repercussions.

What can ecologists do to improve the quality of our environment and pass onto the next generation a legacy of high biological and social value? A few examples from my own circle of acquaintances yield cases of social action by ecologists which should concern us.

Dr John T. Curtis, University of Wisconsin, was instrumental in formulating a legislative document to enable the preservation for the future of scientific areas in Wisconsin in 1955 (State of Wisconsin, Board for the Preservation of Scientific Areas). Large tracts of natural communities are now preserved and managed as reference sites for ecological study.

Here was professional knowledge, an ecological conscience, and unselfish action combined into a single devoted ecologist. His actions

have already provided handsome landscapes to the next generation of Wisconsin's citizens and study sites for scientists of the world. More will yet be preserved because of the agency he was able to create.

A professor of law, Jacob Beuscher, University of Wisconsin; started collaborating with ecologists several years ago. His understanding of the land compelled him to draft legislation (State of Wisconsin, Water Resources Act, 1965) which was passed into law requiring all sub-governmental units in Wisconsin to create strict zoning ordinances which specify protective use of all lands within 300 meters of a lake shore, or 100 meters of a river. These regulations control uses which will pollute the adjacent water.

Lake Monona in Madison, Wisconsin at the turn of the century became an algae and weed-ridden lake owing to additions of human sewage effluent. Limnologists at the University of Wisconsin, interacted with politicians, engineers, and legislators in lengthy discussions, committee meetings, public lectures, and report writing in order to present the facts needed for public action. The same has been made possible in the last 5 years for nearby Lake Mendota. All of this was accomplished on evenings or weekends at much personal inconvenience, but we were able with facts and persistence to convince legislators to pass the necessary laws and convince people and government to spend money to divert the sewage and enable a recovery of the lakes to their former beauty and utility.

In the Ecological Society of America a study committee has issued a report recommending the creation of a National Institute of Ecology to become an agency for environmental fact finding and analysis which would be independent of political influence and would serve four functions:

1 Advise on ecological questions to government and the private sector, including the conduct of studies in depth.

2 Protect and administrate branch laboratories and natural areas.

3 Set up a research center with permanent staff and larger rotating staff.

4 Set up a data storage and retrieval center.

A feasibility study has been initiated to work out the details of organization, and it is hoped private and federal funds will be assigned to establish this much needed national institute.

Last year a group of ecologists, in collaboration with interested lawyers and citizens, organized the Environmental Defense Fund Inc, and are using the U.S. courts to establish a 'body of common law under which the general public can assert its constitutional right to a viable, clean, and healthy environment.' Their current focus is to restrict the use of DDT and similar persistent pesticides. Recent court cases have been highly publicized. Government agencies are already restricting the uses of DDT even before any cases have been actually won. Over 100 scientists are giving their time without pay to appear as expert witnesses and present research facts in the courts and hearings.

I could list many similar examples from other areas and am respectful of the many who have demonstrated their ecological conscience through effective action in other parts of the world. We need more, and I urge each of you to similar action.

I would like to suggest that all ecologists prepare a budget of their time for each month and give to society as much personal effort as his conscience will permit over and beyond his research activities. An ecologist's knowledge through teaching, research, and public service is indispensable to society. Others can give the money, you can give your talent and time.

Your efforts can be exerted in and around your own community, or on national or international education, research, or public action problems.

Technology and our natural environment

The catastrophe of our urban blight in our technological society is a witness to lack of proper land use and social planning. Our great cities which were stimulated by industrialization in the nineteenth and early twentieth centuries have become places that make it impossible for people to relate to anything like a natural environment. Many people know 'country' only from what they see on weekends

or vacation trips. More important, city dwellers often forget that their lives depend on what happens to forests, grasslands, farms, orchards, ranches and rivers, hundreds and even thousands of miles away. Thus the quality of their lives can be seriously affected by what becomes of open spaces and resources. Decisions regarding such questions are generally made at the level of local government and are all too frequently determined by expediency.

The decisions that will determine the future of landscapes and our lives are many and varied; and every man, from the area affected to the remotest reaches of the world, has the right to learn the choices that affect his life, to seek the best advice on the probable consequences of those choices. He also has the responsibility to exert his effort in influencing the decisions.

What should we do?

1 Accept as the norm the two- or three-child family, because planning family size is an essential part of planning for a viable environment.

2 Recommend the assignment of *landscapes to be placed on deposit* for the future. Urge local governments (village, city, town, county, province) to create water authorities to regulate water quality and reserve or zone land in immediate areas for future use and development: for example, (a) land for future needs of urban population, (b) land for local parks, (c) demonstrations of natural plant and animal communities indigenous to your geographic region. These would serve to teach the coming generations ecological principles associated with man's prehistoric past.

3 Urge state and national agencies to plan land use so as to conserve the communities and species of plants and animals. Areas comprising extensive acreage can be reserved by: public or private purchases; establishing conservation and scenic easements; dedication of private, church or community-owned lands; and zoning laws and regulation prohibiting use of these lands for urban or industrial use.

4 Develop local or private institutions for the planning of, and

education in, the use of these parks or arboretums. Paid employees, competent in ecology, would manage and/or teach here. Educational institutions have a new chance to use electronic media to 'visit' these natural areas from the classroom.

5 Furnish trained ecologists to interpret field biology and ecology to interested citizens, such as vacationing families, at appropriate locations.

6 Urge public and private educational institutions to introduce ecology into their curricula. It is essential that engineers, landscape architects, urban and regional planners, economists, lawyers, theologians, political leaders and other professionals include ecology in their professional training.

7 Urge newspapers, magazines, radio and television to help establish the concepts of an ecological conscience and of land ethics.

8 Offer short courses and clinics on ecology to conventions of service clubs, churches, banks and insurance companies, city and county managers, government officials, and political leaders.

Projected plans and impact of ecological knowledge

We have developed a warped interpretation of the philosophy that man should subdue the earth and have dominion over it. The power to use carries with it the power to misuse. Man's ecological conscience toward his environment entails responsibility for replenishing as well as utilizing its resources.

As many nations have become predominantly urban and as rural dwellers have become technologically minded, a profound faith in the scientist and technician has emerged. But science is neutral and technology is often directed by economic, political, and other criteria. The values by which science and technology are to be governed derive from our aspirations for man. We cannot, therefore, abrogate our responsibility for the by-products of science and technology.

Many have been callous to the long-range consequences of our conduct and treatment of our environment. We have been unaware of the content and quality of the life around us. It now becomes apparent that acting responsibly in relation to our environment is a

profoundly human issue. It determines life itself.

At this stage in our history we possess both the physical and intellectual resources to regulate our land and water. It yet remains to be seen whether we will organize and utilize those resources for the ultimate benefit of ourselves and posterity. Things are wrong with our environment, but they are wrong in a way that can be understood and some can yet be put right. In recent years the governments have come late to major social issues.

Finally our new association (Intecol) will develop commissions for fact finding and further research which will lead to betterment in the management of our renewable resources. These commissions are: National and International Affairs; Human Ecology; Education and Exchange; Resources and Conservation, Pollution, Terrestrial Ecology; Freshwater and Marine Ecology; Physiological Ecology; Population Ecology; Soil Ecology; Tropical Ecology; Systems Ecology; and Industrial Ecology.

International issues will be brought to our new association for study and advice. Out of our deliberations we can develop an international code of ecological ethics. This can be used by the U.N. to draft standards which would in turn obligate nations to conform to sound ecological principles in the management of their landscapes, flood plains and water. This international code would help to prevent irreversible perturbations.

Our scientific advice and data could be presented to an international agency on such resources as world fishery and whale populations to assure a sustained yield of valuable species and the protection of endangered species.

Moreover, our commissions could draft standards and legal codes for international courts on the use of pesticides, herbicides, radionuclides, precautions for marine oil drilling and oceanic transport of oil. Our studies would provide scientific justification for recommendations on international efforts to improve environmental quality. A case in point is the new evidence that chlorinated hydrocarbons like DDT and DDE volitalize from the soil and are airlifted and transported across national borders and even continents where they are

deposited by rain and snow. Here they circulate in local ecosystems and become harmful to living communities, including man.

Our commissions should study the feasibility of founding an International Center for Ecology. Such a Center, if adequately financed by international and private funds, could undertake ecological studies for Developing Countries which do not have access to sufficiently large teams of specialists, but who will be in future generations vastly increasing the exploitation of their resources. Moreover, an educational aim of such a Center would be to receive and train young scientists for the Developing Countries. These commissions with old and new facts can help assure humanity a healthful and more aesthetic future.

When activities arising from two or more nations affect the biota of a region or ocean, an unbiased evaluation could be initiated by this Center. A prime example is the trend toward river basin development in drainage systems that cover two or more nations. The scientific facts and projected effects on society would then be the basis for new international regulations or cooperation.

I invite you to write to me or any member of our board giving us facts about yourself and on which commission you feel you could be of service. I will soon appoint the chairman and an executive committee for each commission. All who are willing to serve will be used wherever possible. Appointments to executive posts will be biannual at first. Only those who promise to work will be appointed. There will be no honorary posts.

Appendix I

Biographical Sketches of Colloquium Participants

W. Frank Blair; Francesco di Castri; Christian A. Herter, Jr.; Kwan Sai Kheong; Bengt Gustaf Lundholm; Thomas F. Malone; B. R. Seshachar; Maurice Frederick Strong; Russell E. Train; Peter Edward Walker.

W. Frank Blair, Chairman, U.S. National Committee, International Biological Program

Born Dayton, Texas; June 25, 1912; B.S. (Zoology), University of Tulsa, 1934; M.S. (Biology), University of Florida, 1935; Ph.D. (Zoology), University of Michigan, 1938. Assistant, Division of Mammals, Museum of Zoology, University of Michigan, 1935–37; Research Associate, Laboratory of Vertebrate Biology, University of Michigan, 1937–46; Assistant Professor of Zoology, University of Texas, 1946–47; Associate Professor of Zoology, University of Texas, 1957–55; Professor of Zoology, University of Texas, 1955– . Military service, 1943–46. Member: A.A.A.S. (Fellow, rep. ESA on council, 1957–61; committeeman-at-large, Section F, 1963–66), A.I.B.S. (Governing Board, 1945), American Society of Ichthyologists and Herpetologists (Board of Governors, 1951–55, 1956–61, 1962–66; Vice-President, 1955), American Society of Mammalogists, American Society of Naturalists (Editorial Board, 1957–58), American Society of Zoologists (Chairman, Ecology Section, 1966); Australian Mammal Society; Ecological Society of America (Vice-President, 1956, Editorial Board, 1960–64, President, 1963, Chairman, Public Affiars Committee, 1967), Herpetologists League, Society for the Study of Evolution (Treasurer, 1954–57; Vice-President, 1958; Council, 1959–61; Associate Editor, 1961–63; President, 1962, Council, 1966–68), Society of Systematic Zoology, Southwestern Association of Naturalists (President, 1953–555), Texas Academy of Science (Vice-President, 1951; Associate Editor, Texas Journal of Science, 1950–51), Texas Herpetological Society (Secretary-Treasuer, 1950–51; President, 1951X53); Chairman, U.S. National Committee for the International Biological Program. Member, Advisory Committee, Division of Biology and Medicine, National Science Foundation.

Francesco di Castri, Vice President, Scientific Committee on Problems of the Environment, International Council of Scientific Unions

BACKGROUND

Born 4 August 1930 in Venice, Italy. Studies at Universities in Milan (Italy), Montreal (Canada) and Santiago (Chile). Degree in Animal Sciences from University of Chile, Santiago (1958). Degree in Animal Ecology from University of Padua, Italy (1960).

PRESENT POSITIONS

Director, Institute of Ecology; Full Professor of Ecology, Faculty of Sciences, Austral University of Chile, Valdivia. Vice-Chairman of SCOPE (Special Committee on Problems of the Environment), ICSU (International Council of Scientific Unions. Chairman of the Working Group on Developing Countries, SCOPE, ICSU. Member of the Executive Committee of IUBS (International Union of Biological Sciences), ICSU, as representative of the Div. of Environmental Biology. Elected member of SCIBP (Special Committee for the IBP), ICSU, for Latin America. Co-Director of the Mediterranean Scrub Project and member of the Advisory Committee, Structure of Ecosystems Integrated Research Programs, U. S. National Committee IBP and National Science Foundation. Member of the Advisory Committee of the International Society of Biometeorology and representative for South America. Member of Soil Ecology Committee, INTECOL (International Association for Ecology). Member of Committee on Pacific Island Ecosystems (Pacific Science Association). Member of International Editorial Board of the following Journals: *Revue d'Ecologie et Biologie du Sol; Journal of Interdisciplinary Cycle Research; Water, Air, and Soil Pollution (An International Journal of Evnironmental Pollution)*.

PREVIOUS EXPERIENCE

Director, Institute of Animal Production, Univ. of Chile, Santiago (1961–1969); Prof. of Animal Ecology, Univ. of Chile, Santiago (1962–1969); Prof. of Zoology, Faculty of Sciences, Univ. of Chile, Santiago (1964–1969); Chm., Chilean National Committee, IBP (1967–1970); Member National Research Council of Chile (1967–1969); Exec. Vice-President, Development Project Office, Austral Univ. of Chile, Valdivia (1969X1970); President, Section of Natural History and member Exec. Committee, Society of Biology, Chile (1966–1967).

OTHER ACTIVITIES

Director, First Latin-American Course of Soil Biology, UNESCO, Santiago-Chile, 1965; Head, scientific expeditions to the tropical regions of Chile, Argentina, Paraguay and Brazil, UNESCO, 1965–1966); Consultant of UNESCO for terrestrial ecology, 1965–1968; Prof, in the International Summer Schools, University of Chile, Santiago (1961, 1962, 1968); Travel grants or official invitations by the Rockefeller Foundation, U.S. National Academy of Sciences, U.S. National Science Foundation, Swedish International Development Authority, UNESCO and the Governments of Italy, France, Finland and Hungary; Official representative of the Government of Chile, the Chilean Antarctic Institute and UNESCO to scientific congress and meetings.

PUBLICATIONS

Author of 77 publications (papers, chapters, monographs in Spanish, English, French and Italian). Three books in press or in preparation to be published within 1971. Main subjects: soil ecology, species diversity of terrestrial animals from the Tropics up to the Antartica, convergence of ecosystems, impact of man on terrestrial ecosystems, ecological management of irrigated lands, biolcimatology, organization of science in the less developed countries.

CHRISTIAN A. HERTER, JR., SPECIAL ASSISTANT TO THE SECRETARY OF STATE FOR ENVIRONMENTAL AFFAIRS

Personal.—Born January 29, 1910, New York City; married—3 children.
Education.—B.X. Cum Laude, Harvard College, Phi Beta Kappa, LL.B., Harvard Law School.
Military.—January 1941 to January 1946. Combat, France and Germany, 14th Armored Division. Decorated.
Occupation.—Lawyer; partner in Bingham, Dana & Gould, Boston, 1956 to 1961; Generl Manager, Government Relations Department 1961 to 1966; Vice President, Public Affairs, *Mobile Oil Corporation*, 1967.

Public Service.—Member, House of Representatives, Mass. General Court, 1951 to 1953; Administrative Assistant to the Vice President of the U. S., 1953 to 1954; Deputy Counsel and later General Counsel. Foreign Operations Administration, 1954 to 1956; Governor's Councillor, 3rd Mass. District, 1956 to 1958; Republican candidate, Attorney General of Mass., 1958. Appointed Special Assistant to Secretary for Environmental Affairs and Director of Office of Environmental Affairs in the Bureau of International Scientific and Technological Affairs, Department of State, January 1970. Appointed United States Commissioner on the International Joint Commission of the United States and Canada, March 1970.

Organizations.—Member, Boston and American Bar Associations; Former Director, Boston Lying-In Hospital and Boy's Club of Boston; State Chairman, Mass. Heart Fund, 1961; President, World Affairs Council of Boston, 1959 to 1961; President, Mass. Higher Education Assistance Corporation, 1960 to 1961. Director, Foreign Policy Association; Member, Advisory Committee to the Foreign Affairs Program, Assumption College; Member, Committee on International Policy, National Planning Association; Member, Foreign Policy Committee, Chamber of Commerce of the U. S.; Member, Board of Directors, National Foreign Trade Council; Member, Director, Atlantic Council of the U.S.; Board of Governors, Middle East Institute; Member of Board, U. S. Committee for Refugees; Member, Advisory Council, School of Advanced International Studies; Director, International Center in NY; Member, Public Advisory Commission on Trade Negotiations; Member, Advisory Council on African Affairs; Department of State.

Other.—Member, Council on Foreign Relations; Member of Overseers' Committee to Visit the School of Fine Arts and Fogg Museum, Harvard University; Member, Board of Trustees, Fisk University; Director, Berkshire Life Insurance Company.

Clubs.—River Club of New York City; Maidstone Club; Metropolitan Club; Chevy Chase Club.

Residence.—2912 Garfield Terrace, N. W., Washington, D. C. 20008.

KWAN SAI KHEONG, PERMANENT SECRETARY, MINISTRY OF EDUCATION, REPUBLIC OF SINGAPORE

Date of Birth.—11 September 1920

Marital Status.—Married; one son, one daughter.

Citizenship.—Singapore Citizen

Address.—Home—14 Bukit Tunggal Road, Singapore 11 Office—Ministry of Education, Kay Siang Road, Singapore 10

Education.—Secondary—Raffles Institution, Singapore. Tertiary—Diploma in Arts, Raffles College, Singapore, 1941. Bachelor of Arts, London University, 1949; Second Class Honours, Upper Division, in Classical Chinese. Associate of the Royal College of Art, London, 1956, majored in Painting

Present Appointment.—Permanant Secretary and Director of Education

Other Posts Concurrently Held.—Chairman, Singapore National Commission for UNESCO; Chairman, Permanent Examinations Board for the Civil Service; Chairman, Educational Publications Bureau; Chairman, Environmental Control Organization Planning Committee; President, Young Musicians Society; Director, National Cadet Corps; Director, University of Singapore Press; Director, Toppan Printing Company; Council Member, University of Singapore, Nanyang University, University of Malaya, Institute of Southeast Asian Studies; Chief Representative of Singapore to the Southeast Asian Ministers of Education Organization (SEAMEO) and the Regional English Language Centre (RELC)

Participation in Recent Conferences.—UNESCO Seminar on Educational Planning, New Delhi, January, 1962; CETO (Center for Educational Television Overseas) Conference, London, December, 1964; IAU (International Association of Universities) Conference, Tokyo, July, 1965; Special Visitor to Australia, September-October, 1965; UNESCO 1 General Conference, Paris, October, 1966; INNOTECH (Regional Centre for Educational Innovation and Technology) Conference, Western Samoa, October, 1968; UNESCO 15th Gen-

eral Conference, Paris, November, 1968; UNESCO Educational Workshop, Geneva, May, 1970; various meetings of Officials and Project Directors of SEAMEO in Bangkok, Manila, Kuala Lumpur, Jakarta, Saigon, 1966–1970.

Decorations.—Public Administration Medal, Gold, 1963; Meritorious Service Medal, 1968.

BENGT GUSTAF LUNDHOLM, SECRETARY, ECOLOGICAL RESEARCH COMMITTEE, SWEDISH NATURAL SCIENCE RESEARCH COUNCIL

Born April 28, 1916 in Karlstad, Sweden
1947; PhD in Zoology, Uppsala University.
1948–50: Director, Mammal Dept. Transvaal Museum, Pretoria.
1952–61; Teaching in Sweden.
1961–67; Ex. Secretary and Member, Natural Resources Committee, Swedish National Science Research Council.
1968– Exec. Secretary and Member, Ecological Research Committee, Swedish National Science Research Council.
1968– Member, Air Pollution Advisory Council, Swedish National Environment Protection Board.
1969– Chairman, Ad Hoc Committee on the Problems of the Human Environment (International Council of the Scientific Unions).
1968–70; Chairman, IBP (International Biological Program) (Committee on Global Monitoring).
1970– Chairman, Commission on Monitoring. Set up by the Special Committee on the Problems of the Environment (SCOPE).

Swedish delegate for environmental matters in numerous international organizations such as the Scandinavian Research Council, Nordic Council, European Council, OECD, UNESCO and U.N.

THOMAS F. MALONE, VICE PRESIDENT, INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS, RAPPORTEUR FOR THE COLLOQUIM

Dr. Thomas F. Malone, Dean of the Graduate School of the University of Connecticut, was born in Sioux City, Iowa, 1917. He is presently Deputy Foreign Secretary of the U.S. National Academy of Sciences, and was formerly Senior Vice President and Director of Research for The Travelers Insurance Companies. He was graduated in 1940 with a degree in general engineering from the South Dakota State School of Mines and Technology. In 1962, he received an honorary Doctor of Engineering degree from the South Dakota State School of Mines and Technology and in 1965, he received an honorary Doctor of Humane Letters degree from St. Joseph College. Married Rosalie A. Doran, Dec. 30, 1962; 6 children.

Upon completion of his engineering studies, Dr. Malone began his formal training in meteorology in the Graduate School of the Massachusetts Institute of Technology, where he received the degree of Doctor of Science in meteorology in 1946. In 1941, he was appointed to the staff in the Dept. of Meteorology at M.I.T., promoted to assistant professor in 1943 and associate professor in 1951.

Between 1942 and 1945, Dr. Malone assisted in the training of groups of Air Force and Navy officers to be forecasters with the armed services. He was appointed a special consultant to the Air Weather Service in 1945 and served a tour of duty in North Africa where he gave lectures to Air Weather Service officers. In 1949, he was appointed editor to the Compendium of Meteorology, a thirteen hundred page volume devoted to an appraisal of scientific progress in meteorology.

In 1954, Dr. Malone was appointed Director of The Travelers Weather Service and the Travelers Weather Research Center for The Travelers Insurance Companies. In 1956, he was named Director of Research; in 1964, was appointed Second Vice President; in 1966, he was appointed Vice President and Director of Research; and in 1968, was promoted to Senior Vice President and Director of Research.

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Dr. Malone is Past President of the American Geophysical Union and Past President of the American Meteorological Society. He was elected Secretary for International Participation for the American Geophysical Union in 1964. In October 1967, he was elected a Bureau Member of the International Union of Geodesy and Geophysics. He served as Chairman of the U.S. National Commission for UNESCO during 1965–1967; he served as Chairman of the Committee on Atmospheric Sciences of the National Academy of Sciences from 1962–1968, and presently serves as Chairman of the Geophysics Research Board and Chairman of the Advisory Committee on International Organizations and Programs for the Office of the Foreign Secretary. He is a member of the Advisory Panel on Science and Technology to the Committee on Science and Astronautics of the U.S. House of Representatives. He served on the Visiting Committee, Engineering and Applied Physics at Harvard from 1963–1969 and on the Visiting Committee for the Department of Earth Sciences at the Massachusetts Institute of Technology from 1961–1968; In 1969 he was elected a Director to the Board of the Alumni Association of the Massachusetts Institute of Technology.

Fields.—Applied meteorology, synoptic climatology, science and public policy.

B. R. Seshachar, D. Sc., F.A. Sc., F.N.I., President, Indian National Science Academy

Dr. Seshachar has 44 years teaching and research experience in Biology. He is Professor and Head of the Department of Zoology, Delhi University. His special field is Cell Biology. He has to his credit over 100 publications in India and abroad In 1965, he was awarded the Sunder Lal Hora medal for outstanding research in Biology.

Apart from his teaching appointments, he currently holds the following offices:

(i) President, Indian National Science Academy;

(ii) Chairman, Indian IBP Committee;

(iii) President, Indian Committee for Biological Sciences.

He also holds visiting Professorships in the Columbia University, New York and Ping's College, London.

Professor Seshachar has travelled widely and has visited the United States from time to time for Conferences, Meetings and Lectures.

Maurice Frederick Strong, Secretary-General, U.N. Conference on the Human Environment

Maurice F. Strong, Secretary-General of the United Nations Conference on the Human Environment, is a Canadian who brings to his assignment broad experience in business and government.

Prior to his appointment, Mr. Strong was President of the Canadian International Development Agency, supervising Canada's $400 million annual foreign aid program in some 60 countries. He came to government service directly from the business world resigning the Presidency of the Power Corporation of Canada, Ltd., one of the country's largest investment concerns. He has held other executive positions with financial, petroleum and natural resources development companies. Mr. Strong was born on April 29, 1929, in Oak Lake, Manitoba where he attended the local public and high school. At 13 he left home to stow away on a Great Lakes steamer. When discovered he was kept on to work in the crew galley. At 15 he joined the Merchant Marine making several Pacific voyages before moving to Canada's East Arctic as an apprentice fur trader for the Hudson Bay Company. During his two years in the region he lived among the Eskimos, learned their langugage, and collected rock samples. When Mr. Strong was 17 these samples enabled him to participate in the formation of a successful mineral exploration company. Subsequently, he worked briefly at United Nations headquarters, married the former Pauline Williams and took a two-year trip around the world.

During the trip he spent a year in East Africa establishing automobile service stations for an oil company and helped develop a graphite mine in Tanganyika.

Upon his return to Canada Mr. Strong entered the business world, and held a series of positions with companies in the fields of finance and natural resource development, including the Presidency of an oil and gas company which he founded in 1967. In 1962 he became Executive Vice-President of the Power Corporation of Canada. Two years later at the age of 35 he was named President.

Mr. Strong left private industry in October 1966 at the invitation of Prime Minister Lester B. Pearson to become Director-General of the External Aid Office, Government of Canada, with the rank of Deputy Minister. At the same time he resigned all his business positions. When the role of the Aid office was enlarged and it was redesignated the Canadian International Development Agency, Mr. Strong was named President of the Canadian International Development Board.

During this period he also served as a Governor of the International Bank for Reconstruction and Development, the Asian Development Bank, the Caribbean Development Bank and had principal responsibility for Canada's participation in the U.N. Development Program. On a number of occasions he headed the Canadian delegation to international meetings.

Mr. Strong also served as an officer or director of a number of private organizations active in international affairs, including the World Alliance of YMCA's, the World Council of Churches, the Society for International Development, and the Society for Development, Justice and Peace.

In Nov. 1970, Mr. Strong resigned his positions with the Canadian government to accept appointment as Secretary-General of the U.N. Conference on the Human Environment. He is also responsible for environmental affairs within the U.N. Secretariat with the rank of Under-Secretary-General. Holds honorary degrees from a number of Canadian universities and was a visiting professor at York University, Toronto. Enjoys mountain climbing, fishing, boating and skin diving. The Strongs have five children including a foster child.

RUSSELL E. TRAIN, CHAIRMAN, U.S. COUNCIL ON ENVIRONMENTAL QUALITY

Russell E. Train became Chairman, Council on Environmental Quality, February 9, 1970.

Born in Washington, D.C., in 1920, Train has served in all three major branches of the national Government, executive, legislative and judicial. He began as an attorney for the joint Congressional Committee on Internal Revenue Taxation in 1947, and became Clerk and then Minority Advisor to the House Ways and Means Committee in 1953–1956. From 1956 to 1957 he headed the Treasury Department's tax legislative staff.

In 1957, Train was appointed to the Tax Court of the United States by President Eisenhower. He was reappointed to a full 12-year term in 1959.

Train became active in conservation work while serving on the Tax Court. He founded and became the first president of the African Wildlife Leadership Foundation, which led to participation in the work of other conservation groups at home and abroad. On August 1, 1965, he resigned from the Tax Court to become president of The Conversation Foundation, a nonprofit research, education and information organization concerned with a broad range of environmental matters.

While president of The Conservation Foundation, Train was named by President Johnson to membership on the National Water Commission in 1968. Following the elections of that year, President-elect Nixon appointed him chairman of a special task force to advise the incoming Administrattion on environmental problems.

Train resigned from the Conservation Foundation after being nominated Under Secretary of the Interior, in early 1969.

He holds a B.A. degree from Princeton University and a law degree from Columbia. He served in the Army from 1941 to 1946, rising to the rank of Major. Mrs. Train is the former Aileen Bowdoin; they have four children.

THE RIGHT HONORABLE PETER WALKER, M.B.E., M.P., SECRETARY OF STATE FOR THE ENVIRONMENT, GREAT BRITAIN

Mr. Peter Walker was appointed Minister of Housing and Local Government when Mr. Heath formed his Cabinet in June 1970, and at the same time was created a Privy Councillor. The following October the Government announced a reorganization and regrouping of various Ministries, with Mr. Walker as Secretary of State for the Environment, head of a department merging three former Ministries—Housing and Local Government, Transport, and Public Building and Works.

Mr. Walker has been Conservative Member of Parliament for Worcester since 1961, and in April 1966 was appointed a member of the Shadow Cabinet (the Consultative Committee of the Leader of the Opposition). For the Shadow Cabinet he led on Transport, and later on Housing, Local Government and Land. He added Transport to his responsibilities again in October 1969.

When the Conservative Party was previously in power he was from 1963 to 1964 Parliamentary Private Secretary to the Rt. Hon. Selwyn Lloyd, at that time Lord Privy Seal and Leader of the House of Commons.

Peter Edward Walker was born on 25 March 1932, and was educated at Latymer Upper School. As a schoolboy he was a founder member of the Harrow West Young Conservatives, later became the Young Conservatives' National Chairman, and as elected President in 1968 He is well known in the City of London, where he was a pioneer of the unit trust movement and before his ministerial appointment had also a number of other business interests including chairmanship of a firm of Lloyd's insurance brokers.

He is a former member of the National Executive of the National Union of Conservative and Unionist Associations and of its Advisory Committee on Policy as well as of its committees concerned with publicity and speaking. He himself has often spoken on radio and television.

Mr. Walker's home is at Warndon in Worcestershire; his recreations include walking, good conversation, and collecting rare books. He married Miss Tessa Pout in February 1969, and has a son.

APPENDIX II

[Congressional Record—Senate, April 27, 1970]

SENATE RESOLUTION 399—RESOLUTION SUBCOMMITTEE TO CREATE A WORLD ENVIRONMENTAL INSTITUTE

Mr. Magnuson. Mr. President I submit for appropriate reference a Senate resolution relating to the creation of a World Environmental Institute to aid all the nations of the world in solving their common environmental problems of both national and international scope.

I submit this resolution on my own behalf, and on the behalf of the Senator from Nevada (Mr. BIBLE), the Senator from Massachusetts (Mr. BROOKE), the Senator from Nevada (Mr. CANNON), the Senator from Kentucky (Mr. COOPER), the Senator from New Hampshire (Mr. COTTON), the Senator from California (Mr. CRANSTON), the Senator from Michigan (Mr. HART), the Senator from Indiana (Mr. HARTKE), the Senator from South Carolina (Mr. HOLLINGS), the Senator from Iowa (Mr. HUGHES), the Senator from Hawaii (Mr. INOUYE), the Senator from Washington (Mr. JACKSON), the Senator from Massachusetts (Mr. KENNEDY), the Senator from Louisiana (Mr. LONG), the Senator from Wyoming (Mr McGEE), the Senator from South Dakota (Mr. McGOVERN), the senior Senator from Montana (Mr. MANSFIELD), the junior Senator from Montana (Mr. METCALF), the Senator from Utah (Mr. MOSS), the Senator from Maine (Mr. MUSKIE), the Senator from Wisconsin (Mr. NELSON), the Senator from Oregon (Mr. PACKWOOD), the Senator from Rhode Island (Mr. PASTORE), the Senator from Kansas (Mr. PEARSON), the Senator from Rhode Island (Mr. PELL), the Senator from Illinois (Mr. PERCY), the Senator from Vermont (Mr. PROUTY), the Senator from West Virginia (Mr. RANDOLPH), the Senator from Illinois (Mr. SMITH), the Senator from Virginia (Mr. SPONG), the Senator from Missouri (Mr. SYMINGTON), the Senator from Maryland (Mr. TYDINGS), the Senator from New Jersey (Mr. WILLIAMS), the

Senator from Texas (Mr. YARBOROUGH), and the Senator from Ohio (Mr. YOUNG).

Mr. President, this resolution represents the first step in creating the World Environmental Institute, and a first step in solving the international aspects of pollution and environmental quality. At a time when so much action is still needed on the environmental front here in the United States, some might question the wisdom of broadening our efforts to the global scale envisioned in this World Environmental Institute proposal. But the inescapable fact is that human ecology is global in nature, and without some form of international cooperation, environmental efforts within a single country like the United States are ultimately doomed to failure.

Before discussing the details of the World Environmental Institute that I have proposed, I would like to discuss briefly the background against which this resolution is offered.

The United States, unquestionably, is the major polluting Nation of the world. But the United States has no monopoly on pollution, environmental problems, or ecological concern. Few, if any, environmental problems are unique to a particular country. With the exception of isolated species of wildlife whose existence is threatened, most environmental problems—like pollution—are common to all industrialized nations, regardless of their size, location, or form of government.

We are all familiar, for example, with the problems of the United States and other Western nations; but it is interesting to note that the Soviet Union is undergoing environmental difficulties similar to our own. Pollutants from pulp mills are quickly destroying beautiful Lake Baikal, and a recent accident in a chemical plant is known to have killed millions of fish in an important Soviet river. And while we in the United States are still in the "talking stage" with respect to noise pollution, the Soviets have already taken action: cars and trucks are no longer permitted to drive through Moscow during the hours when most Muscovites are asleep. Perhaps these developments foretell a new contest to replace the arms race and the space race: an "environment race" between the East and the West to see who will have the cleanest air and water and the quietest streets. This would be a healthy and welcome form of competition indeed.

Yet, the problems of environmental quality are global in scope and extend far beyond the industrialized nations of the East and West. Rapid population growth and economic development efforts make the environment a problem for the modernizing nations of the world as well—regardless of their political systems or their foreign policy. The Ganges River in India is more polluted than the Rhine; DDT is spread far more thickly in the tropics than in North America. Any nation that hopes to increase its gross national product, its per capita consumption, or other indices of economic growth is faced with an inescapable dilemma about the impact of such development on its environment.

It is with this realization in mind—that environmental problems are rooted in the growth of population and technology, not in ideology—that my cosponsors and I have proposed creation of the World Environmental Institute. The Institute is based on a special hope, a hope that I believe is more than just a dream. It is a hope born of concern for the dozens of modernizing nations for whom environmental quality is a necessarily low priority today but for whom the experience of the industrialized nations could provide valuable assistance in making economic growth and environmental quality compatible. These nations have seen, and desire, the glamorous fruits of industrialization; and most of them have not yet paused to consider questions of ecology that we ignored ourselves for generations. A cooperative international effort could clarify the choices these nations face and could help them avoid the costly mistakes that we made in similar stages of our own development.

But my hope is born of other, more ominous concerns about the international aspects of environmental quality: concern about DDT being found in the fat of Antarctic penguins; concern about the oil globules that now dot the surface of the oceans; concern about the steady build-up of carbon dioxide in the earth's atmosphere. These findings indicate that international cooperation on environmental problems would be more than helpful—it may hold the key to survival for all of mankind.

I know that it is not fashionable today to raise the issue of survival when speaking of the environment. We are told not to be alarmists, not to jeopard-

ize public support for environmental programs by raising unjustified fears. But the rate at which the nations of the world are pumping poisons into the air, the water, and the soil makes survival a very real issue in the long run. No portion of the complex chain of life on this planet can die without threatening all other forms of life; the death of the oceans, for example, might seal the fate of mankind.

The issue that this raises is stark: No nation can survive while other nations perish; no country can prosper while other countries pollute the ocean and the atmosphere. Ultimately, for man to continue his existence on this planet, international cooperation and understanding will have to prevail. A pragmatic concern for survival will force us to achieve what an idealistic concern for peace and friendship never could: The realization that we are all brothers, destined to perish or prosper together as a species.

Adlai Stevenson, an American who was really a citizen of the world, summed up this realization long ago. He wrote:

We all travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work, and the love we give our fragile craft.

Ironically, we had to launch spaceships of our own before we saw what Stevenson had seen: Earth is a spaceship herself, on which every member of the human race travels together through the solar system and the infinitive universe. An Apollo astronaut on the lunar surface can block out the vision of our distant planet simply by lifting his thumb. When he looks at earth, he can see no national boundaries, no capitals, no place names, no armies. All he can see is a tiny, shining ball suspended in the black void of outer space.

Most of us will never stand on the moon. That makes our task even more difficult than the astronauts'. We must learn to see earth as the astronauts have seen it, yet we must do so without ever leaving the ground. If we can achieve this vision—and we must achieve it—we will concentrate less on the issues that divide mankind and more on those matters that emphasize our common problems and our interdependence. We will realize that pollution of the Yangtze, the Ghanges, the Rhine, or the Dnieper is no less important to our continued existence than pollution of the Missouri and the Potomac. We will learn that DDT is no less hazardous to us all if it is sprayed on the Indian subcontinent instead of on the United States. And we will see that all wastes and poisons from around the world mingle together in our common environment—the air, the water, and the soil—to form a blanket of danger that envelopes the guilty and innocent alike.

When we achieve this understanding, we have only two alternatives available: action or despair. To despair is to forget mankind's greatest virtues: his ability to cooperate, his ability to pass knowledge between peoples and between generations, his ability to establish goals for himself and to work until those goals have been met. Even with the aid of these abilities, however, action will not be easy. We will have to overcome centuries of mistrust, generations of conflicting ideologies, and years of suspicion and fear. But we will never be alone: no nation, no government can ignore the issue of survival.

Fortunately, there are many international organizations working today to bring about controls on pollution and harmful substances—the United Nations, NATO, and the Organization for Economic Cooperation and Development, to name only a few. These groups are attempting to establish international treaties, inspection procedures, and environmental police powers. Their success—and the success of many similar organizations—is essential to all men.

But these organizations, important as they are, cannot provide one vital function that must be performed: the gathering and dissemination of environmental information to all nations of the world. Since each of us has a stake in the environmental quality of other nations, we cannot afford to work only through existing international organizations that include some nations and exclude others. NATO by definition involves only one community of nations; the United Nations excludes the largest country in the world.

In addition, each of the existing organizations on the world environmental front is political in nature and is involved in disputes between different nations and blocs of nations. Even though politics will play an important part in environmental treaties and arbitrations, politics must not be allowed to inter-

fere with the free flow of information and knowledge between all nations and all people. The world pool of knowledge and talent is a resource that belongs, like the air and water, to all mankind. No nation should be denied access to this pool because of political disputes with other nations. In fact, the solution to international environmental disputes may hinge on the sharing of knowledge and technology by all nations alike. This knowledge includes more than conventional environmental techniques—the technology of mass transportation, housing development, and automobile safety are clearly related.

So I am proposing, in this resolution, that a new international organization be created. This organization, which might be called the World Environmental Institute, would serve as a central information center for all nations of the world. Every nation—regardless of its form of government or its international and domestic policies—could consult the Institute for expert advice on all forms of environmental problems. The Institute would serve both as a research center and as the repository of that worldwide pool of knowledge and talent. Through the use of computers, any country could obtain a thorough guide to the scientists and scientific studies around the world that relate to a particular environmental problem.

Under the auspices of the Institute, a continual exchange of scientists and technological information between the countries of the world would be possible on a nonpolitical basis—not simply on the unilateral scale of today but on a multilateral level never dreamed of before. Task forces could be set up—consultants who would work as a team and on request visit the distant parts of the globe to undertake special projects. A constant flow of specialists between the Institute and other public and private research centers throughout the world would insure a balance in the Institute's personnel and purpose.

The Institute would be an international organization similar in spirit and purpose to the Olympic games; but, like the games, it would not heal the political divisions of the world, even with respect to environmental problems. International environmental disputes would continue to rage, with British soot falling on Swedish forests and with an Egyptian dam upsetting the ecology of the Mediterranean. The Institute would not attempt to arbitrate such disputes—that is the function of organizations like the United Nations. But the Institute would attempt to provide as much and as accurate information as possible to all those concerned and to the international organization within which such conflicts will be resolved. The Institute, let me emphasize again, would have no police powers—it would be like a reference book available to any and all nations with environmental difficulties.

It is not my intention to supplant the work of those hundreds of research institutions where scientists are now at work on complex ecological problems. On the contrary, the World Environmental Institute would serve as an index to these men and their work—helping to speed the flow of knowledge between those few who discover and those millions who need. The Institute will be an exchange, a reference center, a "clearing house" on environmental information—not a monolithic superbureaucracy. It will be founded on a simple ideal: That the stock of knowledge about environment problems ought to be held in common by all men and that all men should have access to such knowledge whenever they desire it.

Surely the time has come for the United States to take the lead and to propose creation of the Institute to the nations of the world. The time has come for us to realize that world leadership and world prestige are based on the power of ideas, not on the power of weapons. And the time has come for knowledge—that most precious of man's many resources—to be liberated from the prisons of nationalism and the shackles of the cold war.

The Senate resolution I have just introduced is designed to accomplish these aims. The broad, bipartisan support of the resolution's cosponsors indicates that this is a practical proposal, one that can be achieved if we dedicate ourselves to the task. The resolution is intended to produce action, not more rhetoric. And it will produce that action if the Congress, the President, and the leaders of foreign nations accept it with the seriousness and urgency in which more than a third of the Senate has offered it.

The resolution urges creation of the World Environmental Institute "to act as a global research center and to disseminate knowledge of environmental problems and their solutions to all nations of the world upon request." It says

that the Institute should be "independent of existing international organizations, nonpolitical, and open to all nations of the world."

The resolution further urges that the World Environmental Institute proposal be presented to the First International Conference on the Human Environment, scheduled by the United Nations for Stockholm in 1972. And it urges that all nations who are not presently members of the United Nations be invited to that Conference in order to discuss the World Environmental Institute concept.

Finally, the resolution asks that creation of the World Environmental Institute be an official policy of the U.S. Government "to be pursued with other nations both formally and informally, at Stockholm and in other appropriate forums where the cause of the Institute can be furthered."

In future addreses, I will expand upon the Institute concept and go into greater detail concerning some of its functions. Today, I have presented the basic thinking behind the Institute and the concerns that led to propose its creation.

Perhaps this World Environmental Institute plan is only a dream; perhaps, despite my hopes, the centuries of nationalism cannot be washed away by all the polluted waters of the world. Perhaps mankind cannot muster the will and the energy to insure his own survival. But as a Nobel Prize-winning novelist once wrote, man is not yet a finished creation: He is a challenge of the spirit. Response to that challenge of the spirit is the measure of man.

Survival is a challenge. Cooperation is a challenge. Peace is a challenge. A world view of the environment is a challenge. We may not meet these challenges, but we must try. For our response to these challenges will determine not only how we are remembered by future generations—it will determine whether or not there will be future generations to remember us at all.

I ask unanimous consent that the full text of the resolution be printed at the conclusion of my remarks.

The PRESIDING OFFICER (Mr. JORDAN of North Carolina). The resolution will be received and appropriately referred.

The resolution (S. Res. 399), which reads as follows, was received and referred to the Committee on Foreign Relations:

91ST CONGRESS
2D SESSION

S. RES. 399

IN THE SENATE OF THE UNITED STATES

APRIL 27, 1970

Mr. MAGNUSON (for himself, Mr. BIBLE, Mr. BROOKE, Mr. CANNON, Mr. COOPER, Mr. COTTON, Mr. CRANSTON, Mr. HART, Mr. HARTKE, Mr. HOLLINGS, Mr. HUGHES, Mr. INOUYE, Mr. JACKSON, Mr. KENNEDY, Mr. LONG, Mr. MCGEE, Mr. MCGOVERN, Mr. MANSFIELD, Mr. METCALF, Mr. MOSS, Mr. MUSKIE, Mr. NELSON, Mr. PACKWOOD, Mr. PASTORE, Mr. PEARSON, Mr. PELL, Mr. PERCY, Mr. PROUTY, Mr. RANDOLPH, Mr. SMITH of Illinois, Mr. SPONG, Mr. SYMINGTON, Mr. TYDINGS, Mr. WILLIAMS of New Jersey, Mr. YARBOROUGH, and Mr. YOUNG of Ohio) submitted the following resolution; which was referred to the Committee on Foreign Relations

RESOLUTION

Relating to the creation of a World Environmental Institute to aid all the nations of the world in solving common environmental problems of both national and international scope.

Whereas human ecology is global in nature and human survival depends ultimately upon the cooperative effort of the entire human species; and

Whereas worldwide pollution of man's common resources—the air, the water, and the soil—poses a threat to all peoples; and

Whereas environmental problems caused by technological and population growth are common to all nations alike, and

knowledge of such problems must be shared among all nations to insure the survival and well-being of the human species; and

Whereas existing international organizations are political in nature, noninclusive of all nations, or limited in their environmental activity; and

Whereas a nonpolitical international institution open to all nations of the world is needed to provide objective information and scientific knowledge to each nation and to international organizations dealing with environmental problems; and

Whereas a forum for advocating the creation of such an institution exists in the First International Conference on the Human Environment to be held under the sponsorship of the United Nations at Stockholm in 1972: Now, therefore, be it

Resolved, That the Senate recommends, urges, and supports the creation of a World Environmental Institute to act as a global research center and to disseminate knowledge of environmental problems and their solutions to all nations of the world upon request; and be it further

Resolved, That said World Environmental Institute should be independent of existing international organizations, nonpolitical, and open to all nations of the world, with its location and funding to be agreed upon by representatives of said nations assembled; and be it further

Resolved, That the Senate recommends and urges that the United States representatives to the First International

Conference on the Human Environment prepare to propose creation of the World Environmental Institute to the Conference; and be it further

Resolved, That in furtherance of the World Environmental Institute concept, the Senate recommends, urges, and supports the invitation to the Conference of all nations not presently members of the General Assembly of the United Nations; and be it further

Resolved, That the Senate recommends, urges, and supports creation of the World Environmental Institute as an official policy of the United States Government, to be pursued with other nations both formally and informally, at Stockholm and in other appropriate forums where the cause of the Institute can be furthered.

Appendix III

United Nations—Nations Unies,
New York, N.Y., March 3, 1971.

Reference: GI 42/4/1, EC 114/23(1–3–3).

Sir, I have the honour to refer to the report of the Preparatory Committee for the United Nations Conference on the Human Environment on its second session, held at Geneva from 8 to 19 February 1971 (copies of this report. A/CONF.48/PC/9, will be distributed shortly).

As will be noted from paragraph 28 of this report, the Preparatory Committee recommended the establishment of an inter-governmental Working Group to meet between sessions of the Preparatory Committee with the task of preparing a preliminary draft of the Declaration on the Human Environment for consideration by the Preparatory Committee at its third session.

Considerable debate took place in the Preparatory Committee on the question of the composition of this Working Group and the financial implications thereof. As to the latter, the Committee recommended (paragraph 86 of its report) that the Working Group be convened at United Nations Headquarters in New York for a brief organizational meeting as soon as possible, to be followed by a substantive session in the period May–June, so that the results, including a draft declaration, would be available well in advance of the next session of the Preparatory Committee in September. Accordingly, arrangements have been made for an organizational meeting to be held at United Nations Headquarters in New York, beginning on 15 March at 10:30 a.m. and to last for two or three days, as necessary.

On the question of the composition of the Working Group, having regard to its task of preparing a draft text of the Declaration, it is my understanding, based on the relevant debate in the Preparatory Committee, that the Working Group should be confined at this stage to Committee membership, that is to say, Member Governments not represented in the Preparatory Committee will be free to take part in the Working Group as observers. In this connexion it should be noted that the Preparatory Committee recommended that the Secretary-General of the Conference renew his invitation to all Member Governments to send their replies to his letter EC 114/23(1–3–3) and questionnaire of 21 December 1970, or other comments on matters for possible inclusion in the draft declaration.

The debate at the second session furthermore envisaged the possibility that the Preparatory Committee, after considering a preliminary draft of the Declaration at its third session, might wish to invite all interested Member States of the United Nations system to take part in the further elaboration of the text of the Declaration as full participants of the Working Group.

Accordingly, it would be appreciated if Member Governments desiring to participate in this Working Group (whether as members of the Preparatory Committee or as observers) communicate the name of their representative as soon as possible. Furthermore, I renew the invitation of 21 December 1970 for written comments on the possible form, scope and contents of the draft Declaration for the information of the Working Group. These comments should be received not later than 15 April 1971, in order that they may be made available to the Working Group in advance of its session in the period May–June.

Accept, Sir, the assurances of my highest consideration.

Maurice F. Strong,
Secretary-General,
U.N. Conference on the Human Environment.

United Nations Conference
on the Human Environment,
Stockholm, March 3, 1971.

GI42/4.

Sir, I have the honour to refer to the Report of the Preparatory Committee for the United Nations Conference on the Human Environment on its second session, held at Geneva from 8 to 19 February 1971 (A/CONF.48/PC.9), a copy of which is enclosed.

In addition to the proposed Declaration on the Human Environment, the Preparatory Committee identified a number of topics on which action could be

completed (even in an initial stage) at the Stockholm Conference and for which prior preparation is therefore necessary. Such actions are identified as "level III action" in both the Report of the Secretary-General to the Second Session of the Preparatory Committee (document A/CONF.48/PC.8) and in the report of the second session itself. The Preatory Committee recommended that a number of intergovernmental working groups should be established in order to begin the process by which decisions for specific actions may be submitted to the Conference. The first purpose of this letter is to bring information concerning such Intergovernmental Working Groups to the attention of all United Nations Member States, so as to facilitate participation by those who are interested. In the last part of this letter Governments' contributions (in the form of case studies and basic papers) are invited.

Preparatory Committee Recommendations.—As set forth in paragraph 87 of the Report, it was recommended to establish four separate IWG's to deal with the following subjects: Marine Pollution, Monitoring or Surveillance (possibly including pollutant release limits), Conservation, and Soils.

The Preparatory Committee considered other topics, including training, information exchange and genetic pools, and requested that certain advance preparations be undertaken by the Secretariat with a view to enabling the Preparatory Committee at its third session (New York, 13–24 September) to consider whether additional IWG's should be created on these subjects.

For each of the four recommended IWG's the Preparatory Committee agreed upon an "initial" membership (consisting of those Governments whose representatives were present and who indicated a desire to participate), but made clear that all other interested UN Member States who indicate a desire to participate should be invited to do so together with the appropriate components of the UN System, as well as certain international non-governmental organizations, such as the International Council of Scientific Unions and the International Union for the Conservation of Nature and Natural Resources.

It also suggested that Governments might consider providing expert services to the Conference Secretariat for the preparation of the basic documentation to be made available to IWG's. In the paragraphs which follow there is a brief discussion of each of the IWG's for which indications of interest in participation are now solicited:

Marine Pollution.—This IWG is discussed in paragraphs 37–45 of the Report; initial membership is listed in paragraph 42. While arrangements for the convening of this IWG have not yet been completed, it is contemplated that this group will meet during the period 14–18 June in Western Europe. It may further be desirable to hold another brief session of this group in early September. As noted in the Report, a good deal of information is already available, and by the time this IWG meets it can expect to have before it the Report by the Secretary-General of the United Nations pursuant to General Assembly Resolution 2566 (XXIV). The IWG will be expected to complete a full appraisal of the comprehensive subject of marine pollution, and to develop an integrated plan—whether on a national, subregional, regional or global basis—for dealing with marine pollution from all sources. The terms of reference of this IWG are broad enough for it to consider specific actions and recommend them to the Conference if it finds that agreement on specific actions is feasible. The IWG is also to consider possible general guidelines and criteria and such specific actions as are suggested in paragraph 42 of the Report.

Because of mounting worldwide concern for the preservation of the health of the oceans, it is anticipated that a large number of Governments may wish to participate in this IWG. It is not possible at this time to indicate the maximum number of full participants who may be accommodated; in view of the early convening date it is requested that Governments desiring to participate so indicate no later than 15 April 1971. Considering the terms of reference and objectives of this IWG, it is suggested that Governments interested in participating appoint persons having expert knowledge of marine pollution, including knowledge of present methods of its prevention and control, and of enforcement measures, and of relevant international legal aspects. Governments should also be prepared to address the question of how sources of marine pollution which are themselves far removed from the high seas, or even the marine environment itself, shall be evaluated and, where appropriate, progressively brought under international control and regulation.

Monitoring or Surveillance (possibly including pollutant release limits).—This IWG is discussed in paragraphs 46–48 of the Report. It will also be noted in paragraph 50 that a Secretariat report will be made to this IWG in the event of positive recommendations in specified areas. These relate to the question of establishing, on an international basis, guidance for the limitation of the release of pollutants. Initial membership is listed in paragraph 47.

Because of the requirement for considerable advance preparations in order to lay before this IWG all relevant information regarding current monitoring or surveillance activities, whether national or international (as well as the requirement for compilation of considerable information regarding pollutant release limits), it is not contemplated that this IWG can meet prior to the month of August 1971. Governments desiring to participate in this IWG should so indicate no later than 31 May 1971. It is scheduled to meet from 16 to 20 August at WMO Headquarters in Geneva.

In order to facilitate the compilation of appropriate data, Governments are encouraged urgently to submit any specific information on national or international monitoring or surveillance activities which should be brought to the attention of this IWG together with an indication of the adequacy or inadequacy of current efforts and such other comments as are appropriate to the topics cited in paragraph 48 of the Report, especially with regard to the processing and evaluation of data thus obtained.

In relation to both the monitoring or surveillance topic, as well as to the possible discussion of pollutant release limits, it is anticipated that the Special Committee on Problems of the Environment of the International Council of Scientific Unions will make an important contribution to the background documentation and discussions of this IWG.

Having in mind the subject matter, it is recommended that Governments appoint persons with broad current knowledge of existing monitoring or surveillance systems, of the related data analysis and evaluation function, and of the uses to which the resulting information is put by national Governments. Governments should also be prepared to discuss possible guidance for the limitation of the release of pollutants.

Conservation.—This IWG is discussed in paragraphs 53–59 of the Report. Initial membership is listed in paragraph 55.

In keeping with the recommendation of the Preparatory Committee this IWG will hold its first meeting concurrently with the third session of the Preparatory Committee (13–24 September), and unless advised to the contrary, the location will be the UN Headquarters in New York City.

It will be noted that advance preparations are already underway in UNESCO, together with the IUCN and FAO, for the conservation of certain areas of natural, cultural or historical significance, and there are related conventions being developed concerning the conservation of wetlands and Islands for Science. A number of Member Governments are believed to be already associated with this ongoing process.

Governments desiring to participate in this IWG should so indicate no later than 31 May.

Soils.—This IWG is discussed in paragraphs 60–67 of the Report. Initial membership is listed in paragraph 65.

This IWG will be convened in Rome from 21–25 June 1971. FAO has offered to host the meeting at its Headquarters and to provide a Technical Secretariat.

The purpose of this meeting is to prepare a draft plan of action for consideration by the Stockholm Conference. This plan would be designed to enable national authorities, with the assistance of existing international institutions and organizations, to take measures necessary to prevent various forms of soil degradation arising from erosion, pollution, over-exploitation, salinization, misuse, flood damage, and other hazards. Furthermore, the plan of action should indicate the means to improve or restore degraded lands, and to make the best possible use of marginal lands. This action programme would cover not only policy and technical aspects, but would also stress appropriate educational and training programmes aimed at an effective exploitation of soil resources based on sound ecological principles. As is noted in the Report, paragraph 84, for budgetary reasons the Preparatory Committee suggested that the meeting

of this IWG be conducted in English only (as is believed to be the practice of the FAO for this subject).

It would be welcomed if participating Governments could submit to the Conference Secretariat by 31 May background papers on the present status of soil conservation activities, on future programmes in this field, and on requirements for international co-operation. Draft recommendations for the proposed action plan would also be welcomed in advance. The Secretariat will also prepare background papers for submission to the meeting.

Considering the objectives of this meeting, it is recommended that Governments appoint persons having executive responsibilities in this field. Governments desiring to participate in this IWG should so indicate by 15 April.

As is noted in the Report of the Preparatory Committee (paragraph 80) progress reports on the work of each of the IWG's should be presented to the third session of the Preparatory Committee in September so that the Preparatory Committee may then consider what further guidance might be needed, including whether any of the above four IWG's should be terminated (as well as whether additional IWG's on other subjects are desirable). Thus it should be borne in mind that the work of the above four IWG's may or may not be concluded by September 1971; indeed, it is possible that in the case of some IWG's there will be a requirement for further sessions in the following months (November–December), possibly extending into early 1972. From the outset each IWG will be free to settle on its own programme of work within certain practical and financial limitations; it is suggested that in many cases interested Governments may wish to set up particular working groups or drafting parties to carry out specific assignments in the period following the initial meeting of the IWG's.

As was noted in the fifth point of my letter dated 21 December 1970, technical assistance is available to developing countries in respect of their preparation for the Conference, particularly in preparation of their national reports and, where appropriate, case studies. Because of the lack of response to the earlier letter of 25 November 1970 concerning case studies, it was not possible at the second session of the Preparatory Committee to present a list of invited case studies, as had been foreseen in the report of the first session of the Preparatory Committee (A/CONF.48/PC.6, paragraph 36). As indicated, however, in the report of the second session of the Preparatory Committee (paragraph 102) the Secretariat will circulate a list of suggested topics for case studies as well as topics already proposed by Governments. In this connexion the Secretariat would welcome suggestions from Governments for specific case studies applicable to the action process foreseen in the four IWG's above.

The Preparatory Committee also agreed on a list of elements to be considered in relation to the recommended agenda subjects (see paragraph 20). As spelled out in Annex V of the Report, "basic papers" are to be prepared on those aspects. Basic papers will be prepared by the United Nations, its specialized agencies, as well as by certain intergovernmental and non-governmental organizations. In addition, Governments are also invited to prepare, on a voluntary basis, one or more such "basic papers" on subjects which may not be fully dealt with in national reports or case studies. Should your Government wish to do so, it would be appreciated if it could inform the Conference Secretariat, by 15 April, of its intentions. Basic papers themselves should be made available by 31 May 1971.

Accept, Sir, the assurances of my highest consideration.

MAURICE F. STRONG,
Secretary-General of the U.N. Conference on the Human Environment.

EXCERPT FROM REPORT OF THE SECOND SESSION, PREPARATORY COMMITTEE FOR THE UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT.*

ELEMENTS TO BE CONSIDERED IN RELATION TO RECOMMENDED AGENDA SUBJECTS

A. In respect of all subjects the following factors would be especially considered in relation to action proposals:

(i) Requirements for collection, interpretation, inventory and distribution of data and information to guide decision-making; types of data and information required and sources; mechanisms for efficient collection, inventory, distribution and use.

* U.N. General Assembly. A/CONF.48/PC.9, 26 February 1971.

(ii) Requirements for analysis, evaluation and research to identify problems, foresee significant future trends, help develop new solutions, new technologies and new means of improving environmental quality and assessing future quality; identification of gaps in knowledge, technology and capability.

(iii) Requirements for establishment of criteria, standards and guidelines for achievement of optimum environmental quality; development of methods and techniques for implementation and co-ordination.

(iv) Identification and evaluation of principal development alternatives; criteria and techniques for evaluating trade-offs between economic and social factors in consideration of development alternatives.

(v) Economic and financial implications of policies and programmes; alternative financial and fiscal measures.

(vi) Legislative, legal, organizational and administrative factors—harmonization of policies; requirements for national legislation to complement and support local policies and programmes; requirements for national legislation to complement and support agreed international measure; organizational and administrative requirements at national, regional and international levels for implementation and enforcement of policies.

(vii) Special concerns of developing countries; concerns of particular developing regions; possible requirements for additional financial resources; role of development assistance programmes.

(viii) Related ongoing and planned activities of the United Nations system of organization and their capacity to implement action proposals.

B. In respect of each of the six main subjects, the elements proposed for consideration in relation to the Conference Agenda are:

I. The planning and management of human settlements for environmental quality

(*a*) *Comprehensive Development Planning* as a means for incorporating environmental considerations in development programmes for human settlements on national, regional and local levels; human environmental rights and socio-economic costs and benefits on fundamental criteria in planning and decision-making; avoidance of replication of inadequate and faulty environmental patterns and policies; optimum use of land and space.

(*b*) *Management of Settlements Development*—Governmental organization and administrative machinery for decision-making in planning, implementing and management of settlements networks; legal, economic and fiscal measures for settlements development; urban land reform as a means for environmental improvement.

When considering planning and management of human settlements the following components should be taken into account:

(i) *Population growth and distribution*—factors affecting population flows to urban areas; trends in urbanization; urban-rural relationships; integral planning of urban and rural development; social and environmental aspects of settlements patterns.

(ii) *Rural development*—planning of rural development with special emphasis on the needs, problems and priorities of developing countries.

(iii) *Industry*—national and regional distribution of productive forces, location of industries within settlements framework. Control and incentives affecting industrial development, with special emphasis on industrial zones and cities. Environmental specifications for working places.

(iv) *Housing and related facilities*—human requirements and developing standards; mobilization of technological, financial and human resources.

(v) *Transitional and marginal areas*—in-migrant settlement problems, improving living conditions and services in slum areas, specific environmental conflicts in suburban and rural-urban fringe areas; problems of central city areas.

(vi) *Recreation and leisure*—facilities and space for recreation and their environmental role within the framework of settlements networks. Environmental aspects of tourism.

(vii) *Transport and communication*—development and environmental aspects of roads, railways, urban and inter-urban transportation networks; terminal facilities (airports, docks, etc.); telecommunication as an alternative to transport.

(viii) *Water supply, sewage and waste disposal*—sources, consumption water quality standards; human and industrial waste disposal, recycling technologies; role of infrastructure in settlements patterns.

(ix) *Human health and welfare factors*—factors affecting physical and mental health; pollution and nuisances—standards and enforcement in context of urban management; problems of noise, crowding and densities of development; specifics of urban microclimate.

(x) *Social, cultural and aesthetic factors*—attitudinal and cultural factors, problems of creating sense of community; development preservation of aesthetic values; preservation and use of significant historical, cultural and natural sites.

II. The environmental aspects of natural resources management

(a) Means for incorporating environmental considerations in the comprehensive planning and management of natural resources development; relationship between natural resources development, transport and utilization, and environmental considerations on national, regional and global levels.

When considering the planning and management of natural resources, the following components should be taken into account in due respect to the principle of national sovereignty:

(i) *Agriculture and soil*—use of chemicals (e.g., pesticides, herbicides, and fertilizers); alternative technologies; control of animal wastes; animal productivity; plant productivity; ecological aspects of monocultures; erosion.

(ii) *Forestry* afforestation; ecology and forest areas; implications of environmental management of forests for forest-related industries.

(iii) *Fisheries and other aquatic resources*—conservation of stocks and species; effects of land reclamation and pollution on inland fisheries.

(iv) *Wildlife and recreational resources*—conservation of wildlife; preservation and development of nature reserves and wilderness areas; national parks, beaches and other recreational facilities; implications of and for tourism.

(v) *Water*—maintenance of water quality; the environmental impact of development and utilization of water resources; special problems of rivers and lakes as recipients and transport mechanisms for various pollutants.

(vi) *Air*—the quality of air as a resource to support life.

(vii) *Energy*—environmental consideration on production and use of energy; alternative sources and technologies; special problems related to nuclear energy and fossil fuels.

(viii) *Minerals*—environmental aspects of mining operations, location and development of processing facilities (other than petroleum), special problems related to petroleum industry.

(ix) *Transport*—relation of transport facilities to resource development and utilization; environmental aspects of international transportation networks.

(b) Management of natural resources of special regional importance, e.g., resources common to more than one national jurisdiction—river basins, inland waters; control of pollution to prevent damage in other countries.

(c) Effect of man's interventions in natural ecological systems; special ecological problems of arid regions, tropical regions, arctic regions, marshlands and islands.

III. Identification and control of pollutants and nuisances of broad international significance

(a) Most serious *sources* and types of pollutants and nuisances of broad international significance:

(i) Identification of principal sources and future trends—e.g., manufacturing, mining, energy production, agriculture, water transport, air transport, land transport, with special reference to automobiles, nuclear activities, human settlements.

(ii) Identification of principal types of pollutants, their dispersion, and transformation.

(iii) Identification of economic and fiscal measures for achieving environmental quality: incentives, subsidies, penalties, compensations, prohibition, taxation, effluent charges. Discharge standards, environmental quality criteria, operational requirements, harmonization of policies, treatment of special interest groups, industrial planning.

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(b) Effects of pollutants and nuisances of international significance:

(i) Transport of pollutants in the biosphere, contamination through man's food chain, contamination through water supply and air supply, criteria, standards and guides for permissible levels of human exposure.

(ii) Identification and evaluation of the principal acute and long-term effects on man's health including effects on man's genetic development.

(iii) Identification and evaluation of related effects on other living organisms and soils.

(iv) identification and evaluation of effects on climate; changing chemical composition of atmosphere; cloud effects, released heat.

(v) Identification and evaluation of effects on goods, materials, buildings, construction, etc.; problems of corrosion.

(c) Co-operative measures for maintaining and improving the quality of global environmental media;

(i) Atmosphere—measures required to control effects of changes in composition and conditions of atmosphere.

(ii) Hydrosphere—measures required for rational use, management and conservation of water resources in relation to environmental quality; specific proposals for prevention and control of marine pollution at the international levels.

(iii) Land—measures required to identify, evaluate and control changes in composition and condition of land, soils and sub-surface waters from the point of view of the environment.

(iv) Outer space—measures required for identification and control of potential hazards of pollution from man's intervention in outer space.

(v) Measures for identification and study of principal elements in planetary life-support system, application of systems approach to global environmental planning.

(d) Means of minimizing and possibly preventing hazards from natural disasters e.g., floods, earthquakes, typhoons, including the improvement of techniques for disseminating warnings to people in the path of the impending natural disaster.

IV. Educational, informational, social and cultural aspects of environmental issues

(a) *Education:* Means for inclusion of environmental and ecological principles in formal education at all levels; implications for both the substance and methodology of education.

Means for development of capable manpower through education; training to provide competence in all aspects of environmental management; types of capabilities required and most efficient means for supplying them at national and international levels.

Role of adult education, including workers and management education.

(b) *Information:* Methods of public information, particularly for children and youth in support of environmental improvement; measures to arouse the interest and participation of young people in environmental activities; development and presentation of information to the public to enable them to understand the costs and benefits of alternative policies and actions.

(c) *Social:* The impact of environmental considerations on relations between people; demographic and behavioral aspects of societies in relation to the environment.

(d) *Cultural:* Cultural and quality of life implications; environment in relation to human rights; development and acceptance of an "environmental ethic".

V. Development and environment

(a) Environmental policies as a component of comprehensive development planning, taking specially into account the particular problems, interests, needs and priorities of developing countries; link and relationship to strategy for Second Development Decade.

(b) Environmental problems, priorities, perspectives and actions concerning developing countries.

(c) Impact of national and international environmental action on economic growth; impact of economic growth on the human environment.

(d) Means of calculating costs of environmental factors in economic transactions and of providing for allocation of such costs; development of criteria

and techniques for evaluation and presentation of social factors in cost-benefit analysis of alternative policies and actions; means and criteria for relating economic growth indicators to quality of life factors.

(e) Fiscal implications of planning, conserving and developing natural resources and of environmental programmes for decontamination of air, treatment of water and elimination of industrial wastes.

(f) Environmental consideration in the choice of location of new industries on national and international level with particular reference to new industries in areas of lower industrial concentration, for example, developing countries.

(g) Resources required to meet needs for environmental quality at different stages of economic development; implications for alternative use of resources and resource flows; financing of international programmes of environmental action, technical co-operation and assistance—all with particular reference to developing countries.

(h) Implications of environmental issues for international trade, technical and development assistance, including technology transfer, its required cost and financing.

VI. The international organizational implications of action proposals

(a) Consideration of functions which would have to be carried out at international level based on acceptance of Conference's action proposals.

(b) Review of existing organizational situation at the international level as it is related to dealing with environmental issues and in particular in relation to action proposals being considered by the Conference; current and planned activities and capacities of existing organizations; particular reference to United Nations system.

(c) Consideration of alternative means of meeting needs for performance of required functions with particular reference to United Nations System; means of meeting special needs of developing countries; particular organizational requirements for meeting needs at regional level.

OBSERVATIONS AND COMMENTS

General

21. Approval of the agenda annotations was made on the understanding that not all items of the annotated agenda would necessarily appear in the form of Action Papers. Several delegations expressed concern that the actual scope of the subject matter to be considered be carefully determined within the framework of the time and priorities proposed for the Stockholm Conference. It was understood that the inclusion of respective subjects in the annotations of the agenda did not prejudge any decision or institution for their implementation. In addition, several delegations expressed the conviction that proposed plans of action should not lead to the addition or proliferation of new machinery, and that all efforts should be made to work within existing institutions and programmes.

22. One delegation requested that particular emphasis be given to the subject of water management and use in the context of subject areas (I), (II) and (III). Another delegation asked that special attention be directed to man's physical and mental health, particularly in subject areas (I) and (II).

Subject area (II)

23. When approving the sub-item a(v) on water, some delegations indicated a desire that sufficient attention be given to the ecological repercussions of dams and reservoirs. Other delegations, however, felt that the ecological problems, even if they did not exist, were not of overriding importance in view of the magnitude of the economic benefits to the development of the respective areas.

Subject (III)

24. One delegation requested that in the preparation of the Position Paper the subject matter be organized in the following sequence: sources and types of critical pollutants, transport of these pollutants to man, the acute and long-term effects of these pollutants on man, standards, and monitoring for research and compliance with standards. Another delegation requested that the Stockholm Conference concentrate on marine pollution by agents other than oil or radioactivity, so as to avoid the unnecessary duplication of activities of existing institutions, and that agreements be initiated on a regional basis.

Subject (IV)

25. Although recognizing the importance of this subject as a topic for discussion, several delegations expressed the desire that it not be given disproportionate time and attention at the Stockholm Conference.

Subject (V)

26. In reference to item (g) two delegations expressed the concern that financing of international programmes be taken within the context of the existing budgets of international organizations. A number of delegations were not in favour of item (h) as drafted, and one delegation criticized the emphasis of the whole section.

DECLARATION ON THE HUMAN ENVIRONMENT

27. The Preparatory Committee was informed that, as of 11 February 1971, 14 replies had been received to the Secretary-General's letter and questionnaire of 21 December 1970 inviting Governments to comment on the possible form and contents of a draft Declaration.

28. There was general agreement that the Declaration could represent one of the most important documents of the Stockholm Conference and should be carefully prepared by an Intergovernmental Working Group meeting between sessions of the Preparatory Committee. It was agreed that the Intergovernmental Working Group should be composed of all Members of the Preparatory Committee and such other Member States as would express the wish to participate in its work. It should be convened in New York. Its first meeting, a brief organizational meeting, should take place as soon as possible after the end of the second session; a substantive session should take place in the period May–June so that the results, including a draft Declaration, would be available well in advance of the third session of the Preparatory Committee. The Secretary-General was requested to renew the invitation to Member Governments to submit their views on the questionnaire or as regards other matters for possible inclusion in the draft Declaration, so that the Intergovernmental Working Group could take them into account and base its discussions on a larger number of Government's replies, as well as on a summary of the discussions at the present session. The Committee urged that the Intergovernmental Working Group proceed in such a way that a preliminary draft for the Declaration could be discussed in detail at the Committee's third session.

29. The Preparatory Committee held a general discussion on the Declaration, its principal objectives and possible form and contents. There was a general consensus that the Declaration should be inspirational and concise; it should be readily understandable by the general public so that it could serve as an effective instrument for education and stimulate public awareness and community participation in action for the protection of the environment.

30. Most members of the Committee felt that the Declaration should be a document of universally recognized fundamental principles recommended for action by individuals, States and the international community.

31. With regard to the structure of the Declaration, it was generally agreed that it should contain a preamble of an inspirational character.

32. There was some divergence of views on the question to what extent the Declaration should also attempt to lay down specific guidelines for action. The prevailing view, however, was that while the Declaration could outline broad goals and objectives, it should not set out a detailed action programme which would be more appropriate in the context of other action to be taken by the Conference (e.g. resolutions, conventions).

33. It was pointed out that, by its very nature, the Declaration should not formulate legally binding provisions, in particular as regards relations between States and individuals, or as between the latter, which were considered in principle to be governed by national legislation. The Declaration could, however, in the view of some delegations, make an important contribution by universally recognizing the fundamental need of the individual for a satisfactory environment which permits the enjoyment of his human rights. Other delegations were of the opinion that the Declaration could contain a separate section embodying general principles elaborating the rights and duties of States with respect to the environment. Some delegations favoured emphasis in the Declaration on the responsibilities of States and the need for solidarity in combating environmental problems.

34. The importance of international co-operation in solving environmental problems was stressed. The Preparatory Committee considered that it would be desirable for the Declaration to focus on the need for States to legislate internally to protect and preserve the environment, as well as on the need for international co-operation for the same purpose.

35. The Committee agreed that the relationship between environment and development is one of the issues of crucial importance and it would be useful to make a particular reference in the Declaration to the protection of the interests of developing countries.

36. On the question whether the Declaration should include a definition of the term "human environment", many delegations felt that it might be difficult at the present stage to reach agreement on a satisfactory definition which would not be unduly restrictive; and that an attempt to formulate a definition might unprofitably delay the preparatory work on the substance of the draft Declaration. Some representatives, however, favoured a definition as a necessary element to clarify and guide future environmental action.

(Other subjects proposed for completion at the Conference (3d-level actions).

A. MARINE POLLUTION

37. The Preparatory Committee heard presentations of the various activities of the United Nations system in respect of marine pollution from the representatives of the Department of Economic and Social Affairs of the United Nations, the Intergovernmental Maritime Consultative Organization, the Food and Agriculture Organization, UNESCO and the World Meteorological Organization. Throughout these presentations, the co-operative character of many of these activities was emphasized, including, in particular, the work of the Joint (IMCO/FAO/UNESCO/WMO/WHO/IAEA) Group of Experts on the Scientific Aspects of Marine Pollution, the Long term and Expanded Programme of Oceanographic Research and the International Global Ocean Station System being undertaken by the Intergovernmental Oceanographic Commission and the report being prepared pursuant to General Asembly Resolution 2566 (XXIV) on promoting effective measures for the prevention and control of marine pollution. Also mentioned prominently in these presentations, and of particular relevance to the subject of marine pollution, were the 1954 Convention for the Prevention of Pollution of the Sea by Oil, the FAO Technical Conference on Marine Pollution held in 1970 and the conferences on pollution of all kinds from ships and on the law of the sea to be held in 1973.

38. The Preparatory Committee held a general discussion on the problems of marine pollution. There was general agreement, in the light of the urgency, importance and complexity of these problems, that an Intergovernmental Working Group on Marine Pollution should be established. This Intergovernmental Working Group would look at the problem of marine pollution as a whole and attempt to develop an integrated plan for dealing with marine pollution. This plan would take into due account those areas in which the United Nations system is already active as well as those areas in which initiatives may be needed.

39. It would consider marine pollution arising from land-based, bottom-based and sea based activities as well as air-borne pollutants. In this connexion, the importance of national, sub-regional and regional, as well as international activities was emphasized, as was the need for assistance to developing countries in taking action to control marine pollution. Several delegations expressed the view that, in addition to this plan, the Stockholm Conference could receive from the Intergovernmental Working Group a number of principles to be used as guidelines in undertaking future action in the area of marine pollution.

40. On the question of whether specific actions for the control of marine pollution should be taken at the Stockholm Conference, there were a number of views. Several delegations felt that specific actions should be taken at Stockholm on such problems as the deliberate marine dumping of toxic materials and the discharge of chlorinated hydrocarbons to the environment. Several delegations stated that such actions need not take the form of conventions. Other delegations felt that it would not be possible to take specific actions for the control of marine pollution at the Stockholm Conference, but it was generally agreed that the terms of reference of the Intergovernmental Working Group

should be broad enough to enable it to consider specific actions and to recommend them to the Stockholm Conference if it found that agreement on specific actions was feasible. The view was also expressed that specific actions on marine pollution arising from certain marine activities should be left to the IMCO conference on pollution from ships and the Law of the Sea Conference both of which will be held in 1973. It was however, suggested that the Stockholm Conference might specify in any plan for the control of marine pollution particular subjects which should be considered at these conferences in 1973, as well as recommended guidelines as to how they might be approached.

41. With respect to the ongoing activities of the United Nations system relevant to the problem of marine pollution, there was general agreement as to the importance of what was being done, as set forth both in the documents made available by the Conference Secretariat and in the statements of the representatives of the various parts of the United Nations system. It was, however, the general view that a synopsis of these activities was required. Such a synopsis might be prepared by the Intergovernmental Working Group, or it might be provided by the United Nations Department of Economic and Social Affairs from work already underway pursuant to General Assembly resolution 2566 (XXIV), but in either case it would include the activities of all the different parts of the United Nations system.

42. In the light of this discussion, the Preparatory Committee has reached the following conclusions:

(a) The Preparatory Committee recognizes the deep concern over the pollution of the marine environment being felt by many Governments and by many international bodies as well as by other intergovernmental and non-governmental organizations. It considers that this is a topic deserving full discussion at the Stockholm Conference, that international action may be appropriate on many aspects of marine pollution, and that to facilitate Conference consideration there should be a full appraisal of this subject by an Intergovernmental Working Group.

(b) The Preparatory Committee recommends the establishment of an Intergovernmental Working Group initially composed of Argentina, Australia, Belgium, Brazil, Canada, France, Iceland, India, Iran, Japan, Mexico, Norway, Sweden, USSR, UAR, U.K., USA, Yugoslavia, of such other interested United Nations Member States who indicate a desire to participate and of appropriate components of the United Nations system, to consider the reviews of aspects of marine pollution now available, including the pending reports of the Secretary-General of the United Nations pursuant to General Assembly resolution 2566 (XXIV), with a view to recommending, *inter alia* and in the light of the discussions as deflected in this section of the report:

(i) The extent to which any general guidelines and criteria can usefully be established to assist Governments in preventing or controlling the pollution of the marine environment;

(ii) Specific actions which might issue from:

A consideration of the extent to which any particular substances can be identified whose discharge in the marine environment should be prevented or limited because of their toxicity, persistence, accumulation in living tissues of other properties, and in the light of this to consider the possibilities for action to prevent or control pollution by these substances;

An appraisal of international arrangements in particular sub-regional or regional ones, both as a start for later actions on a broader scale and to give immediate protection to areas of the marine environ ment which are especially liable to dangerous pollution. Such steps may be based upon or comprise more limited measures which have already been proposed or initiated in certain regions;

An appraisal of the action that might be taken by the Conference to improve the enforcement by Governments of existing instruments or conventions relating to the prevention and control of marine pollutions and to encourage the early implementation of further instruments now being formulated or to be formulated in this field.

43. In reaching these conclusions the Preparatory Committee has considered the following documents relevant to the discussion on marine pollution provided by the Conference Secretariat:

"Progress Report on the Implementation of General Assembly Resolution 2566 (XXIV) on Promoting Effective Measures for the Prevention and Control of Marine Pollution" (A/CONF.48/PC.8/Add.1, Annex IV)

"Possible Third level Actions in Respect of Marine Pollution" (A/CONF.48/PC(II)/CRP.4 Annex II)

"Summary of Relevant Parts of Resolutions Adopted by the General Assembly Dealing with Marine Pollution" (A/CONF.48/PC(II)/CRP.5)

"Excerpts of Relevant Parts of Debates at the 25th Session of the General Assembly (including debates in the Committee I) Dealing with Marine Pollution" (A/CONF.48/PC(II)/CRP.6)

"Marine Pollution: Review of Possible Level III or Level II Actions" (A/CONF.48/PC(II)/CRP.7 and Corr.1)

"Summary of Some Selected Recommendations Approved by the FAO Technical Conference on Marine Pollution (1970)" (A/CONF.48/PC(II)/CRP.12)

44. In addition, the Conference Secretariat had made the following documents from within he United Nations system available to the Preparatory Committee:

"Report of the Second Session (2–6 March 1970) of the Joint Group of Experts on the Scientific Aspects of Marine Pollution" (GESAMP II/11)

"Marine Pollution Problems and Remedies" (UNITAR Research Report No. 4)

"The Sea: International Co-operation in Questions Relating to Oceans", a report of the Secretary-General of the United Nations to the Forty-ninth session of ECOSOC (E/4836)

"Marine Pollution and other hazardous and harmful effects which might arise from the exploration and exploitation of the sea bed and the ocean floor, and the subsoil thereof, beyond the limits of national jurisdiction", a report of the Secretary-General of the United Nations to the Committee on the Peaceful Uses of the Sea Bed and Ocean Floor beyond the Limits of National Jurisdiction (A/7924)

45. Additionally, the following documents were available in limited supply:

Extracts from the Report of a Group of Experts on Long term Scientific Policy and Planning established by the IOC (first session held at Monaco, 16–25 November 1970)

Summary of a Report of the FAO sponsored Seminar on Methods of Detection, Measurement and Monitoring of Pollutants in the Marine Environment (Rome, 4–10 December 1970)

B. MONITORING OR SURVEILLANCE

46. The Preparatory Committee recommends that preparations be initiated so as to enable the Conference to review the adequacy of, and take any appropriate action to make full use of, and improve, present regional or world-wide arrangements for the monitoring or surveillance of certain variables of the environment that relate to the proper balance of the biosphere and the health and well-being of men. These shall include the monitoring or surveillance of environmental variables making possible:

(a) the continued assessment of those physical, chemical and biological changes in the environment that are brought about by human activities;

(b) the continued assessment of the changes of the natural resources of the biosphere;

(c) the detection of climatic changes, and

(d) the forecasting of natural disasters.

47. For the purposes outlined above, the Preparatory Committee recommends the establishment of Intergovernmental Working Group initially composed of Argentina, Australia, Canada, Japan, France, Mexico, Sweden, USSR, UK, USA, of such other interested United Nations Member States who indicate a desire to participate and of appropriate components of the UN system.

48. The Intergovernmental Working Group should:

(a) Consider the needs and priorities of Governments for the various aspects of environmental monitoring or surveillance and, in its work, clearly define the purposes for which any monitoring or surveillance activity might be undertaken.

(b) Review and assess the adequacy and compatibility of existing regional or world-wide monitoring or surveillance activities in air, in water, on land and on man and ecosystems.

(c) Assess the value of:

(i) using, co-ordinating, and extending existing monitoring or surveillance systems;

(ii) supplementing them through the utilization of remote-sensing techniques and

(iii) establishing new systems including early warning systems.

(d) Examine and recommend possible means for improving, where required, present monitoring and surveillance arrangements.

(e) Estimate the financial implications of any such recommendation.

(f) Consider which organs should receive the resulting data and which should evaluate them on a world-wide scale.

(g) Consider and recommend those organs to which the overall evaluations should be submitted for possible remedial action at Government level.

C. POLLUTANT RELEASE LIMITS

49. The Preparatory Committee, having considered the question of establishing, on an international basis, guidance for the limitation of the release of pollutants, requests the Secretariat to compile information on and, with appropriate consultation with experts, to examine the feasibility of the following:

(a) The development and recommendation, in co-operation with the competent international organizations, of additional international environmental quality criteria [1] aimed at the protection of man's health and his environment for use by Governments in limiting the release into the environment of critical pollutants;

(b) The continuing review of existing criteria [1] relevant to environmental problems and the identification of areas in which new or revised criteria are needed;

(c) The identification of substances which, because of their toxicity, persistence, accumulation in living tissues or other special properties, should not be discharged into the environment when this is avoidable, or failing that, whose discharge should be limited;

(d) The development of internationally agreed recommendations for the use of pesticides;

(e) Conducting a critical review of existing practices in the transportation, storage and disposal of toxic substances and developing if necessary additional guidelines or rules.

50. The Secretariat should report to the Intergovernmental Working Group on "Monitoring" and if it makes positive recommendations in any of the above areas should submit them to the Intergovernmental Working Group on "Monitoring" for consideration.

51. The Preparatory Committee has considered the proposals for an International Registry of Potential Chemical Pollutants and considers that these proposals should be discussed at level II for the time being.

52. It requests the Secretariat accordingly to seek Basic Papers from governments and appropriate governmental and non-governmental organizations, and to collate these papers in the light of discussion during the second session of the Preparatory Committee, and to present the results of its work of collation for further consideration at the third session in September 1971, when the Preparatory Committee may wish to consider initiation of possible level III preparations.

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[1] In pollution control the word *criteria* has come to have a special meaning which is, briefly, the data describing quantitatively the effects of a pollutant on a variety of receptors. These data require a knowledge of the quantitative and qualitative differences in the effects of the pollutant as a result of: the chemical form of the pollutant, the target organism and the type of exposure, i.e., acute or chronic. The kinds of harm which might be considered and which may be determining include effects on human health, fauna, flora and natural resources. Knowledge of all these permits the identification of the most likely effect in the most sensitive organism.

Norms or *standards* are regulated levels of quality of a natural resource or emission rates of pollutants prescribed for specific control purposes. They are arrived at by objective and subjective judgment weighing the risks of biological damage (described by the criteria), economic, social and aesthetic factors against the expected benefits of accepting a certain level of a noxious agent or environmental pollutant. The judgment requires taking into consideration, as well as the risks of harm, local conditions, available control technology, needs of developing industries and other scientific, social and political factors.

D. CONSERVATION

I. Areas of natural, cultural or historical significance

53. The Preparatory Committee recommends that preparations should be initiated in order to enable the Governments present at the Stockholm Conference, should they so decide, to agree to establish a World Heritage Foundation under which special recognition would be accorded to certain areas of natural, cultural or historical significance, as well as to take favourable action, possibly including the opening for signature, of two related conventions presently in preparation: one on the conservation of wetlands, one on the conservation of islands for science.

54. In order to assure adequate preparation, the Preparatory Committee recommends that UNESCO together with the IUCN, FAO and interested Member States, develop a constitution for the proposed World Heritage Foundation, to define its objectives and mode of action, to settle the criteria for the selection of natural areas and sites, and to outline the measures to be adopted by States for the conservation of trust areas.

55. For the purpose outlined above the Preparatory Committee recommends establishment of an Intergovernmental Working Group initially composed of representatives of Brazil, France, India, Iran, Italy, Japan, Sweden, USSR, UK, USA, Zambia, and of such other interested United Nations Member States who indicate a desire to participate, together with representatives of UNESCO, FAO and IUCN. The Preparatory Committee recommends that this Intergovernmental Working Group hold its first meeting concurrently with the third session of the Preparatory Committee to discuss reports previously prepared by UNESCO, FAO and IUCN.

56. Additionally, the Preparatory Committee recommends that UNESCO ensure that this action process in respect of the proposed convention on islands for science is called to the attention of the South Pacific Commission at its meeting at Noumea in August 1971 and to assure that appropriate action is taken for its discussion at the Pacific Science Congress in Canberra in August-September 1971.

II. Protection of endangered species

57. The Preparatory Committee recommends that preparation should be initiated in order to enable the Governments present at the Stockholm Conference should they so decide to take positive action on a draft convention to regulate the import, export and transit of threatened species of animals and plants.

58. In order to assure adequate preparation, the Preparatory Committee agreed that it would not be necessary to establish a special Intergovernmental Working Group since a draft convention is already in preparation by the IUCN with the assistance of FAO.

59. While recognizing that present plans call for a meeting open to all Member States early in 1972 to agree on the text of a convention, the Preparatory Committee recommended that IUCN, in co-operation with FAO and UNESCO, accelerate the preparatory process in order that Governments not yet involved could be apprised of the state of the convention in time to consider associating themselves with its signature at the Stockholm Conference.

E. SOILS

60. Considering that the steady and sometimes irreversible degradation of soils, followed by highly detrimental decline of productivity, it a matter of serious concern, particularly for developing countries, the Preparatory Committee recommends that preparations should be initiated in order to enable Governments present at the Stockholm Conference to endorse a Plan of Action for the purpose of strengthening and increasing the efficiency of national programmes of soil preservation and reclamation, with particular reference to wise land use, already initiated or to be proposed by Governments and competent Specialized Agencies of the United Nations acting in close co-operation with each other and with non-governmental Organizations.

61. Such preparation should permit, in particular, the determination of the most appropriate form of the measures which ought to be taken by the Stockholm Conference in this respect (e.g. an international Convention, the establishment of a Special Fund and of a permanent international group of experts to keep the situation constantly under review and recommend appropriate actions at the national, regional and international levels, etc. . .).

62. The proposed Plan of Action should enable national authorities, with the assistance of existing international institutions and organizations, to take measures necessary to:

(a) prevent various forms of soil degradation such as:

mechanical erosion (mainly by water flows including tidal action and tsunami waves and wind),

pollution resulting either from deliberate (but inappropriate) use of chemical substances (such as pesticides and fertilizers) or from accidental side effects of nonagricultural activities (for example, oil pumping, mining wastes, transport and storage of fuels, etc.)

overgrazing, fatigue resulting from too intensive exploitation, destruction caused by the use of inapproriate mechanical equipment, secondary salinization or alcalinization and, in general, all negative effects of misuse of lands,

destruction caused by floods, earthquakes or other disasters resulting from development projects being undertaken without the careful scientific investigations necessary to forecast their short and long term consequences (impact) on the bio-geo-equilibrium.

(b) improve or restore the productivity of degraded lands, make best possible use of naturally unproductive lands and, more generally, counteract by appropriate educational and training programmes the detrimental effects of ignorance, negligence or shortsighted exploitation on the quality of the soil or unwise land use not based on sound ecological principles.

63. In order to ensure adequate preparation the Preparatory Committee recommends the establishment of an Intergovernmental Working Group to:

(a) consider proposals to be submitted by Member Governments, the FAO in close co-operation with UNESCO, the IUCN, the International Soil Society and other organizations (including possibly Regional Economic Commissions of the United Nations, the UNDP, the IBRD) whose experience and support might contribute both to the efficiency of this preparatory planning work and to the success of the future Plan of Action;

(b) prepare the recommendations to be submitted to the Stockholm Conference for adoption;

(c) consider the scientific, legal, administrative and financial implications of such recommendations;

(d) prepare the instruments (agreements, resolutions etc.) necessary for such recommendations to become effective at the time of the Stockholm Conference.

64. The Preparatory Committee, being informed that present plans of the Secretariat make provision for the preparation of basic papers on these subjects by interested specialized agencies (with FAO as focal point) and also by interested Governments and non-governmental organizations by the end of May 1971, suggests that the Intergovernmental Working Group should meet in June 1971 in order to discuss these basic papers and elaborate proposals for immediate actions in the areas outlined above.

65. For the purposes outlined above the Preparatory Committee recommends establishment of an Intergovernmental Working Group initially composed of Argentina, Australia, Brazil, Canada, India, Iran, Italy, Jamaica, Japan, Mexico, USSR, UAR, USA, Yugoslavia, Zambia, of such other interested United Nations Member States who indicate a desire to participate and of appropriate components of the UN system.

66. Concerning the contents of the Plan of Action referred to above, the Preparatory Committee considers that the following problems would require special attention:

adoption of policies enabling farmers or agricultural communities to let the soil rest whenever necessary for its conservation or reclamation;

stabilization of marginal lands;

establishment of guidelines in order that economic development planning may take account of the necessity to preserve biological balances, with due consideration of the conditions (climatic, demographic, socio-economic, etc.) prevailing in various regions;

establishment of national bodies to advise governments and local authorities and communities on land and soils survey and mapping, proper land use planning, adequate legislation, research and experimentation activities required, and to promote the necessary information, educational, training and demonstration activities;

establishment of regional research and training centres for collecting data relating to similar ecological conditions, experimenting techniques, advising national authorities upon request and, in general, promoting regional co-operation in devising adequate soil use and reclamation policies.

67. The Preparatory Committee considers that the urgent necessity to preserve and improve the productivity of the soil required for the proper supply of future generations with food and other natural products should be one of the main principles reflected in the future Declaration on the Human Environment and invites the Secretariat to extend to the Intergovernmental Working Group in charge of the draft Declaration all advice and information required for this purpose.

F. TRAINING

68. The Preparatory Committee recommends that preparations should be initiated in order to enable the Governments present at the Stockholm Conference to consider specific international measures for the education and training of specialists in various fields of environmental problems (including the social, economic and cultural aspects of the human environment) such as:

(a) establishment or development of regional training centres on the human environment which might be sponsored by the relevant bodies and agencies of the United Nations system;

(b) determination of means for financing these centres ad provision of fellowships and scholarships for the study at these centres or other institutions;

(c) preparation, in consultation with the United Nations system and the appropriate non-governmental organizations, of programmes of co-ordination of the teaching and training activities of the United Nations system and non-governmental organizations in this field;

(d) determination of appropriate ways and means by which Governments might obtain expert services on an international basis.

69. In order to assure adequate preparation, the Preparatory Committee recommends the following action process;

(a) the Secretariat should undertake, on the basis of data made available by UN Agencies, national reports and other sources the preparation of a general outline of the status of:

(i) teaching and training programmes; bibliographies;

(ii) the availability of funds, scholarships or any financial means to support international training;

(iii) the availability of experts in various fields of environmental problems who may serve for international teaching and consultation.

(b) This information will be available for consideration by the Preparatory Committee at its third session at which time the Preparatory Committee would recommend whether or not an Intergovernmental Working Group should appropriately be established for level III consideration.

70. In making such recommendations the Preparatory Committee at its third session will be guided by the need to determine whether the functions envisaged in paragraph 68 above can be carried out satisfactorily by existing or planned programmes in the United Nations system, and non-governmental organizations with particular regard to such proposed programmes as an "International Centre for the Environment" which, if established, might sponsor advanced educational and training programmes in environmental problems and which might also play a co-ordinating role for the regional training centres.

G. INFORMATION EXCHANGE

71. The Preparatory Committee agrees that one important objective of the Stockholm Conference should be an analysis of the adequacy of the present machinery for interchange of information on environmental matters between Governments, and a consideration of ways in which it may be improved, particularly with regard to information other than scientific.

72. To this end the Committee recommends that the Secretariat of the United Nations Conference on the Human Environment;

(a) determine the needs of Governments for international exchange of information about the environment including scientific data, and information about legislative and administrative experience in the environmental field, planning, resource management, environmental aspects of economic development and

human health, pollution and pollution control, and the technical and scientific methodology which has been found valuable in these fields.

(b) ask United Nations Member States, either directly or through an appropriate intermediary agency, for an assessment of the extent to which the present machinery for international exchange of information meets their requirements.

(c) ask United Nations Member States, especially in developing countries, how far inadequacies in the flow of information concerning the environment result from a shortage of bibliography, trained librarians, abstractors, and other interpretative personnel, rather than from deficiencies in the primary sources of material.

(d) review in the light of the needs of United Nations Member States the adequacy of the information gathering, storage, assessment and dissemination currently being undertaken by economic regional commissions, and by intergovernmental and other international agencies as well as the adequacy of the training of personnel referred to in section F.

(e) provide information that will allow United Nations Member States to determine how far the work in this field of the existing international agencies, including regional commissions, requires co-ordination or expansion, and, if necessary, how far it might be appropriate and feasible to organize a comprehensive system for the exchange of information on environmental matters and an adequate series of centres with expertise in this field.

(f) keep United Nations Member States informed at all appropriate stages of this work, and to report progress at the third session of the Preparatory Committee, at which meeting recommendations for Third Level action at the Stockholm Conference could be made.

H. GENETIC POOLS

73. The Preparatory Committee, taking into account the accelerating rate of plant and animal species extinction, largely because of the destruction of suitable habitats for them; noting that the extensive use of high-yielding varieties contributes to the disappearance of primitive and other forms and earlier varieties which may be needed, for instance, for further advances in selection and breeding work, and to meet the needs of developing countries for varieties adapted to their specific ecological conditions; recognizing that the conservation and rational use of the existing diversity of the genetic resources and ecosystems of the world constitute not only a necessity for scientific purposes and ethical reasons, but can also help in selecting pest resistant varieties and thereby reduce the use of persistent pesticides, in selecting species and varieties for possible uses; recommends that preparation should be initiated in order to enable the Governments present at the Stockholm Conference:

(a) To take full cognizance of the existing acitivities of Member States, specialized agencies of the United Nations and non-governmental organizations in the important field of utilization and preservation of genetic resources and to evaluate progress made in this respect.

(b) To take additional measures for the rational conservation of world genetic resources including the survey and collection of these resources, the creation of additional centres of conservation in natural conditions (natural reserves and parks), in gene banks and other storage centres of genetic material, and also for strengthening their co-operation.

(c) To reinforce and co-ordinate, wherever needed, existing activities of registration, exchange of information and exchange of biological material for breeding and other purposes, eventually leading to the establishment of a world register of genetic resources.

(d) To strengthen and harmonize on-going programmes of selection and breeding of plants and aminals with a view to:

(i) developing additional high-yielding varieties especially adapted to the needs and to ecological conditions of developing countries;

(ii) increasing the resistance to pest and diseases of those varieties, thereby reducing the use of persistent pesticides.

(e) To take similar measures as under b) and c) above regarding culture collections of micro-organisms, for example, those used for anti-biotics and for soil improvement (nitrogen fixation by rhizobia).

(f) To recommend, wherever needed, the creation of additional national and regional centres which could perform the above-mentioned general activities, especially in subtropical and tropical regions, and also some specialized institutes performing the above tasks (b, c and d) for specific crops such as rice and for domesticated animals in order to increase their productivity and resistance to pest and diseases.

74. In order to ensure adequate preparation, the Preparatory Committee recommends that interested Member Governments, FAO, UNESCO, WHO and other interested specialized agencies as well as ICSU, IUCN and other non-governmental organizations, provide the Conference Secretariat, by the end of May 1971, with "basic papers" on the subject. The Secretariat will then ensure the compilation of these papers and prepare action proposals in those specific sectors which require urgent action, for consideration by the Preparatory Committee at its next session.

APPENDIX IV

NATIONAL REPORT

on the

HUMAN ENVIRONMENT

United States of America

Prepared for:

UNITED NATIONS
CONFERENCE ON HUMAN
ENVIRONMENT

June, 1972
Stockholm, Sweden

COMMITTEE ON INTERNATIONAL ENVIRONMENTAL AFFAIRS

DEPARTMENT OF STATE 1971

INTRODUCTION

Despite man's efforts to reach to the stars and distant worlds in outer space, his environment today and in the foreseeable future -- and perhaps forever -- must continue to be defined by the natural limitations of one finite planet.

So richly endowed eons ago with the resources to provide abundant life, this planet -- within the memory of living man -- has been forced to endure stresses and depletions that have strained the quality of its life-support systems.

Thus, man suddenly finds himself confronted with the perplexing problems of determining how best to stem the tide of environmental decline, and to preserve as much as possible the quality of life to which he has become accustomed. In a larger sense, 20th century man has come to the realization that the dimensions of human environment include not only all ecological systems, whether natural or manmade, but also a multitude of social and cultural values -- all of which react and interact between and among one another.

Man's status is measured, therefore, by the quality of the environment in which he exists. Whereas, in primitive societies, man's activities had little impact on the pristine quality of the environment, the advent of technology and larger masses of people have brought undesirable changes in that quality. Moreover, man's exploitation of his environment has also brought a degree of affluence that has drawn dangerously near to embracing a philosophy of the invincible sovereignty of man without regard for the inevitable reactions that govern all other life systems.

As the effects of environmental degradation become more and more evident on a world-wide basis, the United States finds itself in the difficult position of trying to determine reasonable social goals for environmental quality. Until fairly recently, these goals have been rather vague. The benefits of uncontaminated air, water and soil were recognized in a general way, but we had no effective means of determining how to balance benefits from physical change against the inescapable social costs of detrimental side effects. To adequately set proper values, some means must be determined first for identifying how much degradation of

environmental quality our life-support systems can safely endure. Some progress seems to be emerging in this regard, although reliable knowledge is still rather meager in many cases.

High on the list of priority issues is the need to establish land-use policies for urban and rural areas alike -- not just for isolated areas of critical concern but on a global basis. For the quality of our environment -- indeed of life itself -- is land-dependent. No other segment of human environment deserves more grave consideration than this fragile crust of soil from which we derive our sustenance.

Although we are rapidly developing an awareness of the effects of man on the environment, little is known of the effects of the environment on man. Since man responds both mentally and physically to his environment, we need to know to what degree technological interference may impede or disrupt nature's self-regulating mechanisms -- or, indeed, even threaten our own welfare or survival. Furthermore, if all societies are to contribute productively to human life processes, it seems imperative that we expand our knowledge on how changing environments -- and man's interactions with them -- can affect human potentiality.

The goal of the United States is to adopt an environmental program that will not force us to abandon growth but to redirect it. To do so, we must balance economic development with conservation of land, water, air and other resources in such a way as to maintain a life of dignity and social justice.

This goal will not be easy to achieve, because it implies a balancing of individual freedom versus responsibility to others. To attain this balance, difficult value decisions must be made. No one individual -- and no nation -- will likely escape facing up to this situation. Nothing can be gained from a posture of isolation. The task mankind faces will demand the wholehearted cooperation of both motivated citizens and motivated governments.

If the world intends to capture the full potential of goal-directed scientific and technological change, then it seems imperative that social changes must keep pace. Only in this way can the quality of human environment be maintained at a level that will allow generations yet unborn to share the resources which they rightly deserve.

ENVIRONMENTAL PROBLEMS: HUMAN SETTLEMENTS

The Impact of Urbanization

The current pattern of human settlements in the United States is largely the product of a major long-term, worldwide, socioeconomic process -- urbanization. This process is the centuries-old evolution in man's way of life from the rural-agricultural life pattern to the urban-industrial way of life.

The changes wrought by urbanization cover many aspects of man's life: occupation, values, habits, affluence, social structure and -- perhaps most important of all -- the relocation of people from relatively simple, low-density rural living patterns to high-density, complicated urban agglomerations. In the relatively short history of the United States, urbanization has changed a nation which at birth was 95 per cent rural to a country with more than 75 per cent of its people living in urban areas. More than 150 metropolitan areas have populations between 100,000 and one million, two dozen metropolitan areas have a population in excess of one million, and the largest metropolitan area is well over 10 million inhabitants.

Urbanization in the United States and the resulting change to an urban nation have brought many advantages. The industrial development associated with urbanization -- greater amount of capital utilized per unit of labor, the specialization and division of labor, economies of scale, improved transportation and communication, and the like -- resulted in ever greater output per worker which in turn yielded higher and higher levels of material comfort. Greater affluence permitted better health and living conditions for increasing numbers, increased educational opportunities and social and cultural advances. But the benefits of urbanization and the development and growth of very large urban areas were also accompanied by serious disadvantages and problems. Today, for many in the American city, the quality of life leaves much to be desired. And for many of the small towns and rural settlements, their viability, continued attractiveness and very future are in serious question.

We have come in the United States to feel that we cannot expect to solve the problems of our cities unless

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we solve, too, the problems of towns and rural settlements. We have programs to prop up faltering economies in rural and sparsely populated areas and we have programs for the deepening problems of cities. But it is only recently that we have begun to realize that the two problems are very closely related. In some cases rural areas have lost the young and the enterprising to the city; in other cases migration has been the export of rural problems to the city.

Despite this urban growth, the rather stable population growth rate of about 1 per cent a year gives credence to the belief that the United States is not facing an impending population explosion. However, the issue cannot be defined solely in quantitative terms. Rather, Americans have developed a new concern for the quality of life. The criteria for judging the population problem in the United States then are the kind of life its citizens can live in terms of health, education, housing, work, play, intellectual achievement and personal freedom on one hand and resource utilization on the other. Material wealth obscures the dangers inherent in rapid growth and at the same time aggravates many of the difficulties such growth entails. All this has led many individuals to espouse various and controversial levels of "optimum population size" for the United States.

Although it is difficult to reach agreement on an optimum population size, the issue of population distribution can be readily identified. There have been vase migrations of United States citizens from rural areas to metropolitan centers in recent years. Practically all of this growth has occurred in suburban areas. While central cities grew only about 1 per cent in the last decade, suburban population increased by 28 per cent, so that today more than half the people in metropolitan areas live outside the central cities. It is probable that this fraction will continue to grow.

Assuming that the rural-to-urban movement persists, most of the United States population growth over the next decade will be concentrated in the twelve largest urban regions. These twelve areas will contain over 70 per cent of the population but will occupy only one-tenth of the land area. The result will be further decline in the vitality of small towns and rural areas so that farm populations may decline to only 2 per cent of the total population by the year

2000. If the matter does not receive attention, smaller communities will be bypassed by the economic mainstream, while the vitality of central cities declines and growth proceeds in a disorderly, congested pattern at the edge of urban areas.

Urban Congestion

Perhaps the foremost problem of American urban settlements is congestion, a situation that results in part from the short supply of good housing, ineffective land-use controls and inadequate mass transit facilities.

Although the United States is by many standards a young country, many American cities have major structures which were constructed in the 19th century. Far-reaching changes in technology, among which are major improvements in transportation and communication, as well as changes in social and cultural values and objectives, have made many commercial, industrial and residential parts of these cities inadequate and unsatisfactory. High densities, frequently better described as overcrowded housing, are accompanied by inadequate open space and recreation areas, no parking facilities for automobiles, aging and obsolete schools, an absence of health and community facilities, and below-standard mechanical equipment in housing, both in quantity and quality. Narrow streets, which were satisfactory for horse-and-buggy days, are much less than adequate for modern life and modern standards.

The problems of American large cities are greatly complicated by internal shifts in location and changes in the pattern of activities, which have been especially significant since World War II. Peripheral or suburban residential growth, much of it unplanned and sprawling, has been enormous and has affected virtually every large city. The major transportation improvements which permitted large-scale residential development in suburban areas have also led to important commercial and industrial relocation from central city to suburbia. The central city has become more and more an area of poverty and blight. In all too many cases, these changes had either not been anticipated; or, if they had been, physical and organizational changes had not been made to accommodate the changes. Or perhaps the changes were hasty, shortsighted or in error.

Many of the emerging problems are so different or new that they require experimentation and innovation in the search for solutions. Until recently, few of our cities possessed the over-all climate or the professional leadership needed if such approaches were to be adopted.

Separate from, yet intimately related to, the physical aspects of human settlements are the socioeconomic aspects. The inner-city poor and the newly arrived in-migrants are the first to feel the effects of this changed dimension of the urban environment. And there is no question but that they suffer the most. But the socioeconomic costs of poor American urban environment have wide ramifications and important impact throughout urban areas.

Because the cheapest dwelling units in American cities are located in their inner zones, newly arrived residents, immigrants from abroad and in-migrants from domestic rural areas are drawn to these locales. These zones are also the older and blighted areas. In decades past, many of these areas were poor and blighted, had many slum characteristics, but nevertheless incorporated a large measure of vitality and community strength. They were for many residents "way stations," for themselves and their children, from which they launched their moves up the social and economic ladder. More recently, however, the inner vitality and strength of these inner-city societal groups appear in many cases to have dropped greatly. Physical slum appearances have become more commonly associated than before with negative social attitudes, apathy, frustration, losses in motivation and increases in crime and delinquency. This downhill socioeconomic cycle affects the physical environment adversely. In turn, it adds momentum to social degradation and alienation, each feeding on the other.

Declining Environmental Quality

The quality of urban life is increasingly affected by a multitude of environment-related factors: contaminated air, water and food, higher noise levels, dangerous streets, crowded dwellings, uncollected garbage and rubbish, tenant and landlord irresponsibility, inaccessible community facilities, lack of recreation space and facilities, and inability to bridge the communications gap between technology and the people who benefit from it. All of these factors contribute to the problems of disadvantaged citizens in a man-made environment.

The quality of urban life also is affected by aesthetic factors. Economic pressures have forced many cities to replace historic buildings and distinctive architectures with steel- and glass-box office buildings with a dreary sameness.

Many cities have lost the spirit to attract people downtown. With the growing number of shops and other services locating in the suburbs and with crime threatening many local urban businesses, much of the vitality is missing from the central cities. Litter and waste, the by-products of affluence, continue to deface the urban landscape. In too many cities the amount of open-space parklands, which give breath and beauty to an urban environment, is inadequate to meet needs.

Inadequate Governmental Structure

Another major problem of human settlements is the limited capability of local governmental machinery to cope with national growth. In this rampant pushing out of human settlements in all directions, there has been a multiplication of governmental bodies and a fragmentation of public responsibilities that has defied a creative approach to bring order out of confusion.

Acceptable standards of community services have risen rapidly with growing affluence; the level of public facilities required to service an increasingly congested urban society have likewise mounted. At the same time, revenue sources of city governments have become inadequate to meet the financial challenge of the urban crisis.

These and other problems have led to a growing consensus in the United States in favor of rationalizing local government and reducing fragmentation through improved metropolitan governing structures. Much thought and increasing support are also being given to the possibilities of channeling migration away from already overcrowded, large cities to smaller cities with superior, over-all environment. New local government structures with wider geographic responsibilities may also be helpful in more effectively meeting the needs of towns and small rural settlements. In this process, it will be extremely important to improve the means by which citizens can make their desires known and to assure that all levels of government are responsive to the views expressed by individuals.

ENVIRONMENTAL PROBLEMS: NATURAL RESOURCES

The United States is blessed with a wide variety of natural resources that provide the basis for its national economy. Rational management of these resources implies the use of policies that are chiefly motivated by reason. One might suppose, then, that the United States has managed its resources rationally for the better part of the nation's existence. Occasionally, however, one of those critical points in time arrives, bringing a realization that something long taken for granted is no longer true. Thus, we are now aware of the extent to which our air and waters are polluted, our wildlife endangered by man and his works, our land scarred and being swallowed up by the demands of a burgeoning population, our mineral resources dissipated through profligate use, and the quality of life of vast numbers of people inexorably diminishing. The present challenge to the United States -- and to every developed and developing nation -- is to determine a more rational way of using resources so that economic growth and social progress can continue, without jeopardizing the health, safety and well being of people or endangering the nation's security.

Paradoxically, as a nation we must discover new reserves of natural resources, while at the same time applying more restraint in how resources are extracted and used, what price is paid for them, and what is done with the land from which they are taken. Our society now has become acutely aware of both material shortages and environmental values. In many instances, these shortages can be projected. What they will mean in terms of impact upon the economy and upon traditional social and political values cannot readily be determined.

Water

The nation's water resources are fundamental to the well-being of present and future generations. They represent a priceless, national asset which can and must be managed to meet all needs. If properly distributed, the total water resource would suffice to meet current and foreseeable demands. Distribution, however, is uneven among the major river basins. In some basins, the water supply is already critical; in others, it soon will be.

The western part of the United States, accounting for about 61 per cent of the nation's area, has only 38 per cent of the water; the East, with 39 per cent of the area, has 62 per cent of the water.

Many areas in the United States are faced with near future water shortages, particularly of potable water, and by the year 2000 the number of such areas will increase significantly. Water resources studies, especially in the water-short areas of the Southwest, show that major new supplies of potable water must be identified by 1980. For many of these areas, desalting or precipitation management may be an attractive means for augmenting supplies.

A 10- to 20-year lead time may be required to develop additional large-scale surface water or other alternate water sources. Planning and decisions concerning the alternate sources of supply must be made as soon as possible to provide the necessary lead time for implementation. To be considered as a viable alternative, desalting must be demonstrated as a reliable and economic technology, available when needed.

The nation's precipitation also can be managed to meet growing water needs. Experimental and operational cloud-seeding programs are indicating potential 10 to 20 per cent increases in precipitation. Two billion acre feet of water is a reasonable estimate of the gross potential for the country. Large-scale tests and associated studies are needed to demonstrate operational feasibility, resolve complex environmental considerations, and assure the development of public acceptance of cloud seeding as a practical and economically feasible water-resource management technique.

The development of geothermal reservoirs in the western part of the United States offers great potential for new water supplies, clean energy and minerals.

In addition to the need for on-going applied engineering research in such areas as materials, electric power, hydraulics, water quality, etc., there is an increasing need for expanding research into new areas, such as beneficial recycling of waste waters.

Changing population patterns, economic criteria, environmental effects and sociological influences are of increasing concern to water-resource planners and developers. Research is needed to determine how to deal with these factors while continuing to physically develop our water resources to meet current and future needs.

Research, development, and application of more efficient water-management technology in crop production can greatly improve efficiency of water use. Agriculture will continue to be the largest consumptive user of water. Yet water for allocation to domestic, industrial, and recreational use in many locations must come in part by diverting some from agriculture. Therefore, criteria and institutions for allocation of water must be reviewed and revised.

Land

As the United States population continues to grow, increasing demands will be made for the utilization of all public and private lands and their resources. It is estimated that 2 million acres of rural land are converted each year to nonagricultural use. Half of this is shifted to such uses as wildlife refuges, recreation areas, and parks. The other 1 million acres are converted to more intensive uses. Urban expansion consumes an estimated 420,000 acres of land each year. Open space is continuously eaten up by housing, which often provides few parks. Shopping centers, power plants, transmission lines and highway interchanges take over large portions of land. Airports pose similar problems on an even larger scale, attracting a vast conglomeration of light industry and housing.

Uncontrolled building and construction practices often end in severe abuse of the land and are ultimately costly to the public. The popular practice of stripping subdivisions of all cover before commencing construction destroys tree and plant cover and can trigger heavy soil runoff. Sedimentation from this runoff in urbanizing areas loads nearby streambeds and ultimately river channels. This can cause costly downstream dredging, upstream flood control and destruction of the aesthetic quality of lakes and rivers.

Suburban development often spreads across ridges and slopes which should be left alone because of their beauty

and because their trees and plant cover absorb rain and inhibit flooding. Building on steep slopes can affect soil stability, causing severe erosion which then undermines foundations. Nevertheless, few cities or counties adequately control development of flood plains, steep slopes, or land above aquifer recharge areas.

Farmland near cities is increasingly disappearing into suburban developments. Unfortunately, insufficient effort has been made to keep the most attractive rural lands near cities from being converted to urban uses.

Past practices in the use of land and development of natural resources have resulted in serious resource and environmental damage to both public and private lands. One hundred and seventeen million acres of the 175.2 million acres of public land in the 11 western states are in a deteriorating condition; 45 million acres are severely eroded. (This public land acreage does not include the National Forests.)

There are 150 million acres of public lands in the 11 contiguous western states where livestock grazing is important.

The intensive grazing management program begun in the early 1960's is yielding public benefits beyond the increase in livestock production. Advantages have emerged in improving watershed conditions and wildlife habitats related directly to national needs for environmental-damage correction and future recreational needs.

Living Resources

Forests are the largest self-perpetuating terrestrial ecosystem. They provide global benefits as well as local contributions to man's welfare. Forests contribute significantly to the global cycling of carbon dioxide, and they constitute the largest reservoir of organic carbon. They produce about one-half of the net photosynthesis on the earth and account for over half of all transpiration. The air-conditioning effect of a warm, moist forest is about the same as that of an ocean surface. Forests play a role in cleansing pollutants from the atmosphere, and provide shade and windbreaks, shelter and food for wildlife, and a haven where man can escape from human concentrations.

Our National Forests amount to about 187 million acres. They are managed in consonance with ecological principles, on a multiple-use basis. While principal use varies among the many forest areas, generally water harvest, wildlife habitat, recreation, natural beauty, livestock grazing, and timber production are principal multiple-use objectives.

In all, the United States has about 760 million acres of forests and woodlands, of which about 510 million acres bear stands of commercial value. Timber production in 1970 amounted to about 11.1 billion board feet. It is expected to amount to 13.5 billion board feet in 1980. Increases of as much as 60 per cent over the present level of production are possible.

Emerging demands for environmental quality in forests, combined with an ever-increasing demand for forest products, make traditional silvicultural practices inadequate in today's world. Traditional counterattacks on the primary forces destructive to forests (fire, insects, disease) are no longer adequate -- particularly with reduction or elimination of many pesticides. Yet we have made substantial progress in the protection of our forests and in increasing their productivity. For example, during the 1940-44 period, an average of 3.3 million acres of forest area was burned each year, while during the 1965-69 period an average of 1.6 million acres burned each year.

The social and economic environments of our people depend heavily upon the success and stability of the nation's agriculture and its associated enterprises which provide our food and fiber. In turn, the high productivity of United States agriculture demands wise management of its natural resources -- soil, water, cultivated crops, and domestic livestock. To protect and improve these resources, Federal and state governments and private interests are engaged in continuing, large-scale programs of management, research and extension teaching.

The genetic capacity of crop plants and animals has been greatly increased by selective breeding and hybridization. Development of dwarf wheats responsive to fertilizer has increased yields in the United States and provided genetic material useful for yield increases in other

countries. Hybrid corn and grain sorghum have substantially increased yields of these crops in comparison to open-pollinated stocks.

Of particular significance, cereal breeders in the United States, in cooperation with cereal breeders in other countries, continue to produce stocks resistant to new, virulent strains of cereal rusts as they emerge and thus help protect our own and the world's food supply.

Yield and product quality of livestock and poultry have also been continually improved, providing genetic stocks and production methods widely useful in other countries.

Both crop and livestock production in 1980 are expected to be about 25 per cent more than in the 1967-69 period. Continuous application of increasingly effective research-based technology is expected to make such yield increases possible.

The land resources of the nation can make an important contribution in achieving national goals and objectives for outdoor recreation and wildlife. The stresses and strains of modern urban living have pressed in with such force upon people everywhere that the need for the creation and conservation of areas for recreation is considered one of the most important facets of a nation-wide program to improve the quality of life for more than 200 million people.

Seventy-five per cent of the United States population is located in urban areas but only 25 per cent of the public recreation facilities are located there.

In spite of this, recreation use on public lands increased by 3000 per cent from 9.3 million visitor days in 1964 to 39 million in 1969 and is expected to reach 60 million visitor days by 1976. Between 1965 and 1969, the demand for recreational facilities, particularly for picnicking and camping, increased 35 per cent nationally but over 200 per cent on public lands.

Wild animals add to the value and enjoyment of the total outdoor recreation experience.

The conversion of prime wildlife habitats to other land uses and the degradation of environmental quality are causing a steady decline in available public opportunities to use

and enjoy wildlife. As a corollary, the future of a number of species of wildlife is in jeopardy. These include mammals, birds, fishes, amphibians and reptiles which have value not only in the aesthetic sense but can contribute to a better understanding of ecology and man's relationship to his environment.

Some Federal lands are expressly set aside as undisturbed wilderness areas to preserve them in their natural state for future generations. Delays in setting aside greater numbers of these areas, especially within national parks, have stirred a public controversy, particularly among conservation groups.

Natural areas have become immensely popular with the millions who visit them each year. Yet the enjoyment diminishes as the number of tourists rises. Some of the more popular natural areas in parklands have become clogged with traffic, noise, litter, smog, and other factors which visitors are trying to escape.

Attention is also being given to improving recreational opportunities on private land. More than a thousand small watershed projects are now complete or under construction. Of these, 273 projects include land and water improvements for recreation use. Many of these projects include provision for several lakes. Surrounding land and neighboring recreational facilities such as hiking trails and camping areas also are available. When all projects are completed -- within 2 to five years -- they will provide over 13 million user-days of recreation annually.

Energy Resources

In its various forms, oil supplies a fourth of industrial energy, nearly half of household and commercial heating needs, and virtually all of that employed in moving goods and people. Oil contributes some 44 per cent of the total U. S. energy supply. We consume it in enormous volumes: the current rate is 15 million barrels a day.

The recent history of domestic oil supply is one of gradual transition from abundance to scarcity. Until 1948, the United States was a net exporter of oil. Since then,

we have imported oil under a program which limited the volume of certain oils that could enter our markets. Since 1967, however, the field of choice in the matter of imports has dramatically narrowed. Today, our domestic industry cannot produce our full requirements.

Growth in our dependence on foreign oil sources is related directly to the use of residual fuel oil, which is used mainly by power plants and factories and for heating large buildings. For years, residual was the unwanted by-product of refining operations in the United States and was sold at prices well below the cost of the crude oil from which it was made. Consequently, refiners cut back the production of residual oil as rapidly as they could to provide more yield in the higher valued products. As a result, a steadily increasing portion of the market had to be satisfied by imported residual fuel.

Now the patterns of both supply and demand for residual are changing. Primarily because of air-quality standards imposed by large metropolitan areas, which require low-sulfur fuels, the demand for residual fuel oil with a low sulfur content is expanding even more rapidly. This phenomenon is not confined to the United States; it is world-wide.

The outlook is for domestic production to peak in the next few years at about 13 million barrels a day, counting natural-gas liquids, after which it will begin a slow decline. To the extent that production from the North Slope of Alaska is developed and brought to market, the drift toward steadily greater reliance upon imports can be mitigated.

It could also be mitigated by the amount of oil that could be supplied from development of large oil shale reserves in the Western United States and from conversion of coal to oil.

Natural gas is at once the most attractively convenient and scarce fuel resource. As with oil, our reserves of gas are diminishing. However, over the past two decades, gas demand has grown strongly, at an average annual rate of about 6 per cent. This was half again as fast as total energy consumption grew, which meant that gas displaced other fuels in the market.

This long period of differential growth is now at an end, and the outlook is for gas to lose market position steadily over the coming years. It is not realistic to suppose that gas supply can expand at even the 3.4 per cent annual rate projected for energy as a whole over the coming 15 years.

Meanwhile, gas demand continues to rise by roughly 1 trillion cubic feet a year -- somewhat more than that over the past 2 or 3 years. This means that, once the effective delivery capacity of domestic gas fields has been reached -- and this may be by next year -- we shall have to find additional energy sources -- foreign or domestic; gaseous, liquid, or solid -- to the equivalent of at least 1 trillion cubic feet of gas each year.

In 1969, nuclear-generated electric power supplied two-tenths of 1 per cent of the energy consumed by the United States. Between now and 1980, the nuclear contribution will expand enormously in terms of its present small base. It is estimated that, by the end of the current decade, nuclear-generating capacity will probably reach 148 million kilowatts, providing some 900 billion kilowatt-hours of electricity. This translates into 10 per cent of the nation's anticipated energy supply in 1980. The share of energy provided by nuclear power will therefore be relatively modest until after 1980. To the extent that nuclear power plants displace those fired by oil and gas, the result is a net gain in the share of energy available from domestic sources. But the displacement of coal by nuclear power makes no contribution at all in this respect, since coal is our most abundant energy resource.

In contrast to coal, the amount of known uranium reserves mineable at competitive costs is limited. While new reserves are certain to be added in response to the great expansion in exploratory activity over the past few years, the demands of projected nuclear plants will continue to press hard against supply until the breeder reactor is an accomplished reality. This is not expected at any time before the 1980's.

Depending upon such criteria as depth of deposit and thickness of seam, the United States has hundreds of years' supply of coal in discovered, measured, recoverable reserves. Authoritative estimates agree that our coal resources are ample for as far into the future as we can reasonably foresee.

In 1910, coal supplied over three-fourths of our energy.

Subsequently, coal was displaced, first by oil, then by gas, until currently it provides barely one-fifth of our total energy supply. Today, coal supplies less than 4 per cent of the energy used for household and commercial hearing, virtually none of the transportation market, and about 26 per cent of power and process heat for industry. Only the electric power generation market remains as the major user of coal, accounting in 1969 for 60 per cent of all coal consumption.

Now coal is beset by two powerful inhibitors to its projected growth: the advent of nuclear power and air-quality standards which have effectively barred large volumes of high-sulfur coal from the market. The impact from nuclear competition has been rather slight, as nuclear plants accounted for less than 1 per cent of electricity production in 1970. But the situation is likely to change because a steadily growing number of metropolitan areas are imposing strict sulfur-content limitations which most eastern steam coals simply cannot meet. There is, to be sure, plenty of low-sulfur coal in the western states, but its development will require several years, and transportation costs will in many instances be much greater.

These restrictions on sulfur content of fuels came before any of the affected industries were ready for them. In the absence of any commercially feasible means for removing sulfur from stack gases, utility plants and other consumers began to scramble for low-sulfur alternatives. This meant greater use of residual fuel oil which could be desulfurized or blended to meet prescribed standards. As a result, utility use of residual fuel oil on the East Coast has doubled since 1967, while the use of coal has actually declined.

The immediate prospect, therefore, is for further erosion of coal's position in the energy mix, as air-quality standards continue to be applied by more and more states and municipalities. While much research has been done on the removal of sulfur from stack gases, this course is not yet a commercially feasible alternative to burning low-sulfur fuels. Given time and strong support from both government and industry, it may be.

For the next few years, we shall be in a critical position with regard to the pattern our energy supply will take. Beyond that time we have a great capacity to influence the form and source of our energy supplies. There are many choices to be made and actions to be taken.

Marine Resources

Competition for the use of the limited coastal zone is intense. Shipping activities are increasing, using larger vessels which need deeper channels. Mining and oil drilling in coastal waters grows daily. Industrial and residential developments compete to fill wetlands for building sites. Airport and highway construction follows and further affects growth patterns in the coastal zone. As a result, natural coastal areas are being nibbled away. In addition to the adverse effects caused by physical alterations of submerged and adjacent lands, pollution of estuaries and ocean dumping of wastes pose further problems. In polluted waters, vast numbers of fish and shellfish are affected as well as numerous birds, reptiles, and other wildlife which are part of this food chain. Since over 90 per cent of United States fishery yields come from coastal waters, the dependence of the commercial fisheries industry upon a stable estuarine system is obvious.

The long-range economic and ecological costs of degraded coastal areas are borne not just by the particular local community, but by the people of the state and the region, and no less by the rest of the nation.

On a broader geographic scale, the resources of the open oceans, which are of extremely great importance to human welfare, require improved management.

From the standpoint of biological resources in the oceans, the production of fish and shellfish probably cannot be increased to much more than about 2.5 times that produced in 1968 -- an eventual total of perhaps 150 - 160 million metric tons annually. If the estimated attainable production of food from the sea could be achieved by the year 2000, it would supply about 30 per cent of the world's minimal protein requirement at that time, but only a little over 3 per cent of its biological energy requirements.

The mineral and chemical resources of the sea that will be of practical interest to man over the next half century are those that can be extracted from sea water or recovered from the seabed of the continental shelf and oceanic rises. Marine-resource management must be consistent with all natural-resource objectives but with explicit consideration of delicate marine environmental factors. This latter point

is particularly important in view of the not-yet-well-understood, but crucial, role the oceans play in the natural cycling of materials essential to human welfare.

Non-fuel Minerals

The United States demand for primary minerals in the non-fuel category is expected to increase an estimated 400 per cent by the year 2000 if efforts are not made to reuse processed materials. Based on present trends, the nation's self-sufficiency in primary non-fuel minerals would drop from 69 per cent in 1968 to less than 30 per cent by 2000. This failure of domestic production to keep pace with demand is the result of dwindling reserves of rich domestic ores; increased exploration, mining and processing costs; an expanding population and increased per-capita utilization. Adequate technology has not been developed to recycle used materials, to find concealed ore deposits efficiently, nor to allow economic extraction and processing of lower-grade ores.

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ENVIRONMENTAL PROBLEMS: POLLUTION AND NUISANCES

The United States was blessed with what seemed, in earlier times, an unlimited abundance of land and resources. The attitude of the frontiersman, who viewed nature as an enemy to be subjugated, has remained very much a part of our view of life. Only in recent years is this frontier view giving way to a concern for husbanding resources and preserving or restoring the gifts of nature.

We have tended, moreover, to judge our progress in quantitative terms -- to view growth per se, in any area, as an unalloyed good -- and to accept as an article of faith that nothing should in any way inhibit the application of technology to produce an ever-increasing quantity of consumer goods.

Given these circumstances and these traditional attitudes, it is small wonder that an ecological view of the environment in which all elements, including man, are related and interdependent was slow in developing.

For many years, environmental pollution was tolerated as the disagreeable but acceptable price of progress. Air and water, since they belonged to all, were regarded as free resources, and there were few who questioned the right of industry, communities, or individuals to use them as sewers. Indeed, so limitless did these resources seem that their capacity for absorbing or dissipating the wastes discharged into them was taken for granted.

Only when confronted, in recent years, by gross pollution and threats of irreversible environmental damage have we begun to accept fully the fact that the wastes heedlessly generated by a growing, urbanized, high-production, high-consumption society exceed nature's capacity for self-renewal.

Today, most of our citizens are cognizant of the hazards posed by pollution. They are aware that human health, already affected by environmental stresses, can be seriously endangered by the unrestricted build-up of pollutants. They recognize that scenic beauty contributes importantly to their life, and that these values must not, and need not be, recklessly sacrificed to material progress. It has become clear, moreover, that, even in the narrowest of cost accounting terms, pollution is costing the United States billions of dollars every year.

A new ethic has emerged which repudiates the mistakes of the past and demands the restoration and preservation of a safe, wholesome, aesthetically satisfying environment.

Air Pollution

In the 19th century, when the United States was a developing nation, and throughout the first half of this century, air pollution was regarded fundamentally as a local nuisance. Its adverse effects were considered a necessary accompaniment to economic and industrial growth. This view, until the last decade or so, inhibited almost completely serious control efforts to abate or even seriously study the problem. Today, however, there is widespread and firm public and scientific acceptance of the fact that air pollution is far more than a mere nuisance locally, and that the direct impact, accumulation and recycling of pollutants in various ecosystems have far-reaching global implications.

In the United States, air pollution is a problem in all large cities and in many small towns. It contributes to premature death and illness, as well as to eye and respiratory irritation. It soils and corrodes physical structures of all kinds; it adversely affects agriculture and forests, and by reducing visibility, it increases air and ground traffic hazards and diminishes the aesthetic pleasures of citizens in many sections of the country.

Each year, 200 million tons of manmade waste products are released into the air over the United States. About half of this pollution is produced as a result of our transportation system, coming chiefly from the internal-combustion engine.

In terms of weight, which is not necessarily the best indication of their importance, 42 per cent of these pollutants come from transportation sources, 21 per cent from fuel combustion in stationary sources, 14 per cent from industrial processes, 5 per cent from solid-waste disposal practices and 18 per cent from forest fires and other miscellaneous sources. The main classes of primary pollutants include sulfur oxides, particulates, carbon monoxide, hydrocarbons and oxides of nitrogen. Numerous other noxious gases and harmful particulates also are introduced into the atmosphere from a variety of specific activities. Photochemical oxidants, a category

of secondary pollutants of extreme importance, are formed in the atmosphere when, under the influence of sunlight, nitrogen oxides combine with gaseous hydrocarbons.

It is well documented that episodic levels of gross particulates and sulfurous gases have caused death and illness, particularly among infants, the elderly and people with cardio-respiratory diseases. It is also clear that air pollution in urban areas contributes to the incidence of such chronic diseases as lung cancer, emphysema, bronchitis and asthma. In the United States these diseases have increased dramatically in recent decades. There is a broad range of opinion as to the degree to which air pollution contributes to their incidence.

The delay in fully documenting the extent to which air pollution presents a hazard to health derives from the same complex cultural and historical factors which account for the fact that only now is the world awakening to the health and environmental hazards caused by the chemical and radiological substances produced by modern technology. Scientists are just beginning to give attention to such matters as the capacity of chemical agents in the atmosphere to produce mutagenic effects in biological systems, the metabolism of absorbed pollutants, the ways in which pollutants may alter the normal biochemistry of cells, affect the hormonal system, and alter the general functions of body activity.

Attention to the toxicologic significance of the thousands of chemicals that technology brings into our lives is increasing under the stimulus of Federal air pollution legislation developed in 1967 and extended and refined in 1970. This legislation, reflecting the growing sophistication of scientists, legislators and the public with regard to environmental threats to health is forcing attention not only on such common pollutants as carbon monoxide, oxides of sulfur and gross particulates, but also on lead, asbestos, beryllium, cadmium and nickel, to mention a few of the hazardous substances found in urban atmospheres.

The adverse economic effects of air pollution are much more varied and substantial than is generally realized. They range from the waste of fuel and other valuable resources, through the soiling and corrosion of physical structures of all kinds, to damage to agriculture and forests. Moreover,

by reducing visibility, air pollution contributes to the toll of accidents in both air and ground travel. Efforts to assess the total economic costs of uncontrolled air pollution have been inadequate and incomplete. They are believed to range between $10 and $15 billion annually in the United States. A systems analysis study conducted by the Government in 1970 indicated that damage to materials alone (structural materials, such as steel and concrete, rubber and leather products, fabrics and so on) costs the country $4 billion annually.

The total investment necessary through 1975 to control the major industrial and municipal sources of particulate matter, sulfur oxides, hydrocarbons, and carbon monoxide in 100 metropolitan areas of the United States has been estimated at $2.6 billion. This includes costs for controlling both existing and new sources. By 1975, it will cost another $1.9 billion for operation, maintenance, depreciation and interest.

These estimated costs are based on assumed future control requirements. Still, the yearly cost to control the industrial sources of these four major pollutants is relatively low, less than 1 per cent of the value of the annual output of the industries involved, although the costs to some industries are much greater.

While the health effects of air pollution are no doubt of central importance in the movement toward control of the problem, it is also significant that public tolerance of the soiling, the odors, the reduced visibility and other economic and aesthetic aspects of the problem has altered drastically in recent years. The American public has made it abundantly clear that they no longer regard air pollution as a fair price to pay for progress.

Water

Since the beginning of the 19th century, a steadily expanding population and economic growth in the United States has placed unprecedented demands on our fresh water supplies. Consumption has increased enormously, while quality has steadily declined.

Today, every river in the nation shows in greater or lesser degree the carelessness and negligence to which each has been subjected. The most polluted are: the Ohio, the

Houston Ship Channel, the Cuyahoga, the Rouge, the Buffalo, the Passaic and the Arthur Kill, the Merrimack, the Androscoggin and the Escambia. Even the ground water is subject to pollution from the millions of gallons of waste liquids, mostly from industries.

The pollutants that clog the nation's waters consist of an almost infinite variety of combinations -- metals, minerals, chemicals, and organic matter -- fed into the waters from both natural and manmade sources. Each year, more than 1000 communities outgrow their treatment systems, and more than 1300 communities still discharge their wastes into the waterways without any treatment whatsoever. An equal number employ only primary treatment that removes from 30 to 40 per cent of the pollutants. Waste production from municipal systems is expected to increase by nearly four times over the next fifty years.

The more than 300,000 water-using industrial plants in the United States generate the most toxic pollutants. Wastes from this source are growing several times as fast as that of sanitary sewage, because of the growing per-capita output of goods, declining raw materials concentrations, and increasing degrees of product processing. Over half the volume of industrial waste discharge comes from four major groups of industries -- paper manufacturing, petroleum refining, organic chemicals manufacturing and blast furnaces, and basic steel production.

The northeastern states have the largest amount of untreated municipal and industrial waste discharges and the largest backlog of waste treatment facility needs. Discharge of large volumes of wastes from municipal and industrial sources has greatly accelerated the natural aging process of the Great Lakes. The most seriously affected of the Lakes, Lake Erie, is now in a state of advanced eutrophication or aging. Although Lake Erie is not "dead," as some experts have asserted, it would require a massive effort to restore the productive fish population of the Lake and to make the beaches safe for recreational purposes.

A number of other sources of pollution are contributing in lesser degree to the abuse of the waters: animal wastes from feedlots and runoff from irrigated and fertilized fields and areas where pesticides are used, particularly in the Midwest and the South. The Colorado River becomes more saline

every year as a result of return flows of salts leached from irrigated fields.

Acid and sediment drainage from abandoned mines has destroyed life in many streams in Appalachia and the Ohio River Basin. In Appalachia alone, where an estimated 75 per cent of the coal-mine-drainage problem occurs, approximately 10,500 miles of streams are reduced below desirable levels of quality by acid mine drainage.

Increased amounts of heated water are being discharged into the streams principally by the electric-power industry, which requires tremendous amounts of water for cooling. Thermal pollution has presented a threat to aquatic life and encouraged the growth of harmful plant life. Many authorities believe that waste heat looms as one of the most serious types of future water pollution.

Domestic and vessel wastes from about 46,000 Federally registered commercial vessels, 1,600 Federally owned vessels, and 8 million recreational watercraft have polluted many coastal waters where sensitive shellfish were harvested.

Oil spills from vessels and leaks from offshore oil drilling facilities have caused spectacular oil pollution incidents in the last few years, among them the Ocean Eagle spill and the one brought on by the collision of two tankers in San Francisco Bay, the Santa Barbara offshore well leaks, and the recent fire and oil leaks from drilling in the Gulf of Mexico. Less spectacular oil spills are occurring almost daily in navigable waters across the nation. In fiscal year 1970 alone, there were 283 spills involving about 442,000 barrels of oil.

Despite corrective legislative actions taken in recent years, the efforts to deal with the varied and complex problems of water pollution have been hampered in part by the enormous gap between the technology for producing goods and the technology for disposing of wastes created in their manufacture. The technology of water-pollution prevention and control is still in its infancy, both in terms of the relatively small amount of time and money that has so far been invested in this field and in relation to the magnitude and complexity of the task ahead.

Present technology in water-pollution control falls short in the following respects:

Removal of oxygen-demanding contaminants from waste effluents beyond the present 90 per cent efficiency;

Renovation of effluents to produce water suitable for direct, deliberate reuse;

Abatement of pollution from acid mine drainage;

Control of pollution from irrigation return flows;

Treatment and control of storm and combined sewer discharges;

Retardation or reversal of eutrophication;

Prevention of ground-water pollution by salt-water intrusion.

A principal instrument now being developed to solve many of these problems is called "advanced waste treatment." It aims to reduce the level of pollution of the nation's water resources by permitting repeated downstream water uses; and to renovate waste waters for direct and deliberate reuse for agricultural, industrial, recreational, and even municipal purposes.

Radiation

Throughout his history, man has been exposed to cosmic and other naturally occurring radiation. This natural background radiation still constitutes about 68 per cent of the total radiation dose reaching the average United States citizen each year. In the United States today, however, increasing numbers of people are being exposed to a variety of low-level, manmade radiation sources, including x-rays, radioactive materials, and electronic devices in the home and workplace.

The potential benefits of successful application of nuclear and electro-magnetic technology are tremendous. However, radiation as a by-product of that technology has raised serious questions, both within the scientific community and

among the public, as to the magnitude and nature of the hazard to human health and the adequacy of existing radiation protection standards.

A principal focus of concern is the growing use of nuclear energy to generate electric power. Some 20 nuclear power plants are now in operation in the United States, and about 750 are expected to be in use by the year 2000. Small amounts of radiation are released into the environment from such reactors and from fuel reprocessing plants. Such emissions are a small fraction of limits permitted under radiation-control standards. However, the fact that biological effects of low-level exposures have not been precisely quantified leaves room for disagreement over the adequacy of existing standards, which use a conservative extrapolation of measured data at high exposures. Moreover, public concern about the possibility of accidental release of large amounts of radioactivity into the environment persists, even though safety has been stressed since the very inception of the nuclear power industry to render this possibility extremely remote.

Another area of concern is the disposal of radioactive wastes from nuclear power generation and fuel reprocessing, a problem which may be expected to increase with the growth of the nuclear industry. At present, such wastes are buried or stored at carefully selected sites and a close watch is maintained to assure that leakage does not occur.

Fall-out from weapons testing prior to the 1963 atmospheric nuclear-test-ban treaty currently contributes about 3 per cent of the manmade radiation to which Americans are exposed. It is estimated that individuals who lived in the United States during the heaviest fall-out in the 1950's and early 1960's will accumulate from this source a total genetic fall-out dose, by the year 2000, approximately equal to that received annually from natural background radiation.

It must be borne in mind, however, that radiation generally classed as "environmental" is only a part of the total problem. Levels of radiation far higher than are present in the environment are today reaching increasing numbers of people from "non-environmental" sources. Medical uses of radiation, for example, now represent about

94 per cent of all manmade radiation, or roughly 30 per cent of all radiation sources to which the average person is exposed. Moreover, the last few years have brought increasing application of radiation in research and industrial processing as well as a phenomenal growth in the use of radiation-generating electronic products in the home and workplace.

Health effects which may result from exposure to large doses of ionizing radiation are well known -- leukemia and other types of cancer, reduction in fertility, cataracts and other eye damage, acceleration of the aging process, and damage to reproductive cells. There is need for greater understanding of the long-term effects from repeated exposure to all forms of radiation at low levels. One must recognize that the protracted release of even very low levels of long-lasting radioactivity from an increasing number of manmade sources has implications for human health which science has barely begun to explore.

Noise

In the United States, realization is growing that man cannot tolerate indefinitely the levels and types of noise that are presently a part of a modern, industrialized nation. In urban areas where 75 per cent of the population is located, the roar of air and surface transportation, the general din and hum of construction projects, and industrial noise are nearly continuous during the daylight hours. Moreover, the over-all loudness of environmental noise is doubling every ten years; and, if allowed to continue unchecked, the cost of alleviating it in the future may be prohibitive.

The problem is most severe in industry where noise-induced hearing loss looms as a major health hazard. It is estimated that up to 16 million workers today are threatened with hearing damage. In addition, noise may be a contributing factor to industrial accidents.

Hearing loss is not the only health problem associated with noise. Evidence is growing that intense noise may also harm other organic, sensory, and physiologic functions of man, and researchers are expressing fear that these effects have been seriously underestimated.

Air conditioners, lawn mowers, and a wide variety of power equipment now in common use also contribute to the

problem. In fact, noise levels in apartments and private dwellings, particularly in kitchen areas, are beginning to approach those in factories. The situation is further complicated by the lack of effective noise standards in building codes to prevent the construction of living units in which noise from the outside and from neighbors filters in.

Annoyance, however, is by far the most important product of environmental noise. Although interruptions to sleep, conversation, or recreation may not cause physiological damage, they certainly have an effect on human behavior. When environmental noise is added to air pollution, crowding, traffic congestion, and the other ills that mark our urban scene, the total effect can be overwhelming.

Solid Wastes

Until relatively recently, the United States has not been greatly concerned with environmental problems associated with handling and disposing of solid wastes. In a country comprising a transcontinental land mass, small population density, and seemingly unlimited natural resources, the most convenient disposal method -- usually an open dump -- seemed adequate. There appeared to be no reason to reuse wastes, since virgin materials were abundant and often cheaper than reclaimed materials.

Little attempt has been made to tie the production of consumer goods to the disposal of wastes. Disposal costs are not included in the price paid by the consumer; rather, they are borne by society in general.

However, this situation is now changing, as public appreciation of the magnitude of the economic and social costs of solid wastes is building and a concept of solid-waste management is evolving. It assumes that man can devise a system that will control the quantity and characteristics of wastes, collect those that must be removed, recycle those that can be reused, and dispose of those that have no further use.

These changes in approach to the solid-waste problem have been prompted by profound economic and social changes in the United States, particularly during the last two

decades. Of special significance is the large population increase (from 76 million in 1900, to over 200 million in 1970) and the shift from rural to urban character. These factors have served to increase the waste load, and favor accumulation of solid wastes in urban areas.

The growth in productivity of agriculture and industry, along with changes in certain marketing techniques such as extensive use of packaging and disposable containers, have compounded the problem.

In 1920, on a daily per-capita basis, about 3 pounds of solid wastes were collected routinely; today, this figure has grown to approximately 6 pounds, and by 1980 it is estimated that 8 pounds of solid wastes will be collected for each person daily.

The total solid-waste load generated from municipal and industrial sources in the United States amounts to more than 360 million tons annually. The annual total of agricultural wastes, including animal manures and crop wastes, is estimated to be over 2 billion tons. Mineral wastes add another billion tons a year. The highly combustible, toxic or non-degradable nature of many of these wastes, in addition to the vast amounts which must be disposed of, presents a major problem in many areas. This is particularly true in urban areas, where wastes accumulate in large quantities, and there are few land disposal sites within reasonable hauling distances.

The problem of disposal is aggravated by the widespread use of convenience materials that do not burn or decay, such as one-way glass bottles and plastic packaging.

The inadequacy of present solid-waste disposal practices is indicated by a national survey, which revealed that only 6 per cent of all authorized land disposal sites meet accepted standards. Nearly half of the sites contribute to water pollution, and three-fourths, to local air pollution. The survey also indicated that about two-thirds of the nation's municipal incinerators lack adequate air-pollution-control equipment.

In addition to contributing to environmental pollution, the mis-management of solid wastes results in scenic blight;

poses a threat to public health; adversely affects land values; creates public nuisances; and results in the loss of materials such as paper, and non-renewable natural resources, such as ferrous metals and other minerals. This last point is of crucial importance in determining a new approach to solid-waste management, which includes systematic salvage and reuse of waste materials. The clear necessity for conserving materials by reuse of wastes is implied in the fact that, with less than 7 per cent of the world's population, the United States consumes nearly half the world's industrial materials. Such a rate of consumption cannot continue indefinitely, as more countries industrialize and as competition for world resources increases.

Pesticides

In the United States, pesticides are used (1) to protect human health through control of vectors of human and animal disease; (2) to protect the human environment and food against pest insects, rodents, birds, weeds, and spoilage organisms; and (3) forests, crops and livestock against pests. We treat about 80 million hectares of land and water surface, about one-tenth of our total land area, with insecticides, herbicides, fungicides, and other pesticide chemicals each year.

Pesticides have been of enormous value in improving the lot of mankind throughout the world. Nonetheless, these substances are, by their very nature, biologically active and capable of adversely affecting many kinds of living organisms. Some pesticides are acutely toxic to man but are quite short-lived. Others, relatively less toxic but more persistent, result in residues on foods and feeds. Those with high toxicity are hazardous to animals in the area of treatment or on adjacent lands or waters to which they drift. Those with long persistence may remain in the environment, and some may accumulate at successive levels of the food chain to the point where they can have adverse effects on man and his environment.

There is abundant evidence that certain persistent pesticides are distributed widely in the environment. Large amounts leave the area of application via various routes in the atmosphere or in streams and ultimately reach the oceans. Current knowledge about the concentration and effects of these materials in the open oceans is fragmentary, but it is

known that the residues may collect in living organisms and produce adverse effects. Although more information on the occurrence of pesticide residues is needed - especially since growing amounts are being used throughout the world - steps are being taken in the United States to reduce this form of pollution. Emphasis is being placed on minimizing the use of persistent pesticides, finding effective substitutes which are less harmful in the environment, and developing alternative approaches to pest control, such as the use of radiation in the so-called "sterile male technique" and biological control agents.

EXISTING AND PROPOSED ACTIONS: HUMAN SETTLEMENTS

The establishment and achievement of national goals are difficult tasks. One of the major handicaps is the inadequate or poorly understood information available upon which to frame or base goals and to determine how best these goals can be won. This process must, of course, take into account the very real existence of differing political, economic, and social interests and viewpoints in such a highly varied society as the United States. It is not surprising, therefore, that national goals and programs in the complex subject area of human settlements tend to evolve relatively slowly. The experience in the United States certainly follows this pattern.

The first major involvement of the national government in the effort to achieve better environment in human settlements occurred almost four decades ago. This was a narrow-front assault on slums and involved essentially their razing and replacement with publicly supported housing for low-income families. In time the insufficiency of this approach became apparent. Blighted or slum residential housing was but one part of a city picture which included commerce and industry, public services and community facilities, and a transportation network. Replacement of poor housing by good housing or blighted commercial areas by new structures was not enough because changes in city processes and operations often made relocation or reconstitution necessary. Federal programs, therefore, changed to meet the new understandings. Assistance to urban areas became broader in scope. In the most recent past we have come to see an even broader concept of urban or human settlement environment.

Besides the need to redevelop and revitalize the individual existing settlements, there is a great need to consider the environment available to -- and influenced by -- the tens of millions of new Americans who will be added to our urban population in the next few decades. Should they continue to flock into the same already large cities? Should they be channelled into other smaller cities which offer possible superior environment? Should they be induced to take up residence in entirely new cities which could boast of having the latest technological and planning developments? Or is there a mix of alternatives which offers the maximum in environment as well as the maximum in choice? These are roughly the possible alternatives which have been identified and from which a national goal is to be selected.

National Growth Policy

In his January, 1970, State of the Union address, President Nixon posed this question: Despite our continuing increase in wealth, which will increase by 50 per cent in ten years, will the President of the United States of America in 1980 "look back on a decade in which 70 per cent of our people lived in metropolitan areas choked by traffic, suffocated by smog, poisoned by water, deafened by noise, and terrorized by crime?" He spoke of the need in American cities for "priceless open spaces" and stated that "the truly significant environment for each of us is that in which we spend 80 per cent of our time -- in our homes, in our places of work, the streets over which we travel." He called attention to the continuing flow of in-migrants to large cities already beset with problems. In order to solve the problems of American life in its cities, its great metropolitan areas and in its rural villages and towns, he proposed that "the nation develop a national growth policy."

In December, 1970, Congress passed a law, subsequently approved by the President, which stated, in part, that "the Federal Government, consistent with the responsibilities of state and local government and the private sector, must assume responsibility for the development of a national urban growth policy which shall incorporate social, economic, and other appropriate factors." In an eight-point elaboration, the new law declared that the national urban growth policy should incorporate the following facets:

(1) "Favor patterns of urbanization and economic development and stabilization which offer a range of alternative locations and encourage the wise and balanced use of physical and human resources in metropolitan and urban regions as well as in smaller urban places which have a potential for accelerated growth.

(2) "Foster the continued economic strength of all parts of the United States, including central cities, suburbs, smaller communities, local neighborhoods, and rural areas.

(3) "Help reverse trends of migration and physical growth which reinforce disparities among states, regions, and cities.

(4) "Treat comprehensively the problems of poverty and employment (including the erosion of tax bases, and the

need for better community services and job opportunities) which are associated with disorderly urbanization and rural decline.

(5) "Develop means to encourage good housing for all Americans without regard to race or creed.

(6) "Refine the role of the Federal Government in revitalizing existing communities and encouraging planned, large-scale urban and new community development.

(7) "Strengthen the capacity of general governmental institutions to contribute to balanced urban growth and stabilization.

(8) "Facilitate increased coordination in the administration of Federal programs so as to encourage desirable patterns of urban growth and stabilization, the prudent use of natural resources, and the protection of the physical environment."

Urban Renewal and Redevelopment

As the immediately preceding section indicates, the United States has adopted new measures -- a search for a national urban growth policy -- which will provide the broadest needed perspective for the optimum development of American human settlements. There are already, however, many existing policies and programs at various subordinate levels which have been useful in improving urban conditions or in stemming the negative drift of conditions. Although in sum these urban policies and programs have proved insufficient for the task at hand, most of them will very likely be continued and be fitted into the mosaic which will slowly evolve from the new national growth policy initiative.

The Federal Government carries out several programs aimed at improving the environmental nature and the efficiency of urban areas and of small communities. Some of the programs are aimed at aiding localities in establishing appropriate plans and strategies for the problems they face. An important grant program provides funds for states and local bodies to engage in planning and feasibility studies. The grants are made to help states and local communities to do needed planning and with the recognition, too, that local resources are limited. A program of research

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and demonstration projects develops information and experience which are available to local communities and are also used by the Federal Government in the refinement of programs. Fellowships to college students are also made available, encouraging students to study and become proficient in urban disciplines thereby increasing manpower available for states and local communities.

Rural Development

Rural development is a strategy of growth and development of non-metropolitan America bearing great import for metropolitan America. The central component of this strategy is to redirect the growth of this nation in order to improve the conditions of the urban population and at the same time to increase the rate of growth of non-metropolitan America.

Rural America encompasses about one-third of our population. Yet those who reside there are not fully participating in our national economy.

A variety of types of assistance will be needed in implementing a national policy of rural development. The following are examples which would require consideration and resolution:

1. Parity of opportunity, employment, and income for rural United States of America.

2. Incentives to business and industry to produce the basic employment opportunities which support new growth.

3. Assistance to improve needed educational and health service, housing and other community water, sewer, and solid-waste disposal facilities as well as recreation and cultural activities.

4. Assistance to small cities and towns for the purchase of surrounding land areas for residential growth, for open spaces, for land for industrial parks, and for recreation uses.

5. National policies to provide for the most efficient use of land.

6. Improvement of comprehensive planning capability at the state and district level.

Action Programs

In addition to the above planning and support activities, the Federal Government carries out important action programs. The urban renewal program, aimed at improving blighted and obsolescent portions of cities, is a major program which expended more than $1,000 million in fiscal year 1970. Grants for the installation or improvement of basic water and sewer facilities in the same year amounted to over $100 million. Additional large amounts were expended in support of programs to provide open space in cities, beautify urban areas and provide neighborhood facilities. The urban mass transit support program expended more than $100 million in the improvement of public transportation in local communities.

Two major new programs deserve special mention. A new approach to community development is the "Model Cities" program. Participating communities draw up their own innovative plans for neighborhood restoration and development, receiving special funds or grants. The program and the additional funds are aimed at improving the physical and social environment of major or significant parts of a large city or the whole of a small community. Over 150 communities, ranging in size from small, rural communities to New York City, have been designated as "Model Cities." Expenditures under the Model City program are as yet quite modest, but estimates for the 1972 fiscal year are nearly $500 million.

The second new program is designed to develop complete new communities or "new towns." The authority for a greatly expanded program, in size and concept, was provided under the December, 1970, legislation previously mentioned. State and local public authorities and private corporations may plan and build satellite cities or completely separate new towns under this program and will receive major financial assistance to permit approved plans to be carried out.

Housing

Although some local community efforts to improve housing began in the early 1900's, the Federal Government's first direct housing programs began in the decade of the 1930's. A public housing program provided Federal funds for the construction of housing for low-income families, with management and operation by local authorities. A mortgage insurance program greatly reduced the risks normally incurred by mortgage

lenders and played a large role in attracting funds into the housing market. To these major programs, special-purpose programs for elderly, veterans and similar groups were added. In 1968, Congress passed new legislation setting a 10-year National Housing Program. To meet this program, 26 million new housing units are required. This number would eliminate substandard housing and overcrowding and would provide the units needed during the decade to accommodate population growth and new family formations. Of the 2,600,000 dwelling units which will have to be constructed on an annual average, 600,000 units are intended for families which cannot afford to pay the full economic costs of direct housing.

The number of substandard rural housing units was reduced from about one-third of all rural housing units in 1960 to about one-fifth of all such units in 1970.

Various new housing subsidy systems have been adopted and are being developed to stimulate the production of new housing for the poor, such as rent supplements, interest supplements on rental and cooperative housing, rehabilitated homes for low-income buyers, low-rent public housing, financial assistance to nonprofit sponsors and modernization of public housing projects.

With a view to increasing national housing production, a new program, Operation Breakthrough, was launched in 1969. Breakthrough seeks not merely new technology, but a total breakthrough in the concepts of producing, financing and distributing housing, with a concomitant benefit to the ultimate consumer in terms of a better product at lower cost. Under the impetus of this program, private organizations have associated themselves in configurations never before attempted -- some representing advanced design skills; some, new materials or assembly concepts; others, marketing techniques and experience; still others, financing experience and access to the capital markets. This is a new dimension in housing production.

EXISTING AND PROPOSED ACTIONS: NATURAL RESOURCES

Only in the past decade has an increasingly discomfited public -- assailed by the sights, sounds and smells of a degraded environment and impatient with what is perceived to be a diminished quality of life -- begun to question past policies for managing the nation's natural resources. The public appears ready to respond at all political levels to efforts for achieving a quality environment as well as a steady improvement in the standard of living.

Water

The critical imbalance between requirements and supply of water in certain parts of the nation necessitates immediate and long-range programs to alleviate this condition, as well as to enhance availability of quality water throughout the country. Adequate supplies of quality water at reasonable costs to meet the needs of the public, agriculture and industry must be assured. Similarly, there must be assured a sufficient quantity and quality of water for fish and wildlife, navigation, water-based recreation and for the maintenance and enhancement of the environment.

Water pollution must be controlled to acceptable standards, and sound conservation and coordinated management of all water-use functions to improve water-use efficiency must be encouraged.

Efforts must be directed toward reducing adverse effects of natural hydrologic extremes -- floods and droughts; the full potential of non-conventional water-supply technology such as desalting, reuse and weather modification must be developed; and the potential electric power from Federal water projects must be developed, produced and marketed wherever it is economically justified. Moreover, the nation's experience and technology in water-resources research and development should be shared with other nations to enhance the benefits of national and international water resources.

National efforts have proven productive in a large number of water-resource management fields. New methods are being developed to increase efficiency in management of existing supplies by water-quality and pollution control, elimination of waste in water-delivery systems, and the recycling and recharging of depleted aquifers and the reclamation of waste water.

A decade ago, a research program in precipitation management, better known as weather modification, was undertaken. During the first seven years of the program, research was directed primarily to solving the principal technological problems. Results of the pilot project stage of the program were extremely encouraging, and it is estimated that precipitation and runoff from climatically adapted areas can be increased 15 per cent or more. If future tests confirm this estimate, precipitation management could add several hundred million acre-feet annually to the nation's over-all water supplies. Furthermore, the estimated cost is exceptionally modest -- less than $2 an acre-foot, or less than 1 cent per 1,000 gallons.

Another area of productive research is the desalination of salty or brackish waters. Dissolved minerals can be extracted from saline waters by a variety of processes. The objective is to develop means of extraction which are within economic reach of the prospective users. Significant progress is being made. Approximately 17 years ago, only a few small land-based plants were in existence, and the cost of fresh water produced was about $4 per 1,000 gallons. Present-day costs of operating plants in the 1 million-gallon-per-day size are less than 90 cents per 1,000 gallons. With advancing technology, including the development of fast-breeder nuclear reactors as a cheap energy source, and the construction of large plants producing as much as 1 billion gallons per day, estimates of desalted water before the year 2000 are as low as 10 cents per 1,000 gallons.

If such costs be realized, and it is not unreasonable to expect this of modern technology, the water-supply problems of our coastal areas and economically reachable inland areas would be substantially solved. Moreover, within the continental mass there are vast underground reservoirs of brine water which could also be made available for industrial and human use through desalting.

Finally, another potential water supply possibility is the deep-seated geothermal resource. Superheated ground water, of which the Yellowstone geysers are a manifestation, have long been considered a source of energy, but there is no reason why they cannot also be considered a source of water as well. The energy comes roaring to the surface as superheated steam. When the energy is extracted, water can be further distilled to clarity of a normally high mineral content. Preliminary

estimates show at least 2 billion acre-feet of water in the total brine resource in the Imperial Valley with a potential production of from 2 to 4 million acre-feet of good water annually, along with the generation of 20 million kilowatts of electric power.

Land

Broad national objectives have been established for managing the more than 750million acres of public lands in order to meet future public needs. Also, both Federal and state government programs are directed toward the improvement of millions of acres of private land for agricultural production.

Specific program goals for completion by the early 1980's will provide up-to-date topographic coverage of current urban and urbanizing areas; analysis of urban hydrologic systems and adequate collection and distribution of hydrologic data for the major centers; intermediate scale geologic mapping of the continental margins; delineation of geologically hazardous areas and determination of engineering properties of sea-floor sediments adjacent to harbors, industrial sites and residential areas; and determination of the geologic and hydrologic factors affecting the land and water environment of the coastal margin.

By 1977, the goal is to depict the geology of the nation's continental shelf to a depth of 200 meters; to depict selected small parts of the shelf with high potential resource or scientific value.

Between now and 1980, plans are set to complete geologic mapping of 40 per cent of the United States land area at intermediate scale and 33 per cent at large scale; to collect and analyze data for the cooperative investigations with medical scientists of the geochemical properties of the earth and the suspected relationships with health problems; to participate in and contribute to national and international programs of marine exploration and for solution of fundamental scientific problems through combined international efforts.

We are increasingly concerned with the necessity for pre-emption of prime farmland for farm use. Such land has soils highly responsive to management and is capable of continuous high yields with appropriate application of tech-

nology. Prime farmlands are favorably located with respect to water availability and management, climate, and markets. Much of this prime farmland is near cities where there is continuing diversion of such land to urban uses.

We currently harvest crops from about 300 million acres. This base amount can continue to be sufficient for this purpose if, but only if, production capability for our many diverse crops is maintained.

As a part of the National Cooperative Soil Survey, soil maps that meet current standards for all potential users have been made on about 43 per cent of total land area planned to be mapped. We know, in broad terms, the soil characteristics and productive capability of all our soils. But we need detailed information on specific soils. Such information is essential to urban planning and road construction as well as for agriculture and forestry. Our present projection is that a completion of soil mapping will be achieved on a once-over basis by the year 2000.

In the area of earth hazards, program goals include the development of criteria for predicting the behavior of earth materials during earthquakes both on land and offshore; development of better estimates of earthquake probability in different areas; by 1980, development of techniques for earthquake prediction; installation of a reconnaissance monitoring network of all Cascade volcanos to determine which are potentially active; and, finally, completion by 1985 of detailed geologic mapping of the Cascade volcanos.

The Soil and Water Conservation Needs Inventory of the nation's 1,437 million acres of non-Federal rural land shows that 63 per cent, or 902 million acres, needs conservation treatment of some kind. Land owners and users in soil conservation districts have applied and are maintaining adequate treatment on nearly 516 million acres or 36 per cent of the total.

During the five-year period beginning in 1973, the United States plans an inventory and priority ranking of watersheds for treatment on 160 million acres of public land; a design for land treatment and development practices on 32 million acres; application of treatment and development practices on 20 million acres of deteriorating public lands; reduction of sediment yield by 9 million tons annually and reduction of flood damage by 5 per cent on the public lands watershed.

Living Resources

Objectives in the field of livestock forage are to maintain production or provide additional forage to sustain development of livestock operations and to assure proper management of public lands having watershed, wildlife or other environmental problems which are susceptible to correction through livestock management.

Our forest lands, both National Forests and those privately owned, have far greater production potential than is currently realized. Timber growth and harvest could be materially increased by stand improvement in most forest areas and reforestations of non-stocked lands.

The growing need for augmented recreational opportunities, particularly within and near urban areas, has prompted plans and actions at the national level to accelerate the pace of obtaining areas for parks and recreation use. Emphasis has been placed upon conversion of Federally owned lands to the highest and best use -- which in many cases can be for parks, recreation, or open space. The President has also called for transfer of surplus Federal lands to state and local governments for park and recreation use at as much as 100 per cent discount in the purchase price. Also, methods will be explored for helping local governments buy unused agricultural lands and contract with private land owners for public recreation use of their lands.

The principal means of adding more outdoor recreation opportunities under a Federal program has been through use of the Land and Water Conservation Fund. The fund provides for matching Federal grants to states and their political subdivisions, for acquiring and developing outdoor recreational areas and facilities, and for appropriations to be used to acquire needed national recreation lands and waters. Since 1965, more than half a billion dollars has been appropriated from the fund for recreation purposes.

Emphasis upon urban recreational opportunities has resulted in programs to bring parks to people and to make existing parks more meaningful through improved and expanded services. Also stressed is a vigorous, creative program of environmental education to increase environmental awareness throughout our society.

Energy

Finally, there must be provision for the orderly development of publicly owned energy resources. Alternate routes which might be taken in augmentation supplies of oil, for example, include exploitation of the enormous oil shale resources in western Colorado, Utah and Wyoming. Also noteworthy is the fact that to date less than 35 per cent of the oil discovered in the United States has been produced. Each one percentile by which this recovery rate can be increased means 4 billion barrels of oil that can be reclaimed from known fields. Research could profitably be directed toward this objective. Similarly, many trillions of cubic feet of natural gas remain locked up in the tight formations of the Rocky Mountains. Successful conclusion to tests of the capability to loosen these formations by nuclear fracturing might help narrow the gap between gas requirements and domestic supply.

An essential consideration in meeting the growing energy gap is that adequate data be developed concerning onshore and marine energy resource potentials. Needed are improved techniques and tools for locating and evaluating new energy resources. These would include regional stratigraphic analyses of broad areas, as well as detailed investigations on low-sulfur coal, natural gas, petroleum, uranium and geothermal resources.

More efficient methods for extracting and processing fuel minerals need to be developed, while at the same time preserving environmental quality.

Development of a technology for production of pollution-free fuels is a matter of high priority.

EXISTING AND PROPOSED ACTIONS: POLLUTION AND NUISANCES

Air Pollution

Only within the last decade has there been any widespread understanding of the fact that air pollution is a complex phenomenon of global significance, which involves gaseous as well as particulate contaminants that can sometimes be altered and rendered more hazardous through interreactions in the atmosphere.

In the 1930's, 40's, and 50's, smoke pollution in many United States cities reached levels so high that on some winter days it was difficult to distinguish noon from midnight. Even a public which had long regarded pollution as a symbol of progress and prosperity found such levels intolerable. Civic action, under the spur of public indignation, led to the strengthening of local ordinances and of abatement efforts to control smoke. In this same period fortuitous economic and technological developments were also tending to reduce coal smoke in cities. Important among these were the advent of the diesel engine to replace steam locomotives, the increasing use of petroleum and gas to produce heat and power, particularly for commercial and domestic uses, and a trend toward suburbanization which tended to spread the sources of pollution geographically. The result was a dramatic lowering of particulate levels in the atmosphere of many eastern and mid-western cities.

But continued urban, suburban and industrial growth, sharply accelerating power and energy requirements, increasing technological diversity and a pattern of increasing dependence on the motor vehicle brought the more serious and complex problem of air pollution which we know today.

The persistence of the historical view which equated air pollution with coal smoke, and the lowering of smoke levels in some United States cities, might have delayed Federal attention to air pollution for at least another decade, had it not been for the growing seriousness of smog in Los Angeles, where coal had never been a factor. Beginning in 1947, Los Angeles County mounted a pioneering control program much superior to any local control effort ever instituted. But it was soon apparent that the problem there portended a national problem which would not yield to the knowledge at hand. Primarily through the efforts of California

legislators, the first identifiable Federal program on air pollution was brought into existence in 1955. The new legislation authorized the Public Health Service to conduct a modest air-pollution research program and to offer technical assistance to states and local governments, which have primary responsibility for dealing with community air-pollution problems.

Largely through the research and educational efforts of the Federal program, scientific and public attention to the problem increased sharply in the next few years. In 1963, Congress passed the Clean Air Act. This legislation was responsive to the growing public recognition of the fact that air pollution was more than a smoke abatement problem and that a national effort was needed. It authorized financial assistance to states and local governments for the initiation and improvement of control programs, Federal interstate abatement actions, the publication of criteria describing the effects of pollution, and placed special emphasis on gaseous pollutants, particularly exhaust emissions from motor vehicles, and sulfur oxides from stationary sources.

During the four years after passage of the Clean Air Act, state and local control programs were considerably expanded. Continued educational efforts and Federal interstate abatement actions stimulated scientific and public understanding of the far-reaching political and economic implications of pollution. Parallel with new research efforts, they helped demonstrate the need for new and improved control technology, particularly for gaseous pollutants, and helped underscore the vital necessity for control of emissions from motor vehicles.

In 1965, Amendments to the Clean Air Act gave the Federal program authority to curb motor-vehicle emissions. Federal standards were first applied to 1968-model motor vehicles. They required complete control of hydrocarbons from the crankcase and partial control of hydrocarbon and carbon monoxide from the exhaust system.

Sharply accelerating public and scientific interest was given focus and direction through the third National Conference on Air Pollution held in December, 1966. Immediately following the 1966 Conference, both the legislative and executive branches of Government moved to improve the legislative and budgetary

foundations for air-pollution control. The result was the Air Quality Act of 1967, which called for a coordinated control effort by all levels of Government, and all segments of industry, through a comprehensive and systematic approach far more responsive to the scientific and social ramifications of the problem than had been embodied in any previous legislation.

The legislation required the designation of air-quality regions on the basis of meteorologic and urban factors and the publication of criteria documents describing the effects of pollutants accompanied by related documents on the types and costs of control techniques available to carry out source control. Armed with these data, states were required to establish ambient air-quality standards and implementation plans for regions designated.

Two hundred forty regions have been designated. Six criteria and related control-technique documents have been published. They cover particulates, sulfur dioxide, hydrocarbons, carbon monoxide, oxidants and nitrogen oxides.

Air-quality standards for sulfur dioxide and particulates have been submitted for 46 regions, and 32 have been approved. Five regions submitted standards for carbon monoxide, hydrocarbons, and oxidants, and 17 regions submitted implementation plans for sulfur dioxide and particulates. No implementation plan had yet been approved when the new Clean Air Act Amendments of 1970 were signed into law. Even so, substantial progress was made under the Air Quality Act of 1967.

The 1970 Act continues grant assistance and research authorities of previous legislation, streamlines the designation of regions, and authorizes the promulgation of National Ambient Air Quality Standards by the Federal Government. Moreover, two types of standards are now required: primary standards to protect the public health, and secondary standards to protect the public welfare from the many other adverse effects of pollution.

The states, with the help of further increases in Federal financial and technical assistance, are to develop comprehensive plans to achieve these goals within definite time periods. The primary standards are to be met in most areas no later than mid-1975; the secondary goals are to be achieved as soon as is reasonably possible in each region.

Other important and unique provisions of the 1970 Act include requirements that:

1. Federal emission standards apply to all emissions from new stationary sources and to those pollutants considered to be immediately hazardous to health from any source.

2. Federal authorities be permitted to enter private facilities for the purpose of inspecting pollution-control records or monitoring pollution-control equipment or methods.

3. Motor-vehicle hydrocarbon and carbon-monoxide emissions from 1975 models be governed by standards which require a reduction of 90 per cent from emissions allowable under 1970-model-year standards. The 1976 models shall conform with standards requiring a 90 per cent reduction of oxides of nitrogen.

4. Federal authorities register and regulate fuels and fuel additives.

5. Federal authorities establish a Low-Emission Vehicle Certification Board to ensure the development of inherently low-polluting propulsion technology through Government purchase and use of such vehicles.

6. Federal authorities establish Federal standards for aircraft emissions.

7. Citizens be authorized to take civil court action against private or governmental officials failing to carry out the provisions of the Act.

The task before the United States now is twofold: First, to ensure that all existing air-pollution sources are controlled to the full extent that technology will permit. With regard to the control of particulate pollutants alone, such action would bring about dramatic improvements. For example, if we were to apply the best air-pollution-control systems now adequately demonstrated to be feasible for the control of

smoke and other particulate pollutants, the 17.5 million tons per year from controllable sources we now withstand would be reduced to 700,000 tons -- a 95 per cent reduction. The second major task is to intensify the search for solutions to those aspects of the problem which are still beyond the reach of our knowledge. There is every reason to believe that real progress will be made on both these fronts in the years immediately ahead.

Water

Because an ecological awareness was late in developing in the United States, this nation found itself suddenly confronted with the need to take vigorous steps to reverse the trend in water degradation. The first actions taken by Congress -- a National Clean Water Program launched in 1948 -- were quite modest, operating in its first eight years on a temporary, trial basis. Building on this trial legislation, Congress enacted in 1956 the first permanent Federal Water Pollution Control Act, which was considered quite comprehensive for its time. Given new stature and increased funds, the program made some token gains over the next few years. However, it became apparent that stronger, more effective measures were essential.

Landmark amendments to the Federal Water Pollution Control Act were made in 1961, 1965, and 1966. The Water Quality Improvement Act, enacted into law on April 3, 1970, is the most recent legislative effort.

The Federal legislation which has been enacted over the years has structured a multi-program approach implemented by a number of practical and powerful tools, among which are:

-- A construction-grants program to help remove the backlog of needed treatment facilities.

-- The establishment of water-quality standards for all the nation's interstate and coastal waters, including many lakes. This is the keystone of America's clean-water program. It represents the first systematic nationwide strategy adopted in the United States for achieving water-quality management.

-- Comprehensive planning for river-basin water and waste management.

-- Financial support for research, development, and demonstration activities involving advanced waste-treatment projects; water-purification methods; joint treatment systems for municipal and industrial wastes; and grants to industry or private persons to seek improved ways to treat industrial wastes.

-- Enforcement authority to deal with situations where there is little or no compliance with pollution-control laws. This authority has been one of the chief mechanisms for achieving an accelerated pollution-abatement program.

These major program thrusts represent the basic levers of the Federal Government's sweeping efforts to restore the nation's waters. However, new and more complex environmental problems are constantly emerging to test the nation's capacity to respond with appropriate measures.

Significant moves in this direction were taken recently in several major program areas. The key elements in these program changes are:

-- Basin planning and regionalization of pollution-abatement projects made prerequisites to the receipt of Federal financial aid.

-- Industry is required to guarantee that it will fulfill its responsibilities in joint treatment systems.

-- A system of "cost recovery" will be implemented wherever some industrial wastes are to be treated by a facility constructed with Federal aid.

-- More comprehensive guidelines for the design, operation, and maintenance of waste-water treatment facilities established.

-- Introduction of a "technology transfer" program to accelerate the transfer of technological discoveries into viable treatment or recycling processes.

-- Initiation of a voluntary inventory of industrial wastes by major water users to develop a data profile of all waste-water discharges.

As new challenges arise, they will demand new organizations and institutions, new management techniques, rapid application of new technology, and new directions for research, development, and scientific investigations.

Massive investments will be required to keep pace with the nation's requirements for community waste-treatment facilities. Federal estimates have pointed to a need for at least $12 billion worth of investment by 1974 to correct the national waste-treatment backlog. Recent legislation proposed by the President would provide $6 billion in Federal funds over the next three years for this purpose to be matched by a like amount in state and local funds.

It has also been proposed that:

An Environmental Financing Authority be created so that every municipality has an opportunity to sell its waste-treatment plant construction bonds.

Federal waste-treatment assistance programs give priority to encouraging the development of regional treatment systems in metropolitan areas based on comprehensive sewer, water, and land-use planning.

Federal programs encourage localities to impose user charges based on the volume and concentration of wastes to increase equity and to work toward self-financing systems. These charges would cover not only industrial wastes for which policy already exists, but home and commercial wastes as well.

Vigorous and effective enforcement of water-quality standards be implemented. The President has recommended a broad range of tough, new enforcement procedures which include: extending Federal jurisdiction to intrastate and ground waters, streamlining the conference-hearing procedures, establishing specific effluent requirements, and setting fines for non-compliance.

Increased attention be given to encouraging changes in state and local institutions dealing with water-pollution control and improving state programs.

Professional, technical, and operator manpower be trained. Manpower needs in water-pollution control are great, and training should be accelerated, with the Federal Government, states, municipalities, and industries all sharing in the costs and responsibilities.

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Radiation

The hazards associated with radiation, unlike those of other environmental pollutants, were dramatically illustrated well in advance of widespread commercial application of radiation-producing technology. Strict governmental controls were imposed early, therefore, and the formal procedures and scientific bases for establishing and enforcing standards for protection against ionizing radiation have been the most comprehensive of any applied to environmental stresses. Even so, recent Federal actions have been aimed at making sure that the utmost precautions are observed.

Current standards are now being evaluated against all existing data to determine their adequacy and, hopefully, to end the controversy which persists in this regard.

Federal authorities have developed and have in partial operation an improved state-Federal-industry system for monitoring environmental radiation sources to provide improved surveillance capability as the nuclear-power industry expands.

The National Environmental Policy Act of 1969 provided further safeguards by requiring environmental review of all Federal-agency projects and proposals, including those of the Atomic Energy Commission.

Under the Radiation Control for Health and Safety Act of 1968, performance standards are established for electronic products capable of producing radiation emissions, such as microwave ovens, television receivers, and medical x-ray equipment.

To hold adverse effects from radiation to an absolute minimum, it is clear that research into the effects of low-level doses and into the problems arising from medical uses and consumer products, must be continued and intensified. It is clear, moreover, that careful regulation and control from all manmade sources of environmental radiation is essential.

Other needs include stronger controls for use of certain radioactive materials, strengthened radiation safety training, and more extensive state planning for radiation emergencies.

Noise

As recently as 1968, the Federal Government's total expenditures for all aspects of noise control were approximately $11 million. Of these funds, more than 90 per cent was spent for research on aircraft noise. The remainder was spent on health effects, acoustics and noise control in buildings, and other projects such as the effects of noise on animals and archeological structures.

Since then, the Federal Government has begun to assert its leadership and responsibilities in several areas. In May, 1969, the first Federal standards for occupational exposure to noise were issued, and five months later, the first of a series of noise standards regulating aircraft noise were set forth.

By 1970, Federal expenditures for noise-related programs had been increased 300 per cent. However, 90 per cent of these funds still was allotted to aircraft noise and sonic boom, leaving activities in noise research and control, including health effects, at a relatively minor level.

In an effort to correct this imbalance, the Clean Air Act of 1970, which became law on December 31, 1970, calls for the establishment of an Office of Noise Abatement and Control in the Environmental Protection Agency which will provide a new focus for activities in this area.

Solid Wastes

Primary responsibility for solid-waste collection, processing and disposal has traditionally rested with local levels of government and with state agencies involved in regulatory activity. The Solid Waste Disposal Act of 1965 marked the first significant interest by the Federal Government in the solid-waste field. This legislation was designed to assist state and local governments, and others involved in solid-waste management, by providing financial assistance for demonstrating new technology, by providing technical assistance through research and training, and through encouraging proper planning for state and local solid-waste management programs. The Act took full cognizance of the important factors bearing on the solid-waste problem in the United States, including authority to perform research in the area by recycling and reuse of waste materials.

The 1965 Act has now been amended by the Resource Recovery Act of 1970, with expanded authority to:

-- Perform additional research to find improved methods of recovering and recycling natural resources, and develop new and improved methods in all phases of solid-waste management. Improve the level of training for persons in the solid-waste field; develop a comprehensive plan for a system of national disposal sites for the storage and disposal of hazardous wastes.

-- Assist states and local governments and interstate agencies in planning and development of resource recovery and solid-waste disposal systems.

To date, 50 state and interstate agencies have developed, or are in process of developing, state-wide and regional plans for solid-waste management. Numerous research and demonstration projects have been initiated, and the results from successful projects are beginning to be applied nationally.

It is clear that control of the solid-waste problem must proceed along two fronts: reduction in the generation of wastes and improvement of waste management. Present and future Federal research efforts, therefore, place emphasis on methods to conserve natural resources by reduction of the amount of waste and unsalvable materials, and by recovery and utilization of potential resources in solid wastes. Use of economic incentives and disincentives are among the approaches considered to hold down waste generation, or to encourage use of materials compatible with solid-waste processing and disposal systems. Recovery of heat energy from solid-waste combustion for conversion to electrical power is included among other approaches to resources conservation.

The field of solid-waste management may have international implications from several standpoints:

1. Application of technology developed in foreign countries, with or without modification.

2. Pollution associated with poor solid-waste management practices which may cross national boundaries.

3. Pollution of the oceans from dumping solid wastes at sea.

4. Depletion of the world supply of minerals and other nonrenewable resources by failure to recycle and reuse solid wastes.

Work performed in the United States is consistent with these implications. For example, advances in foreign technology are being considered for application in the United States. Studies have been undertaken to determine the extent of ocean dumping, including the volume and types of waste material disposed at sea. The immediate and potential hazards associated with ocean disposal are also under study.

As specifically directed by the Solid Waste Disposal Act, the results of research and demonstration projects, and information concerning other Federal solid-waste activities, are available to any governmental entity, corporation, or individual having interest in such information. Significant findings and progress reports are made available by publication in scientific and technical journals, and in government publications. It is to be expected that access to information on solid-waste research in the United States will facilitate world-wide application of beneficial developments.

Pesticides

Federal regulations which require the registration of pesticides before they can be moved in interstate commerce are the principal means of controlling the harmful effects of pesticide usage in the United States. Registration consists of a determination that the compound, as formulated, will control the pest under the conditions of use prescribed and that the conditions of use will be safe for the applicator and for man and beneficial plants and animals. If the use will result in a residue on a food product, then a residue tolerance must be obtained. This tolerance must be sufficiently low that it is deemed safe for human consumption and must not be higher than the amount required to obtain effective control of the particular pest involved.

Regulation of the use of pesticides at the point of their application is the responsibility of state and local authorities. Our states vary substantially in the degree of restriction which they impose on pesticide use. Generally, they require Federal registration or its equivalent. Some of them have greatly restricted the use of some persistent pesticides, e. g., DDT.

Research on the acute and chronic effects of pesticides on humans and other living organisms receives considerable attention. Monitoring of air, water, soil, fish and wildlife, and humans is done on a nation-wide scale. The Environmental Protection Agency has been assigned responsibility to unify the regulatory functions involving pesticides.

Much remains to be done before the undeniable benefits from chemical pest control agents can be fully realized with no questions arising about safety and hazard to the public and to public values. New controls are being considered which would identify the hazards associated with the use of various classes of chemicals and would include regulatory procedures commensurate with the hazards of each group. Programs for educating pesticide users both in safe methods of handling and in proper methods of container disposal are receiving major attention.

DESIRABLE ACTIONS AT THE INTERNATIONAL LEVEL

The existing and proposed United States actions sketched in the previous sections indicate the breadth of our approach to the task of controlling pollution and improving the environment in which our people will live in the decades ahead. We are aware of the fact that other nations face similar environmental problems, that they too have initiated environmental programs for similar purposes, and that many international organizations have taken steps toward coping with environmental problems that transcend the boundaries of sovereign states. While much can and must be done by nations for the interests of other countries, the United States Government believes the time has come for much greater cooperation among the nations of the world on problems of international concern. We need to face environmental issues together and to reinforce our respective national efforts by commitment to the protection and improvement of the environment shared by all mankind.

The United Nations Conference on the Human Environment provides an appropriate forum at which recommendations for initiating cooperative and joint actions can be adopted, including programs that could be most effectively executed through existing intergovernmental organizations and programs that may require new institutional arrangements. Collectively, these planned actions would constitute an internationally agreed program to be undertaken in the post-Stockholm period, and would provide the basis for establishing priorities and for allocating resources to environmental tasks of common concern.

The topics listed below represent matters of concern that the United States Government believes are of sufficient importance to merit international attention. The topics are not listed in priority order; instead, they are grouped into three categories.

Category A includes four actions which are essentially concerned with the acquisition and dissemination of knowledge about the environment. These actions would help nations to cope with their environmental problems and should facilitate agreement on preventive or remedial measures.

Category B includes four actions that go beyond international cooperation in research, exchange of information,

and the dissemination of knowledge. They consist of formulating policies for actually preventing or correcting environmental deterioration, whether the operational programs would be carried out by national governments or by international organizations.

Category C includes two actions specifically designed to focus attention on the prerequisites for significant progress in solving environmental problems, vis., trained manpower, adequate funds, and effective institutions. We believe these prerequisites need to be examined in a comprehensive way.

A. The Acquisition and Dissemination of Knowledge

1. Establishment of a system for exchanging environmental information - This would involve the collection, storage, and dissemination of information on the environmental activities, programs, and experience of national governments and international organizations. Although coverage could be initially limited, the system should be designed to provide information to governments pertaining to human settlements, management of natural resources, and a wide range of pollutants and environmental nuisances regardless of their physical character or the media in which they occur. The information obtained would be the basis for strengthened national and regional economic-development programs, through the inclusion of such broad environmental considerations as health and sanitation, housing, land use, transportation, industrial planning, population distribution, aesthetics and culture, resource management, and statutory and legal mechanisms. The essential decisions that need to be made at the Stockholm Conference are twofold:

(a) What the dimensions of such a system would be;

(b) How efforts to develop it should begin - i. e., at a regional or international level, or both.

2. Establishment of systems for monitoring the world environment - A variety of monitoring and surveillance systems will be required to collect and collate data on certain aspects of the environment which affect human welfare. A number of monitoring and surveillance systems currently exist

which are oriented toward detecting pollutants in particular media (e. g., the atmosphere, oceans, rivers, etc.) There is a need for considering what efforts are necessary to assure that the nations of the world are adequately apprised of the current status and likely trends of factors that contribute to the deterioration of the environment. In addition to measuring pollutants, global monitoring and surveillance systems are needed to determine the status of natural resources; to identify long-term climatic change; to provide early warning for natural disasters, such as typhoons; and to relate the health of man and other living organisms to environmental quality. The establishment of an adequate monitoring system should provide for integrating different kinds of data and for disseminating the information to all countries in an understandable form.

3. Public Education on Environmental Issues - The Conference itself as a public event - and particularly the major documents it will generate, i. e., the Declaration and the "State of the Environment" report - will undoubtedly have an educational impact around the world. But we must also move concretely to foster further education of our future citizens and leaders in a new environmental ethic - the duty of each of us to respect our environment for the sake of our fellow man and for posterity. Consideration could be given to such efforts as:

(a) Publication of literature on pollution problems and what is being done about them;

(b) Instructional materials suitable for use in various formal, public-education programs; and

(c) Exhibits, visual aids, and other non-verbal modes of conveying an appreciation of environmental problems to private groups.

4. Coordination and Cooperation in Research - Research programs on known environmental problems (e. g., reduction of air pollution from burning fossil fuels, development of pesticide substitutes) could be facilitated by greater coordination among nations seeking practical solutions to their problems. We recognize that there are some disadvantages

associated with the coordination of research efforts that are focused on environmental problems of essentially local or subnational scope. However, a concerted effort to identify research tasks that could be undertaken more economically by international cooperation or might be aided by pursuing alternative approaches on the part of different nations would be mutually advantageous. In any case, the coordination of national research efforts would go beyond simply exchanging information and, in some cases, might lead to joint research programs carried out by multinational teams.

As a further consideration, there are numerous environmental problems whose eventual solution requires international agreement on remedial or preventive measures but on which additional research is needed. If that research is undertaken on a cooperative or joint basis, subsequent agreement on what should be done is likely to be easier. An attempt should be made to identify relative research priorities and to devise a plan for addressing the highest priority topics in the immediate post-Conference period.

B. The Formulation of Environmental Policies

1. Limiting the degradation of the global environment - While some specific agreements may be consummated at the Stockholm Conference, in most cases the immediate objective will be to make agreed recommendations to national governments and to international organizations. Among the kinds of damage that may require global action are pollution of the oceans from various sources, the introduction into the biosphere of various bioactive chemicals, the burdening of the atmosphere with fuel-combustion products, the overexploitation of both renewable and nonrenewable resources, and the damage to natural and historical monuments. International attention will have to be devoted to the issues surrounding these kinds of topics on a long-term basis. Insofar as there is a consensus on the need for prompt international action, the Conference recommendations should include a provisional statement about the means for accomplishing desirable objectives.

2. Environmental considerations in development programs - This topic is specifically concerned with developing means for evaluating the environmental impact of development projects. The scope of the topic should include factors to be considered in projects financed or administered by inter-

national agencies; regional organizations both within and without the UN system; and national development programs. The action at the Stockholm Conference would be to identify the factors involved and to recommend their consideration by national governments and international organizations.

3. Improved management of natural resources - This topic is threefold. It includes: (a) measures for use by governments in managing their natural resources; (b) planning for the utilization of natural resources on a regional basis; and (c) evaluating alternative programs of resource development from the standpoint of their impact on the environment. The Stockholm Conference should consider not only the possibility of developing policies and plans, but also the desirability of establishing new institutional arrangements for coping with resource-management questions.

4. Policies for improving the immediate environment of human settlements - This topic is primarily concerned with the increasing requirements for facilities and services arising from population growth, urbanization, and changes in human settlements that tend to put greater demand upon governments to improve their countries' environments (e. g., water supplies, sewage disposal, etc.). Broadly conceived, however, it involves exchanges of experience on means to achieve national-settlement objectives and to formulate policies for protecting the environs of large urbanized areas. Most nations are confronted with the prospect of their needs growing more rapidly than the available resources will permit.

C. Prerequisites for Concerted Action

1. Increasing technical and managerial competence in environmental matters - A more adequate supply of skilled personnel is needed to carry out environmental improvement programs in all countries. Technically advanced nations might assist the developing countries in satisfying near-term needs by making suitably trained personnel available to them. In the longer run, greater indigenous competence needs to be developed through training programs. An action plan for both aspects of this problem could be prepared for consideration by governments at the Stockholm Conference.

2. Organizational arrangements for an effective international environmental program - New institutional arrangements may be needed for effective action on environmental problems that cut across the jurisdiction of UN specialized

agencies. In addition, a number of interrelated organizational questions need to be discussed at the Conference with a view toward making recommendations to governments. For example, how long-range programs on the international aspects of the environment should be carried out, how the existing UN structure may be utilized most effectively, how existing non-UN, intergovernmental organizations and non-governmental bodies concerned with environmental affairs can contribute most effectively, and how coordination can be achieved. This is a difficult topic, but there is real danger in pursuing a piecemeal approach to environmental problems that affect the interests of all nations. More important, the UN Conference in 1972 provides an opportunity to come to grips with this problem before a comprehensive action plan is inadvertently constrained by easy decisions and by narrow vision.

APPENDIX V

THE 1972 UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT

FACT SHEET

What is it? What is it expected to accomplish?

The Conference is a meeting of all member nations of the UN family. It is designed to focus the attention of governments and world public opinion on the importance and urgency of the physical and social problems which have been wrought by technology, industrialization, and population pressures. The Conference will be action-oriented, and it is expected that it will result in the drafting of some international agreements dealing with the major environmental problems subject to international control.

Where and When?

Stockholm, Sweden, June 5-16, 1972.

History of Conference:

At the spring 1968 session of the UN Economic and Social Council, Sweden proposed the holding of a Conference on the Human Environment. The proposal, sponsored by fifty-five nations, was endorsed by the Council and approved by the UN General Assembly at the 23rd Session in Resolution 2398 of December 3, 1968.

Who will attend?

It is expected that representatives of the Governments of all member states of the UN family will attend. Limited space requires that delegations not exceed 15 members. The UN Secretariat staff at the Conference will number approximately 200. Some 1,000 press representatives are expected to cover the Conference. Space in the public galleries is also greatly limited. The UN Conference Secretariat is responsible for public admission. Certain International Non-Governmental Organizations (INGO's), selected according to procedures established by the Conference Secretary General, will be invited to attend the Conference. An Environmental Forum will be held concurrently in Stockholm which will be open to organizations and individuals concerned with environment.

What is the expected nature of the U.S. Delegation to the Conference?

Members of the U.S. Delegation to the Conference will be selected at a later date. However, the fifteen member group will include high officials of the U.S. Government; the Chairman of the Secretary's Advisory Committee, Senator Howard Baker of Tennessee; members of Congress representing both Houses and both major political parties; U.S. Government experts; and members of the public.

How are plans for the Conference being developed?

A twenty-seven nation Preparatory Committee has been formed, which includes the United States, to plan for the Conference. The Committee has met on two occasions: March 10-20, 1970, in New York and February 8-19, 1971, in Geneva. The third session will be in New York, September 13-24, and the fourth in New York in early 1972.

Who is representing the United States in the preparation phase?

Mr. Christian A. Herter, Jr., Special Assistant to the Secretary of State for Environmental Affairs, is the U.S. Representative on the UN Preparatory Committee.

Who is managing the Conference?

Mr. Maurice Strong of Canada has been appointed by UN Secretary General of the Conference. Mr. Strong is also UN Under Secretary General for Environmental Affairs. Mr. Strong has a small staff located in New York and in Geneva. He and his staff are working closely with the members of the 27 nation Preparatory Committee.

How is the Conference to be organized?

The Conference, covering the period of June 5-16, 1972, will have plenary sessions throughout the Conference. Beginning approximately June 7 there will be three concurrent Committees at work in addition to the continuing plenary session. The final few days of the Conference will be the concluding plenary session when resolutions will be adopted. The three Committees will each have two Conference topics for consideration as follows:

Committee 1

- The Planning and Management of Human Settlements for Environmental Quality, and,

- Educational, Informational, Social, and Cultural Aspects of Environmental Issues.

Committee 2

- The Environmental Aspects of Natural Resources Management

- Development and environment.

Committee 3

- Identification and Control of Pollutants and Nuisances of Broad International significance.

- The International Organizational Implications of Action Proposals.

How is the public involved in the U.S. contribution to the Conference?

Secretary of State William P. Rogers has established an Advisory Committee on the 1972 UN Conference on the Human Environment. The Committee is chaired by Senator Baker of Tennessee. Its members held their first meeting in the State Department in Washington on May 19-20 to discuss and consider work underway within the U.S. Government for the Conference. The Committee will act as a channel through which the views of the public can be made known. Also, the Committee will serve as a channel to inform members of the public about the Conference and the status of the U.S. preparations.

The names of the members of the Advisory Committee are as follows:

Chairman
Senator Howard H. Baker, Jr.,
of Tennessee

Robert Anderson
Chairman of the Board
Atlantic Richfield Corporation

Mrs. Bruce B. Benson
President
League of Women Voters

Jules Bergman
Science News Editor
American Broadcasting Co.

Governor James Carter
of Georgia

John S. Chapman
Chairman
AMA Council on Environment
& Public Health

Edward N. Cole
President
General Motors Corporation

Christopher DeMuth, past
White House Fellow

Mayor William Dyke of
Madison, Wisconsin

Joseph L. Fisher
President
Resources for the Future

John W. Hanes, Jr.
Vice Chairman
Governor's Council on Environment
Virginia

John Harper
Chairman of the Board
Alcoa

J. George Harrar
President
Rockefeller Foundation

Philip Hauser
Director
Population Research Center
University of Chicago

Martin S. Hayden
Editor-in-Chief
Detroit News

Dennis Hayes
(Organizer of Earth Day)
Environmental Action, Inc.

Sydney Howe
President
Conservation Foundation

Frank P. Lloyd
President
American Society of Planning
Officials

Charles Luce
Chairman of the Board
Consolidated Edison Corp.

James E. Mack
Member of the National
Urban League

Thomas F. Malone
Chairman
Committee on International
Environmental Problems
National Academy of Sciences
National Academy of Engineering

John Nellor
Chairman, Environmental Committee,
Association of State Universities
and Land Grant Colleges

Laurance Rockefeller
Chairman
Citizens' Advisory Committee
on Environmental Quality

James A. Rose, Jr.
President
Family Health Care Institute
Westinghouse Learning Corp.

Richard Stroud
Chairman
Natural Resources Council

George H. R. Taylor
Secretary
AFL-CIO Committee on Atomic
Energy and Natural Resources

Aubrey Wagner
Chairman of the Board
TVA

Mrs. Thomas Mercer Waller
Member of New York State
Conservation Commission

EX OFFICIO MEMBERS

Ambassador George H.W. Bush
United States Permanent Repre-
sentative to the United Nations

Robert Cahn
Member of the President's
Council on Environmental
Quality

Fitzhugh Green
Associate Administrator of
International Affairs
Environmental Protection
Agency

Christian A. Herter, Jr.
Special Assistant to the
Secretary of State for
Environmental Affairs
Department of State

How may members of the public contribute to the Conference?

They may forward specific proposals to Senator Howard Baker in care of the Advisory Committee's Executive Secretary, Mr. Slator C. Blackiston, Jr., SCI/EN, Department of State, Room 7822, Washington, D.C. 20520.

How is the position of the U.S. Government for the Conference being developed?

Preparatory teams within the U.S. Government, aided by the recommendations and contributions of the members of the Advisory Committee and of the concerned public, are drawing up basic papers

on the principal issues of U.S. concern. These papers together with those contributed by the other 27 nations on the Preparatory Committee are to be sorted out by the Conference Secretariat which will then prepare first drafts of Conference Position and Action papers for consideration at the Third session of the Preparatory Committee. Consultations on the draft Position and Action papers will be completed by early fall 1971 and thereafter Conference documents will be put together for distribution to all UN member nations by February 1972. The U.S. Government will develop its national position on these Conference documents in the period between Fall of 1971 and opening date of the Conference. It is in this period of preparation for the Conference that the Advisory Committee will play a most important role in ensuring both that the public is informed on the important issues to be taken up at the Conference and that the U.S. position has taken the public's views into full account.

What are the topics of priority interest to the United States?

The following are the topics of priority interest:

1. Marine Pollution
2. Environmental ~~Considerations~~ Considerations in Economic Growth
3. World Heritage Foundation
4. Other Conservation Activities
5. Regional Environmental Centers
6. Animal, Plant, and Micro-organism Gene Pools
7. Maintenance and Restoration of Soils
8. Monitoring and Surveillance
9. International Education and Training
10. Rational Management of Human Settlements
11. Limiting the Release of Pollutants into the Environment
12. Research, Development, and Analysis
13. Information Exchange
14. Economic Implications of Environmental Policy

A paper on Institutional Arrangements will be submitted at a later date.

June 1971 (Rev. 4)
SCBlackiston

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APPENDIX VI

Problems of Environment in India

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INDIAN NATIONAL SCIENCE ACADEMY
NEW DELHI
1971

Problems of Environment in India

INTRODUCTION

Increasing attention is being given the world over to the rapidly deteriorating environment. Pollution of the air, rivers, lakes and the sea, denudation of land, accumulation of refuse, and dereliction of the surroundings are posing problems which can no longer be ignored. Industrialisation is bringing in its wake environmental changes some of which are being introduced for the first time in our planet's history. Their deleterious effects both on man and on his biological environment are becoming increasingly manifest.

A proper assessment of these effects is only just being made. Competent scientists have often taken extreme positions in regard to the long term impacts of environmental decay. Some declare, quite seriously, that pollution of the environment at the rate at which it is now going on, will result in the total extinction of life on earth in a period of a few centuries, if not decades. Others just as sincerely believe that the self-sustaining capacity of life on earth is so durable that there is no cause for alarm.

Apart from these two sets of extreme views, it does appear that environmental deterioration is causing a great deal of injury to our eco-systems, some of which is irreversible, and it is necessary to pay careful attention to this growing problem.

THE GLOBAL AND THE LOCAL

Some types of environmental degradation are global. These include radio-active fallouts, insecticide poisoning, atmospheric pollution etc. which have made their impact even on the animals of the

Arctic and the denizens of the deep Antarctic. Some others are of special relevance to certain specific areas. Technological advancement, population pressures, and geographical location, often determine environmental quality, and the nature and rate of its deterioration.

India is a developing country, rapidly advancing towards industrial and agricultural self-sufficiency. We have in this country some measure of the environmental deterioration which advanced industrial nations are experiencing; we have in addition some which they do not have.

The additional environmental problems are mainly caused by population pressure. As Fraser Darling said, "Population and Pollution go together". The mere presence of the one accentuates the other. While most of the developed countries are in the temperate zone, India's position in the tropic adds another complicating factor. The sunny climate stimulates chemical and biological changes in the environment at rates considerably faster than those in milder climes. The dehydrating impact of the hot sun is another deleterious factor in times of subnormal rain.

CHANGES IN THE PHYSICAL ENVIRONMENT

India is largely a tropical country, about 3.3 million square kilometers in area, stretching between latitudes 8°N to 38°N, and longitudes 68°E to 98°E. Seventh largest in area, and second largest in population, India comes next to USSR and U.S.A. only, in the extent of its arable land. The net crop area is about 45% of the total area of which four-fifth is rainfed. Eighty percent of the population lives in villages numbering over 560 thousand - each village consisting, on an average, of 4 to 5 well-defined hamlets. India has a land frontier of over 15,000 kilometers and a coast line of 5700 kilometers.

With 80% of its arable land depending upon the monsoons for the major supply of water, vagaries of the monsoons can materially affect conditions in India. Country-wide failure of the monsoons seems to occur on an average once in 20 years, with failure over large areas occurring 3 or 4 times during this period. Similarly, country-wide floods seem to occur once in 20 years or so, with large parts of the country suffering from floods 6 or 7 times during this period. While there is no apparent periodicity in the incidence of country-wide floods or draught, heavy draughts in several instances have been preceded or succeeded by heavy floods in the adjacent years. The largest number of abnormal monsoons seems to occur in the arid or semi-arid regions of Rajasthan.

According to the report of a study team organised by the Indian National Science Academy on the Movement of the Rajasthan Desert, man and his activities have, apart from the influence of natural causes, substantially contributed to the aggravation of desert conditions by indiscriminately exploiting the surface vegetation, irrational use of land to grow his crops, and allowing over-grazing by his domestic animals. A judicious shift in the current land use pattern is therefore an urgent need.

The Himalayan region in the North pose another major problem in the form of recurrent landslides and floods. Being composed of comparatively soft sedimentary rocks, these areas crumble readily under the persistent action of heavy precipitation during the rainy season. A devastating flood which occurred in the Alaknanda Valley in 1970 is being investigated by another study team of the Indian National Science Academy. The excessive rains in short spells in these catchments, the accompanying landslides, temporary damming and bursting/over-flowing of the many reservoirs, and the consequent erosion, transportation and silting, appear to be the main contributory factors for such flash floods causing crores worth of damage.

INDUSTRIAL POLLUTION

For historic reasons, there has been a concentration of industrial undertakings in a few places like Bombay, Calcutta, Kanpur, Ahmedabad, Jamshedpur and Coimbatore. During the post-independence era, over the past few years, there has been further growth and concentration of industries. While industrial expansion received impetus, the treatment of industrial wastes most often went by default.

The location of industries near rivers and water channels has led to the large scale pollution of rivers like the Jumna and the Ganges which drain a major part of the land and carry the deleterious effluvia over wide stretches. Preliminary surveys carried out during the past few years have revealed that there is appreciable pollution in restricted regions of even the big rivers of the country, while most of the smaller river basins, particularly in the industrial belts of the several states, are being heavily and extensively polluted by domestic sewage and industrial wastes.

A 50 miles stretch of the Ganges below the Barauni Refinery was set on fire in 1968 as a result of the discharge of about 1600 tons of oil residues into the river. So polluted did the flow become that it devastated fertile fields, and the supply of urban drinking water

from the river had to be suspended for several days. More spectacularly, in 1968, three circus elephants were reported to have died after drinking water from a public tank near a fertiliser factory at Bajwa near Baroda.

The pollution of the water channels and reservoirs by pesticides and chemicals, increasingly used in agricultural operations, is a problem to which we have yet to pay adequate attention. In the first phase of the 'Green Revolution' we have adopted every measure which could produce two grains where one grew before. The lingering impact of many of the chemicals, being used by people with little education or understanding, is a matter of increasing concern.

India does not have large lakes as in the United States. We have a number of reservoirs for irrigation, and for power generation. The retention of their quality and continued utility, in the face of mounting inroads into the catchment areas, is a matter which calls for serious consideration.

The major source of energy in India is coal and the smoke nuisance poses an increasing threat especially in places like Kanpur, Calcutta and Bombay. The accumulation of coal ash in industrial centres disfigures the city face and poses severe health hazards in times of high wind velocity.

BIOLOGICAL POLLUTION

The mere presence of sheer numbers of human beings brings in its wake immediate changes in the eco-system which can only be deleterious. More people means more food, more goods, and more refuse. The production and disposal of food, goods and wastes involves energy which has to be produced and supplied, leading to further inroads in the environment.

The net area under cultivation has increased from 118.7 million hectares in 1950-51 to 137.0 million hectares in 1966-67. This has entailed the conversion of pastures into culturable land. Land under miscellaneous tree crops and groves which formed about 7% of the total area in 1950-51 had dwindled to 1.4% in 1966-67. The short-term and long-term impacts of this major change in our surroundings have yet to be determined but it was reported by the study team on the 'Movement of the Rajasthan Desert' that the destruction of such wind-breaks had materially contributed to the movement of the desert.

One of the impacts of increasing population and industrialisation has been a steady conversion of cultivable land into non-agricultural

uses. The percentage of such land which constituted 3.3% of the total area in 1950-51 had risen to 5.1% in 1966-67. Forest lands have been cleared in various parts of the country for growing plantation crops like coffee, tea and rubber, or for orchards. The impact of the denudation of our hills and their conversion into crop-lands on erosion, landslides and floods has yet to be worked out.

Man does not live in isolation. He needs domestic animals like cattle, horses and sheep. Their number exceeded 340 million in India in 1966-67.

Livestock	No. in millions in 1966-67	
Cattle	176.9	
Buffaloes	52.9	
Sheep	42.0	
Goats	64.5	
Other Livestock	7.1	
Total Livestock		343.4
Poultry		115.1

Animal farming on a large scale is practically non-existent in India. Animals often have to share living accommodation with human beings. The 'Green Revolution' has in its wake brought increasing hardships for the animal population, partly through the reduction in pastures and non-culturable land available for their movement, and partly through the reduction in fodder as a result of the introduction of dwarf varieties.

Drinking water is an essential facility of which adequate quantities are not available freely in many parts of the country. A bad monsoon may lead to large scale migration out of Bombay because of water scarcity. Delhi faces the problem of contaminated supplies time and again because of insufficient supply in the Yamuna. In some places drinking water contains dissolved impurities which may lead to wholesale physical disabilities. Most of the inhabitants of the village of Sagalia in Rajasthan are reported to be suffering from the crippling effects of fluorosis. The water in the village contains as much as 19 parts per million of fluorides as against the safety level of one part per million.

Water pollution in India was not an extensive problem before the country gained independence in 1947. Community water supplies were limited in number. Sewerage facilities were fewer still, and industrial growth was slow. The pace of urbanisation increased in the post-independence era. Water supply systems have increased and expanded without sewerage and sewage treatment facilities keeping pace, re-

sulting in crude domestic liquid wastes polluting the water courses. Several hundred thousand persons in Delhi were apparently affected by the outbreak of infectious jaundice in December 1955 - January 1956 as a result of sewage contaminating the water supply.

These are living problems. Most of our towns are situated on river banks. The vast majority of the Indian people traditionally consider flowing water as pure and potable. Several toxic chemicals do not have strong odour or taste unlike organic wastes. This makes their presence difficult to detect; some of them may not be detected till much later, until it is too late.

The proper exploitation of underground water has been currently receiving increasing attention, partly as a result of the tragedy which overtook Bihar in the form of a disastrous draught, and partly because of the fact that dry farming has to be adopted in the major parts of our agricultural land. Water technology is a field which has yet to receive due recognition in India.

There has been research on new products but little on disposal of wastes. Research with a view to achieving more efficient and more economic treatment of industrial wastes has to be undertaken or financed by industry itself. The Council of Scientific & Industrial Research has taken some lead in starting an 'Industrial Toxicology Research Centre' at Lucknow.

PROBLEMS OF A DEVELOPING COUNTRY

To meet the pressures of population increase, more food has to be produced, more land has to be brought under cultivation, more forests have to be cut down, and more rivers dammed to provide water for the land and the living. This process involves both biological pollution of the air and water, and thermal pollution. More houses have to be built on productive land, more goods have to be produced, more factories and plants built, more transport facilities provided, more hospitals and health services organised and more schools built, making more demands upon the inadequately available resources. This naturally means pressures on services which in a poor and developing country can cause enormous strain with the resultant inefficiency of the services and even their complete breakdown whether they are health services, transport or education. People tend to congregate in the towns thus adding to the overcrowding and creating a 'ruralisation' of the towns.

The rapid urbanisation which is characteristic of several developing countries, including India, has itself created enormous problems.

It is perhaps true that the transport buses on the streets of a city like Delhi or Bombay are fewer in number than those in London, Tokyo or New York, but they are in a horribly poorer shape, with the result that any single one of them spews noxious fumes equivalent to more than a score of buses of a western city. The pressures on transport are so intolerably heavy that it is neither feasible nor possible to maintain them in a sufficiently inoccuous condition. The situation in regard to the industries is nearly the same. In several advanced countries prior treatment of industrial effluents before they are discharged into the air or water is mandatory. In a developing country like India, any such mandate would mean additional cost of the product, which would ultimately have to be borne by the consumer, who often cannot afford it, with the result that the mandate just cannot be imposed, effluents are discharged without treatment, and pollution continues.

The disposal and fruitful recycling of human wastes, both fluid and solid, raises problems of enormous magnitude and complexity endangering human health, productivity and longevity.

Malaria has been controlled. Plague and Cholera have been checked, and areas which were once endemically affected with filariasis have been cleared. But many of these diseases are showing signs of recurrence and resurgence.

The social consequences of population pressures are even less known. Whatever studies have been made on animals lead us to conjure unimaginable horrors. The growing unrest and violence are a manifestation of increasing social tensions.

Man does not live by bread alone; and those of us who believe that as long as adequate food is grown for the people there is no fear, fail to realize this. The fact that food needs are more directly related to population should not blind us to the other consequences of mounting population pressures, some of which could be even more catastrophic to his survival as Man, than the ravages of famine and pestilence.

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Appendix VII

(Science, Vol. 172, No. 3990, 25 June 1971. American Association for the Advancement of Science, Washington, D.C.)

International Environmental Problems—A Taxonomy

(By Clifford S. Russell[1] and Hans H. Landsberg)

The last few years have seen an explosion of interest in environmental problems among citizens of the developed countries, both East and West. Most of this interest has focused on domestic situations and on possible changes in domestic policies designed to provide remedies. Increasingly, however, the focus has widened to embrace environmental concerns that transcend national borders. A high point may be reached in June 1972, when the United Nations Conference on the Human Environment will be held in Stockholm. Wide-ranging discussions and the signing of international treaties on specific international environmental issues are on the agenda. Even though it will not be the first conference on these subjects (*1*), both the auspices of the United Nations and the publicity that it is bound to receive will give it special importance.

The growth of interest and enthusiasm, however, is not matched by accomplishments. That little action has been taken is perhaps easily explained, since sovereign states are involved in these issues, which are old as a class but essentially novel in degree. So far, it has even proved difficult for concerned parties to discuss the problems (*2*).

A major reason for the lack of communication has been the general failure to look beyond the label, "international environmental problems," to the disparate elements it covers and to limit, in advance, the number of such elements that can be discussed at any one time and in any given group. A second reason may be that environmentalists have sometimes couched their arguments in terms that impugn the morality and intelligence of the parties concerned, thus guaranteeing defensive, hostile reactions (*3*).

A third reason may be that management of international environmental problems is most often thought of in terms of "police actions" and regulatory authorities rather than as a component of growth and development. It should be realized that this component of growth and development, neglected by the now developed countries (and being paid dearly by them), can still be built into the development of emerging countries, probably with long-lasting benefits. Finally, political problems, in terms of a lack of new institutions and mechanisms, have played a role. For example, the growing pollution of the Baltic Sea involves eight countries, three of which are in the Soviet orbit, and one of which (East Germany) has a sufficiently undefined international status to make any international agreement difficult, at best, to achieve (*4*).

Many environmental problems involve citizens of two or more countries and hence are "international." Confusion and controversy arise easily: an individual or a government is usually concerned with (or even aware of) only one or two specific problems and incorrectly assumes that other individuals or governments are talking about the same problem when they use the same general label. Consider, for example, the prospects for agreement when one group's mind is on the long-term buildup of carbon dioxide in the atmosphere and particulates in the lower stratosphere; another worries over the dangers associated with increasing storage of radioactive wastes; a third focuses on the ecological implications of large-scale hydroelectric developments in the tropics; a fourth is concerned with the effect of domestic air pollution controls on export prices and hence trade patterns; yet another is concerned about a specific regional problem in which one nation's pollution, or attempt at protection against pollution, imposes costs on another nation; and finally, a group of developing nations views matters through the prism of its overwhelming interest in increasing per capita income.

Some of these situations affect all the world's people, though significant contributors may number only a handful. Others are problems of a particular region and do not concern nations outside that region. To developing nations, all environmental problems may appear to be potential threats to their domestic de-

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velopment. At the least, they seem to be concerns of those nations that have incomes sufficiently high to permit concern with esthetics and that have health standards high enough to permit detection of the effects on morbidity and mortality of concentrations of sulfur dioxide. To lay the basis for more successful discussion, this article suggests a first cut at a taxonomy of international environmental problems and solutions, as well as areas in which further research can contribute to this discussion. We take the point of view of the social scientist, since that view is most likely to speak directly to the concerns of those who must ultimately do the discussing and deciding, but the categories we suggest are based on characteristics of the physical world.

A TAXANOMY OF PROBLEMS

International environmental problems may profitably be divided into two broad categories, depending on the nature and scope of the international linkages involved: physical-linkage effects and social-linkage effects. The first may be divided again into global and regional effects, and the second into pecuniary and nonpecuniary effects.

Global problems are those problems that physically involve all or nearly all nations of the world, either as contributing parties (emitters) or damaged parties (receptors) or both. Some of the most widely discussed environmental issues fall into this category. For example, since World War II, persistent pesticides have been used all over the world in programs to control disease vectors and agricultural pests. The residues directly affect animal life and potentially affect human life, not only in the country in which a specific application is made, but also through the actions of wind, water, and living carriers, even in regions remote from the point of origin. Notice that it is the combination of persistence and mobility that makes the pesticide problem a global one. If any significant user remains outside a control agreement and continues application of pesticides, the impact on everyone may still be felt. (*5*). Even if they were applied by virtually every nation, highly toxic pesticides that were used in small quantities and that broke down quickly to inert residual chemicals might not constitute an international problem. Each nation could manage its own environmental quality problem by enacting its own laws: It would not be dependent for effectiveness on simultaneous action by all other user nations (*6*).

Two familiar examples of global problems, the balance of carbon dioxide in the atmosphere and the particular content of the stratosphere, are closely related to man's burning of fossil fuels, and both tend to affect the earth's temperaure (*7*). Here again. the essential elements of the program are persistence in the atmosphere (for carbon dioxide, the extended time scale of the carbon cycle and its components) and the global span of the physical systems involved. Carbon dioxide is relatively stable, and the molecules are not removed from the atmosphere very rapidly. The very small particulates do not settle out rapidly, but tend to remain in suspension in the stratosphere over long periods. Thus global agreement will eventually be needed to assure a long-term solution. However, since the sources of fossil-fuel emissions are highly concentrated now in the developed countries (North America, Western Europe, the Soviet Union, and Japan), an agreement on limitations among this group would probably result in a solution good for several decades at least (*8*).

Carbon monoxide and larger particulates are also produced in great quantities in some forms of fossil-fuel combustion and cause specific environmental problems. Carbon monoxide, however, is not stable; it does not survive long in that form in the air and is not a problem at some distance from the source. Similarly, larger particulates tend to settle out relatively quickly after emission. Thus, even though these products of combustion are as ubiquitous as carbon dioxide and the very small particulates, they create almost entirely intranational or local difficulties.

A fourth example of a global environmental problem is the dumping or spillage of oil on the high seas. Here, a look at the registry of the world tanker fleet makes it clear that relatively few nations are emitters. Through its effects on marine life, however, the dumping affects the much larger group of nation's that engage in ocean fishing (or that, by a slightly more remote linkage, depend on another nation's catch).

Ultimately, it could affect every nation directly: if, for example, the as yet controversial possibility that continued large-scale dumping could affect the

photosynthetic activity of the seas and hence could threaten one of our largest sources of oxygen were to be demonstrated; or if changes in the surface reflectivity of the water affected the earth's heat balance. Once again, the global nature of the problem results from the discharge of a persistent residual into a natural system that spreads the effects of the residual over long distances. For example, Thor Heyerdahl sighted numerous, large globs of oil in a recent Atlantic crossing. The list of global environmental problems, which, prior to the nuclear test ban treaty, also included worldwide transport of radionuclides, may become longer as our ability to measure trace elements and track their movements increases and we are alerted to interdependencies as yet unseen. But for the moment, the issues listed appear to constitute the major, truly global phenomena (*9*).

REGIONAL PROBLEMS

Regional problems result from physical, including biological, linkages between two or more nations, with little or no spillover to the world at large because of the particular combinations of relatively low persistency of pollutants and relatively limited scope of the natural systems involved in transporting them. Regional problems often resemble the domestic environmental quality issues now facing most developed nations. That is, because geographic proximity frequently permits identification of "upstream" and "downstream" countries, the *assignment* of costs of control and the benefits from damages avoided presents no difficulty, even if the *estimation* of damages avoided may, in principle, be impossible in many cases. Many of the same analytical techniques developed for dealing with domestic quality issues are directly applicable to regional situations. Examples of such situations are most common in the highly industrialized parts of the world; their natural systems are subject to the most stress, both in quantity and variety of pollution discharges; agriculture tends to be more intensive, with the attendant use of fertilizers and pesticides (*10*); "conventional" pollutants associated with lack of sanitary facilities (toilets, sewers, waste disposal, and so on) are at a low level, thus giving greater visability to the pollutants associated with high technology (detergents, scrapped automobiles, carbon monoxide, and so on); and incomes are high enough to permit people to concern themselves with damages to esthetic values and recreational opportunities.

There is no lack of examples of regional problems of the upstream-downstream variety. The Rhine serves France and Germany as a sewer, but it serves the Netherlands as a part of its water supply. Acid rainfall over western Sweden and eastern Norway has been attributed by some scientists to sulfur oxide emissions originating in industrial operations in Germany's Ruhr and England's Midlands (*11*). As a result, trout fishing in southern Norway is threatened, and there is a suspicion that the growth of trees is being slowed down. The Environmental Committee of the Organization for Economic Cooperation and Development has been asked to investigate the problem, and management of the resulting project has been entrusted to Norway. The seaborne flow of pollutants from Italy to France along the Riviera is another instance of the upstream-downstream syndrome (*12*). The use of Arctic waters by U.S. oil tankers, should this development occur, would be yet another, involving Canada, the United States, and, depending on the implication of ocean currents and the like, possibly other countries.

In other cases, because of the natural system involved, all parties become both emitters and receptors. This is true, for example, of the Baltic Sea and of Lake Erie. Countries around the Baltic are concerned, above all, about oil transportation and mercury pollution from pulp mills. The narrow link with the North Sea makes much of the Baltic practically an inland sea body, and the results of a major oil spill could bring great harm to any or all of the eight countries involved.

Other cases involve despoliation rather than pollution in the conventional sense, but still present the upstream-downstream pattern of damage. Thus, European conservationists are concerned about the effects that the Italian practice of netting will have on migratory bird populations. Large numbers of birds that winter in Africa and summer in the north of Europe are trapped each year as they migrate up the Italian peninsula (*13*). Finally, there are the major environmental alterations that involve neither pollution nor despoliation. A case in point is the Aswan Dam. By cutting the flow of silt and organic debris in the Nile, it appears to have adversely affected the eastern Mediterranean sardine fishery (*14*) (apart from other consequences that are purely domestic at this time).

Although regional and global problems have many similarities, it is useful to distinguish between them in order to emphasize that not every international environmental problem need—or should—be grist for the mill of the United Nations. It may, in fact, be helpful in seeking a solution to involve only the smallest possible group of nations—generally those directly interested (*15*). This is not, however, to suggest that the distinction between the two classes will always be clear. Realistically, one must expect that some large-scale regional problems will be most conveniently dealt with as global issues, while the interests of a very few powerful nations may so dominate a global problem that its solution rests, at least initially, entirely with them (*16*).

SOCIAL-LINKAGE EFFECT

Social-linkage effect is the term we use to refer to a second class of international environmental problems in which no physical linkages exist but in which nonetheless, the policies of one national government impinge directly on the well-being of citizens of one or more other nations. This may occur through established economic relationships between nations (that is, trade and investment, including foreign aid), or in a way that is not, in the first instance, pecuniary. We deal with the second class first and call it, for want of a better term, nonpecuniary linkage.

A classic case of nonpecuniary linkage is that of one country's possessing unique natural or historical gifts that citizens of other nations value as part of the human cultural and natural heritage (*17*). Thus, for example, Uganda's plan to develop a hydroelectric scheme that would involve cutting by 90 percent the flow through Murchison Falls (a very narrow gorge on the Upper White Nile) has aroused considerable ire among conservationists, particularly those in Europe (*18, 19*). The filling of Lake Nasser, behind the Aswan High Dam, stimulated an international effort to rescue a number of tombs, temples, and statues erected along that stretch of the river by early Egyptian civilizations. Similarly, the Italian government's care of remnants of antiquity has postponed the completion of Rome's subway, but has probably prevented it from becoming an international issue (*20*).

Many countries, particularly the developing nations, have been criticized for failing to take effective action to protect animal species that are valued by conservationists around the world. Perhaps the most widely known examples are the African cats, especially the leopard, which are endangered by poachers, and the Ceylonese elephant, threatened by the large-scale clearing of forests for agriculture.

These situations are local phenomena, but they become international problems when citizens of other countries protest and attempt to obtain actions that accord with their own values rather than with those of the country concerned. Aroused citizens implicitly or explicitly involve their own governments in their efforts. Thus, the opponents of the Murchison Falls Dam would persuade the British government to renege on its promise of financing the initial construction phase (*21*). Thus the nonpecuniary interaction can become pecuniary.

It is worth noting that motives are of the highest character in both camps; and, as is always the case when neither side is villainous, the problem appears in its purest and most difficult to solve form.

This is equally true of yet another variety of nonpecuniary interaction—international altruism, in which citizens of one nation endeavor to help citizens of another nation avoid mistakes in dealing with the environment. For example, agricultural experts in the West may be anxious to help African nations avoid exhaustion and erosion of laterite soils. This type of interaction will only lead to problems if the country to be assisted does not agree that the proposal is in its best interests, or if the outside altruists become too insistent or paternalistic.

This situation is apt to arise, above all, in large-scale, agriculture-oriented engineering works. As an example, consider the controversy over the eventual benefits of the Aswan High Dam. Leaving aside the question—often hard to judge—of whether or not some of the effects were or could reasonably have been anticipated, it is useful to distinguish between adverse effects that diminish the chances of success of the primary project objectives, and those that adversely affect some other environmental facet.

In the first instance, decreased soil fertility or increased salinity, for example, if indeed resulting from the changed characteristics of the river, would directly diminish the project's objective—that is, higher agricultural production. Pro-

vided there was no dispute on the scientific findings, it would be a straightforward computation to evaluate the size of the loss in dollars and cents. There would be no room for dispute over the consequences. By contrast, the spread of schistosomiasis, while also damaging to the country, could not, in the same sense, be calculated as a direct offset to agricultural production. Outsiders might view it as part of an ecological horror story and consider it a serious offset to the value of the project as a whole, but the national government, given the already very wide diffusion of the disease in rural Egypt, might view it less severely. Indeed, it might even consider that increased output and income might, in the long run, provide a better basis for a successful battle against the disease *anywhere*.

Weighing of environmental effects is, then, unlikely to lead to controversy in the first instance (direct relation to project objective) but apt to do so in the second (adverse side effects related only tenuously, if at all, to project objective).

Divergences of judgment, as described above, sometimes leading to the attempt to impose some kind of sanctions on another country, are not new. Boycotts, embargoes, and other measures have been used in the past to express disapproval of a country's behavior and force it to comply with more acceptable standards. What is new here is the issue that gives rise to such conflict and pressures; and as that issue gains increased status among the apirations of mankind, the opportunities for intervention, as well as the felt justification, are bound to rise.

PECUNIARY EFFECTS

The issue becomes at once more pedestrian and more pointed when we turn to another class of social linkage—namely, the pecuniary effects upon country B of specific environmental policies followed in country A. Here the cases shade into well-known phenomena in foreign trade, even though the impetus lies in a newly prominent field, the environment.

Thus, when the United States adopts strict automobile emission standards, it raises the costs of European and Japanese auto manufacturers who wish to export to this country. Even if the sales price of U.S. automobiles should rise in proportion, foreign manufacturers will need to make special provision for cars sold in the U.S. market. This fact, together with the likelihood of a proportionately greater financial burden on smaller cars, will directly affect the income of the owners and employees of foreign firms, and will indirectly affect the income of other citizens of those nations. Similarly, limits on the permissible sulfur content of fuels burned in U.S. and European cities imply gains for those nations that own low-sulfur fuel reserves, and lost markets or decreased profits (because of the costs of desulfurization) for others. These examples are only extensions of long-standing regulations in food imports, for example, where tolerances for specific ingredients or impurities, or observation of stated sanitary procedures, are prerequisites for admission to the U.S. market. They bring us squarely up against trade effects as international environmental problems; and for many people trade effects are the most immediate and important of such problems. Thus, it will be valuable to pause and consider how trade effects fit into the taxonomy we are proposing.

There are generally two kinds of trade effects: (i) loss of export markets as a consequence of the increased costs of maintaining high environmental quality in the exporting country, or (ii) the erection of barriers to imports in line with the importing country's policies on environmental quality (*22*). In the first case, by forcing domestic manufacturers to absorb the costs of disposing of production residuals, environmental quality legislation will tend to diminish the competitiveness of domestic products in the world market. This, in turn, will lead to a decline in domestic income and employment and to losses in the value of invested capital (*23*). The second effect is exemplified by the standards on auto emissions and sulfur content of fuels. Here the major losses will arise through action in the importer's country, which raises the additional specter of retaliation.

There is no doubt that both situations can create friction between nations and be the subject of negotiation, unilateral action, and so on. Hence, both are international problems. This is obvious with barriers to imports, but the implications of the loss of export markets are no less disconcerting. As put by Germany's Minister of the Interior Genscher (*24*):

> We must . . . avoid a situation in which individual countries exclude themselves from making investments for environmental protection, thereby securing competitive advantages for their own economy vis-a-vis those countries who do meet their responsibilities.

What is noteworthy here is the use of the term "responsibility," placing environmental effects in a context beyond voluntary action.

It is important to realize, however, that trade effects are quite different from the direct, physical-linkage effects. The loss of export markets due to action in the exporting country is simply an international facet of the classical adjustment process necessary within an economy when tastes or ground rules shift markedly, causing capital and labor to move out of some industries and into others. Some owners of capital suffer unanticipated losses, and, in the short run, lower incomes and some unemployment will result. But the real cost of producing the same goods (or of obtaining the goods internationally) has increased by what it costs to achieve the higher level of environmental quality. Hence, given government policies designed to maintain aggregate demand, there is no reason that full employment cannot again be obtained (25). In the long run, and in the absence of similar environmental policies by other governments, the nation will tend to import those goods that involve the greatest environmental casts and to export those involving the least. It will, in effect, be exporting pollution (26).

The emergence of so-called "pollution havens" is not a theoretical consideration. For example, air pollution standards have led to reductions in copper smelting operations in Arizona, Texas, Montana, and Washington, and to an increase in shipments of ore to smelters in West Germany, Canada, and Japan. Japan is reported to be shipping ore to Indonesia for smelting, though on a very small scale. A movement in the opposite direction is our export of coal and lumber to Japan. To the extent that those exports are stimulated by lower prices, made possible by a lack of strip-mining regulation and of control of timber overcutting, the United States is functioning as a pollution haven, suffering land erosion, acid mine drainage, reduction of wildlife stocks, and disruption of natural vistas in order to support domestic employment in export industries.

Environmental policies that act as direct obstacles to trade affect the outside world as do other nontariff barriers such as product quotas or import prohibitions. For the domestic economy of the importing countries, the higher real cost of imports is, again, simply one facet of the overall cost of attaining the desired level of environmental quality.

Because international trade problems have been dealt with extensively elsewhere, little need be said about them here, even though they arise in a novel context. However, the novelty must be qualified. Nontariff barriers that confer large gains on specific industries are frequently justified in terms of noble objectives—to further health or some other aspect of the well-being of some or all citizens. When environmental objectives act as trade barriers, it is not, therefore, surprising that the motives of those who are responsible for them will be suspected.

It is difficult to predict the effects on international trade of domestic environmental quality policies that are imposed unilaterally. The one attempt with which we are familiar is limited to five major developed countries (France, Japan, West Germany, the United States, and the United Kingdom). The reported results must be interpreted with caution because of the rather strict assumptions and limited data on which they are based (27).

Nevertheless, this study does indicate the order of magnitude of the short-term impact on national income and the balance of payments of domestic environmental control policies, if it is assumed that each nation, in turn, acts alone while others continue present policies and that the government of the nation imposing the controls does not pursue policies designed to reduce the resulting economic dislocations. In this situation, the predicted effect on the balance of payments and national income of the United States is quite small; on those of eign aid on the environment. From such evaluations are likely to come actions to prevent or remedy adverse environmental consequences. Hence, the cost of a given project is likely to be higher than it would otherwise have been, and the host country will be concerned over the competitive status of the goods and services that will result from the investment. Recipients of aid do not look kindly on the need for additional foreign exchange, perhaps foreign technicians, West Germany, moderate; and on those of the other three nations, substantial. These results suggest that U.S. environmental policy need not be constrained by fears of serious national income and balance of payments implications, but that other major developed nations will probably be extremely cautious about acting, except in concert with their major trading partners, in such a way as to force

domestic industry to take account of environmental damages. There is the additional complication that the degree to which adjustments are borne by society as a whole (for example, through subsidies paid out of general revenue), as against being reflected in the price of the affected commodity, will impinge upon relative prices and thus competitiveness in international markets.

Environmental considerations are equally likely to affect the allied field of investment. We have pointed out the tendency to import, rather than produce at home, goods that have a highly adverse effect on the environment. In addition, some countries do not impose strict regulations, either because conditions (whether natural or otherwise) do not yet require them, or because they wish to attract capital, As a result of these two factors, investments may be shifted to those countries. It is easy to see how such moves can lead to international friction.

These investment effects also appear in the field of foreign aid, whether bilateral or multilateral, except that here the reverse situation obtains. By U.S. law, development projects financed by the U.S. government must now be evaluated for their impact on the environment. In a parallel development, the World Bank has recently established a program designed to look into adverse effects of foreign aid on the environment. From such evaluations are likely to come actions to prevent or remedy adverse environmental consequences. Hence, the cost of a given project is likely to be higher than it would otherwise have been, and the host country will be concerned over the competitive status of the goods and services that will result from the investment. Recipients of aid do not look kindly on the need for additional foreign exchange, perhaps foreign technicians, and further delay in achieving economic independence—all for benefits often little understood or valued.

SHARED EXPERIENCES

Before abandoning the taxonomy of problems and proceeding to that of solutions, a comment is needed on a range of matters that are not in any real sense international environmental problems but that do relate to them. These are the domestic environmental experiences common to most countries at specific stages in their growth.

Problems of human settlement, especially those of large urban areas, come to mind at once. These are not new problems. Most of them have merely been given a new label. Thus Calcutta, Rio de Janeiro, Lima, Tokyo, and New York all suffer from problems related to large concentrations of population. Similar problems were noted in London 150 years ago. The international aspect lies in the commonality of such problems, not in any interaction. And so it is with matters like soil erosion, poor drainage and resulting salinity (encountered many thousands of years ago in the plains of the Tigris and Euphrates), deforestation to meet the needs of shipbuilders (Rome), or settlers (United States), and a host of other environmental problems. Here the opportunities for international cooperation are greatest; in the exchange of information, technology, and so forth. In short, here is the possibility of progress without conflict. But, by the same token, it is not here that truly perplexing international issues are found.

A final comment is in order on the above taxonomy. A problem in any of the three categories may be—and usually is—complicated by considerations of the income distribution among the nations (and their citizens) involved. These will be particularly obvious and important when one or more of the interested parties are developing nations, but they will also be present when only developed nations are concerned. Any particular solution to an international environmental problem will involve transfers of real income from nation to nation. These can generally be identified and at least partially quantified at a technical level. But the desirabe direction and size of such income transfers become two variables for consideration in the political process of choosing between alternative outcomes.

A TAXONOMY OF SOLUTIONS

Solutions to international environmental problems may be either negotiated or imposed. If negotiated, the appropriate group of interested parties will, as we have suggested, be defined by the scale of the natural system involved, although considerable improvement may be obtained over a fairly long period through agreements among the smaller group of nations responsible for most of the problem.

Solutions may be imposed by a single nation or by a group of nations that has the required economic—or, in extreme cases, military—power. The imposition may be directly by force: for example, if one nation invades another to destroy a dam that has changed the flow of a river (*27*). More likely are impositions based on the terms of foreign aid (as in the Murchison Falls example mentioned above), trade restrictions (as in auto emission standards for imported vehicles and the prohibition against importing certain furs), or by internal law operating as a trade restriction (restrictions on the sulfur content of fuels or prohibitions against the landing of SST's at domestic airports).

An imposed solution generally implies that the costs and benefits have been assessed by the imposing nation from its own point of view. But if negotiation is to be attempted, the problem of evaluating alternative solutions becomes extremely difficult. There are the usual problems of making cost comparisons among nations with different internal factor-cost structures and correcting the nominal rate of exchange to reflect at least the most serious distortions. In addition, the task of getting any real notion of the benefits will be all but impossible. Nations' preferences for the changes in environmental quality being sought will vary in accordance with their stage of economic development, cultural matrix, political structure, and so on. Moreover, these changes are associated not with private goods, where the market provides a test of preferences, but with public goods, which are consumed willy-nilly in equal amounts by all. Therefore, there exists an opportunity, if not an incentive, to conceal true preferences (for a nation as much as for an individual) and report falsely on the evaluation of benefits (*28*). Solutions may be implemented through the setting of standards or through levying charges on contributing nations, although there are tremendous difficulties in achieving either on an international scale.

Standards, in turn, may be "ambient" (that is, applying to the quality of the environment of the receptor nations) or "discharge" (applying only to the contributing nations) (*29*). If the mechanisms of the natural world are sufficiently understood, a set of ambient standards, if attainable at all, can be translated into a set of discharge standards (*30*).

Because demands for "minimum standards" crop up so frequently in proposals for safeguarding the environment, it is well to stress that such minimums are unlikely to be either unambiguously defined or easily agreed upon. For example, is the minimum standard for oil tanker design simply to require bill thickness and tank sizes such that at least tankers won't break up in storms for their first 10 years? Or is it to require some minimum of oil spillage resulting from a design collision or grounding incident? Who chooses the design incident and the minimum acceptable spillage? Or, consider minimum standards for mercury contamination of foods. For any particular food, the level of contamination that a nation will be willing to tolerate will vary with the importance of that food in the diet of its citizens, *and* with the incidence of poisoning it finds acceptable. Since individual susceptibility to mercury undoubtedly varies, any given minimum standard is likely to result in some (albeit very few) cases of poisoning. The only minimum standard that can, with certainty, prevent poisoning is a zero level. Any nonzero level implies choices of probabilities of incidence; and any level high enough to be a minimum (in the sense that no nation would insist that a higher tolerance be agreed on) would undoubtedly lead to significant incidence in one or more nations.

Notice also that *any* standard which changes the status quo will create costs for some nations and benefits for others. Thus, in the tanker example, nations whose citizens own tanker fleets or ship oil will absorb costs if tankers are made more expensive. Nations with coastlines near busy international shipping lanes will reap obvious benefits from stronger construction, smaller tank size, and soon. Similarly for the mercury example, nations producing and consuming a particular food are likely to differ on the desirability of any standard, even a very low one.

The point is that minimum standards are no more objectively determined than would be optimum standards, and attempting to find and agree on a set of global minimum standards will not make the negotiating problems appreciably easier. Any standard that finds immediate and nearly unanimous international support is likely to be quite meaningless.

The term "monitoring" also tends to give rise to much confusion, even though it is a prominent activity apt to draw nations together rather than push them apart. One kind of monitoring is directed toward exploring basic processes and

flows in natural systems, setting baselines, discovering what needs to be measured, and assuring compatibility of measurements carried on by different nations. Some of this activity is underway. A second sense of the term refers to compliance with set standards and is used in the context of regulation. In terms of sequence, the second sense follows the first. A clear distinction between the two meanings is helpful for avoiding unnecessary conflict and suspicion.

OTHER DIMENSIONS OF VARIATION

International environmental problems differ in a number of dimensions other than the one we have chosen for our basic taxonomy. Thus, problems may involve different time scales between cause and effect and, hence, a different level of immediacy for the present population of the world. For example, the buildup of carbon dioxide is a long-term problem, with the possibility of any detrimental global effects many decades in the future, if they occur at all. This is apart from the fact that the environmental effects of fuel combustion and energy conversion and use generally are as yet poorly understood. Thus, any attempts at timing are highly speculative.

The persistent pesticide problem, on the other hand, is much more immediate, with consequences of past applications observable today and with every indication that the situation will worsen unless action is taken now. Related to this dimension of timing is the degree of certainty with which an event will or will not occur. Generally, the further in advance effects are predicted, the more uncertain the outcome; on the other hand, the continuation of presently observable effects is far more certain.

Two other important dimensions of environmental problems are magnitude and degree of irreversibility of effects. Because the effects will be of different types, occur in different places, and affect different facets of human life, the relative magnitude of particular problems is not easily determined, except in the infrequent cases where some estimates of monetary damages can be obtained.

The scope of effects, however, can roughly be compared: For example, a global warming trend is a "greater" effect than is the extinction of a species. However, this approach is too intuitive, and it becomes progressively less useful as one moves away from extremes.

Reversibility refers to the possibility of returning the world, or one of its subsystems, to the state it was in before some effect occurred. Thus, sulfur dioxide pollution in the atmosphere, because of the speed with which it is scrubbed out, is highly reversible. The construction of a dam, on the other hand, is generally considered to be irreversible. As a matter of fact, many effects are reversible *at some cost;* irreversibility, in everyday parlance, generally means that the cost of returning to an earlier state is very high. True irreversibility can be seen in species extinction, destruction of scenic areas, and changes in global climate and weather (except sub specie aeternitatis).

The dimensions of timing, certainty, magnitude, and reversibility of effects all contribute to the broader dimension of urgency. A situation that produces immediate (thus certain), serious, and irreversible effects is perceived as more urgent than a situation that produces long-deferred (hence uncertain), minor, or reversible effects. There is, of course, no one scale on which all environmental problems may be ranked according to urgency, but individuals and governments make subjective evaluations of this sort all the time, and these evaluations help to determine willingness to negotiate solutions.

The ability to proceed from some mutual willingness to negotiate to an acceptable settlement will depend, in general, on the number of interested parties, the degree of diversity in their development and needs, and the nature of the issues involved. For example, if "national pride" somehow becomes an issue in its own right, negotiation will be far more difficult than if only economic or esthetic questions were involved (though in practice it will be hard to make distinctions). More important, objectives differ. Thus, developing countries will generally desire to exploit their natural resources more rapidly and process more of them at home, in order to earn foreign exchange and raise per capita income. "Some of us would rather see smoke coming out of a factory and men employed than no factory at all. It is, after all, a matter of priority," commented the president of the Consumer Association of Malaysia at the recent meeting of the International Organization of Consumers Unions (*31*). At the same conference, the director of the Consumer Council of India is quoted with this remark: "The

wealthy countries worry about car fumes. We worry about starvation" (*31*). Presence or creation of appropriate institutions will also make a difference. The pooling of the Scandinavian countries' research efforts in "Nordforsk" is likely to promote internationally advantageous action, just as failure to do so in the context of the Baltic will retard action. Thus, building institutions is an important element of progress in negotiated settlements.

SOME RESEARCH NEEDS

We have attempted simply to outline and categorize the range of issues subsumed in the broad heading "international environmental problems." Solutions to these problems must rest on difficult international negotiations, but social scientists can play a useful role in setting the stage for such negotiations by undertaking research to answer questions that are currently being answered, without sound data or analysis, by advocates of one or another solution. The following are examples of such questions:

(1) What are the pitfalls of various types of international agreements as revealed by previous experience, for example, in the field of marine fisheries or international communications via the radio spectrum? What forms and safeguards have proven to be successful in, for instance, international control of uses of nuclear energy? In control of the movement of toxic materials, such as drugs?

(2) What are the costs of altering the behavior curently giving rise to the problems? For example, what would be the costs (economic, political, and in terms of additional radiation hazard) of the widespread substitution of atomic energy for fossil fuel in generating electricity, in order to cut down on global emissions of carbon dioxide and particulates (*8*)? What would be the cost of abandoning the use of DDT in special areas and for specified purposes, and of replacing it with a range of alternatives? What would be the costs of undertaking alternatives to the schemes giving rise to the direct nonpecuniary interactions defined above? As a specific example, what would be the additional costs to Uganda of obtaining the generating capacity of the Murchison Falls project by some other method? Or how valuable is the generating capacity that would be lost in some compromise scheme to preserve a flow through Murchison Falls?

(3) What policies could be devised to assure that the cost differences calculated above could be made up by nations voicing concern? As a sub-problem, how could one effectively assure the country making the substitution—as one would have to—that the cost difference would not come out of development funds that had already been committed? And how would it be possible to erect safeguards against "ecological blackmail" (that is, the threat of an adverse undertaking as a means of securing financial indemnity for acceptable modifications, or abstention from action)?

(4) What are the costs of meeting various objective sets of ambient environmental quality standards in such classic cases as the Rhine and the Baltic? Who would bear these costs in the first instance? And what mechanism could encourage payments from nations deriving benefits to those bearing costs?

This list is not meant to be comprehensive, but to outline a set of specific problems that can be tackled by social scientists with, for the most part, techniques that have already been developed in the context of domestic problems. It is purposely confined to the cost side of the problems and is designed to modify arguments about these problems, at least to the extent that proponents of change know what costs they are imposing on other nations. The task of quantifying benefits is probably beyond the competence of any scientist and must remain a matter for political judgment as exercised in the process of negotiation.

REFERENCES AND NOTES

1. Notable examples are the Study on Critical Environmental Problems held at Williams College during 1970, the results of which have quickly become available in an initial report [*Man's Impact on the Global Environment: Assessments and Recommendations for Action* (M.I.T. Press, Cambridge. Mass., 1970)], and the Prague Conference this spring, sponsored by the United Nation's Economic Commission for Europe.
2. The exception has been the increasing activity by international scholarly bodies. For example, the Scientific Committee on Problems of the Environment

was formally established late in 1970 by the International Council of Scientific Unions and so far has set up at least three study groups. These have begun to conduct research on matters ranging from the effect of chlorinated aromatic compounds on human tissue to the scope and methods of worldwide environmental monitoring systems and the structure and functioning of eco-systems as influenced by man. Specialized agencies like the World Meteorological Organization (with its World Weather Watch) or the planned Global Atmospheric Research Program (to be undertaken as part of the World Weather Program) are similar ambitious programs. The International Biological Programme has been functioning for some years now. Others, such as UNESCO's Man and Biosphere, have barly begun to function. Below the global level, study programs are under way in the Organization for Economic Co-operation and Development, at NATO, at the Council of Europe, and others, but none of these are at this time action-oriented.

3. Thus, some scientists appear to feel that the setting of environmental standards is a "scientific" question, like that of understanding environmental mechanisms. One set of standards then is "correct"; others are "wrong." In fact, however, scientific inquiry only furnishes society with the understanding and the data on which to base decisions. Given identical facts, the differing tastes, preferences, and prejudices of different members of society will lead them to advocate different standards. Because of the impossibility of trading the results of environmental standards in a private market, the problem of combining individual preferences to arrive at a social decision becomes a political problem. Politicians make these decisions not by default, but because such decisions are the very substance of democratic government.
4. *New York Times*, 4 October 1970, p. 15.
5. Persistence alone is not sufficient to cause a global problem. A discarded tire is extremely persistent and creates a visual blight that is surely an environmental quality problem. But the tire is not subject to global transportation by the natural system into which it is discharged. Similarly, mobility without persistence would not create the problem discussed.
6. How subtle are the distinctions involved is evidenced by the possibility that even nonmobile, nonpersistent pesticides could have affects beyond national borders if (i) they affected migratory birds, for example, and thus broke the food chain, or (ii) they were used near international boundaries. But control of these cases would require agreement among a much smaller set of nations.
7. For a recent comprehensive survey of the subject, see H. E. Landsberg [*Science* 170, 1265 (1970)].
8. See W. O. Spofford, "Decision-making under uncertainty: The case of carbon dioxide buildup in the atmosphere," paper prepared for the Study of Critical Environmental Problems, Williams College, July 1970.
9. Dealing with global issues is, in one sense, not a totally new experience. Control of infectious diseases affecting human, animal, and plant life has long been practiced on a worldwide basis with considerable success, since in many instances carriers could be identified and thus isolated. Note also that global "concern," of course, extends far beyond this list, to include population growth, the nuclear threat, and so on.
10. Even this situation is not without its fuzzy edges. Agriculture in the developed countries is conducted with more care for soil erosion: thus, dispersion of nutrients into the environment is lessened. On the other hand, poor farming practices in the less developed countries may be the cause of the major portion of particulates in the atmosphere, according to the Williams College report (*1*). If so, poor agricultural practices would have to be considered a true global environmental issue.
11. *New York Times*, 27 November 1970, p. 64.
12. J. Cromwell, *New York Times Magazine*, 21 February 1971, p. 24.
13. *New York Times*, 19 April, p. 17; *ibid.*, 27 December 1970, p. 16. This is not a new phenomenon, but a new attitude, arising in the context of general concern for the environment.
14. C. J. George, "The role of the Sadd El Aali [Aswan High Dam] in the fisheries of the southeastern Mediterranean," paper presented at the conference on Ecological Aspects of International Development, Airlie House, Warrenton, Virginia, 9–11 December 1968. See also C. Sterling, Washington *Post*, 15, 17, 20, and 24 February 1971; *Life*, 12 February 1971, p. 46.

15. Recent work in political theory on legislatures, individual preferences, and social decisions suggests that it is preferable not to have a decision made on an issue by a legislature in which few individual legislators have a direct interest in that issue [see E. Haefele, *Amer. Econ. Rev.* 61, 217 (1971)]. An analogy between legislators and national government representatives in international organizations does not seem far-fetched.
16. This is true of nuclear disarmament, the extreme case of a threat to life on earth. On a less extreme level, G. F. Kennan has suggested that global problems are best handled by the developed nations in any event—not only because they are the principal polluters but because it will be too much to expect the rest of the world to take an interest in a problem that does not loom large at that stage of economic development [*Foreign Aff.* 48, 401 (April 1970)].
17. J. V. Krutilla, C. J. Cicchetti, A. M. Freeman, C. S. Russell, in *Environmental Quality Analysis; Theory and Method in the Social Sciences*, V. Kneese and B. T. Bower, Eds. (Johns Hopkins Press, Baltimore, in press).
18. P. Géroudet, *Biol, Conserv.* 2, 309 (1970).
19. C. S. Russell, *ibid.*, in press.
20. *New York Times*, 23 January 1971, p. 2. The economics of the preservation of unique historical and geological sites is discussed in (*17*).
21. A translation of a public letter from three prominent British scientist-naturalists (F. Darling, J. S. Huxley, and P. Scott) calling for this action is in (*18*).
22. Both manifestations are mentioned in *Bus. Week*, 23 January 1971, p. 72.
23. We emphasize that income, as measured by such market-based indices as gross national product, will decline relative to what it would have been in the absence of the domestic policies. The fact that the policies were adopted, however, shows that the society judged it would be better off with them than without them. Nonmarket income has increased enough to offset the decline in market income.
24. *J. Commer.*, 15 January 1971.
25. Even in the short run, wise government policies may ease the transition considerably. For example, worker retraining allowances and expanded unemployment coverage, as well as subsidized loans for machinery conversions, can cut the frictional costs of the required employment shifts. Such policies to offset trade effects are possible under the current tariff law but have almost never been used. There are signs that this situation is changing. For a discussion of assistance being given the Massachusetts shoe industry, see *New York Times*, 21 February 1971, section F, p. 2.
26. R. C. d'Arge, Appendix F, in A. V. Kneese, "The economics of environmental pollution in the United States," paper prepared for a meeting of the Atlantic Council, Washington, D.C., 1970.
27. It is hard to visualize anything less drastic, such as water pollution, as a casus belli, even though the consequences in the long run may be just as damaging. But, of course, the invocation of an environmental insult may merely mask a more traditional objective of foreign policy, economic or otherwise.
28. P. Bohm, *Swed. J. Econ.*, in press. The fundamental papers in the theory of public goods are P.A. Samuelson, *Rev. Econ. Stat.* 36, 387 (1954); *ibid.* 37, 350 (1955); *ibid.* 40, 332 (1958).
29. We place the words "ambient" and "discharge" in quotes to indicate that the same notions may be used more broadly. Thus, for example, in the trapping of migrating birds, a discharge standard would require that the trapping nation allow some number or percentage of the flock to escape. An "ambient" standard would require the maintenance of some population in each of the host countries.
30. In addition, of course, the ground rules chosen in translating "ambient" to "discharge" standards will make a difference to economic efficiency. If all individual dischargers may be subject to different discharge constraints, an ambient standard may be attained most efficiently. On the other hand, if notions of "equity" seem to require a uniform standard, then some dischargers will be cutting back too far when the ambient standard is just attained. In any event, however, we are a long way from approaching such sophistication in domestic affairs, let alone international conduct.
31. *New York Times*, 3 July 1970, p. 4.
32. We wish to express our appreciation to L. Carter, M. Clawson, J. L. Fisher, A. V. Kneese, and W. O. Spofford, all of Resources for the Future, for useful criticism and comments on early drafts.

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