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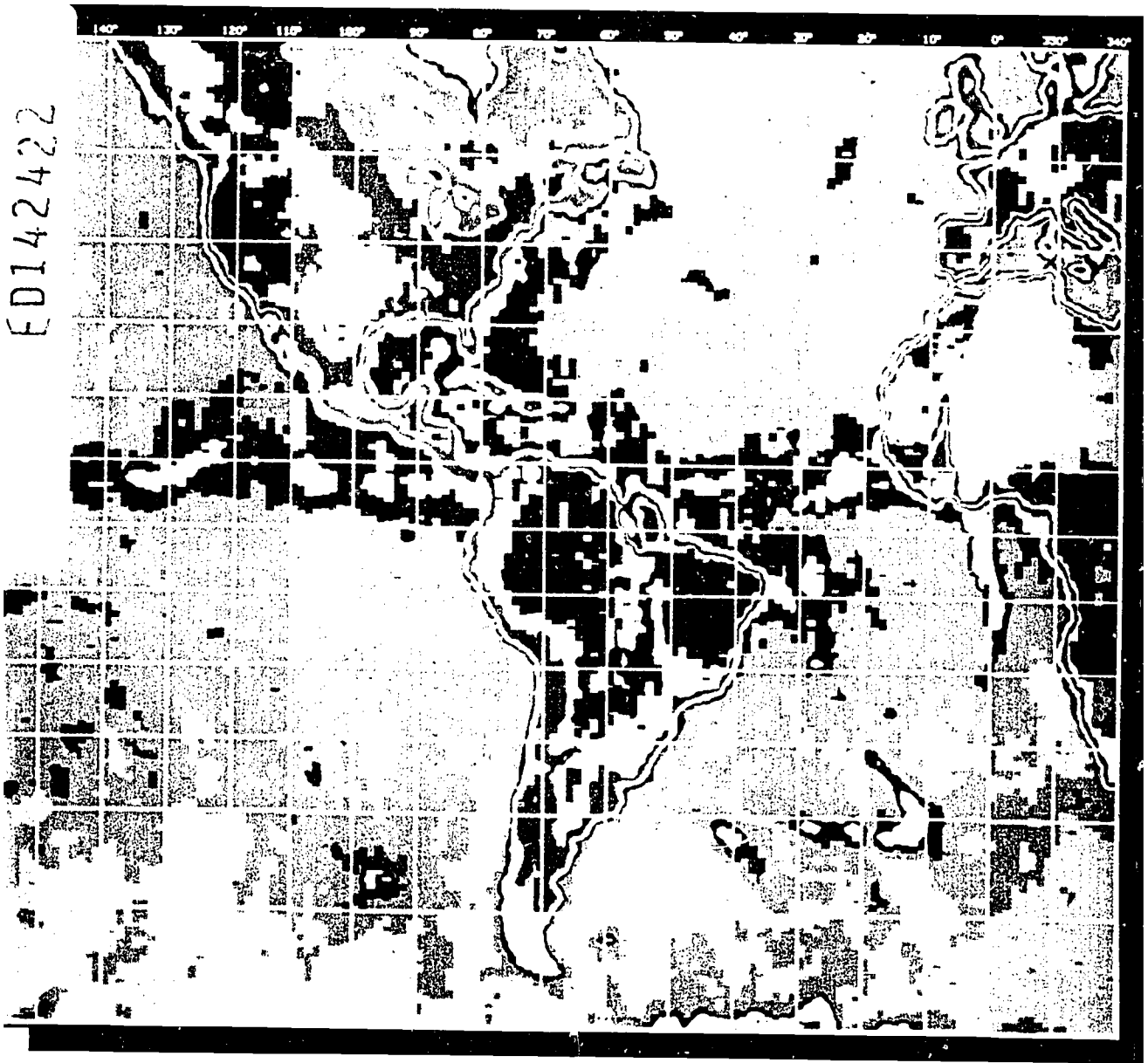
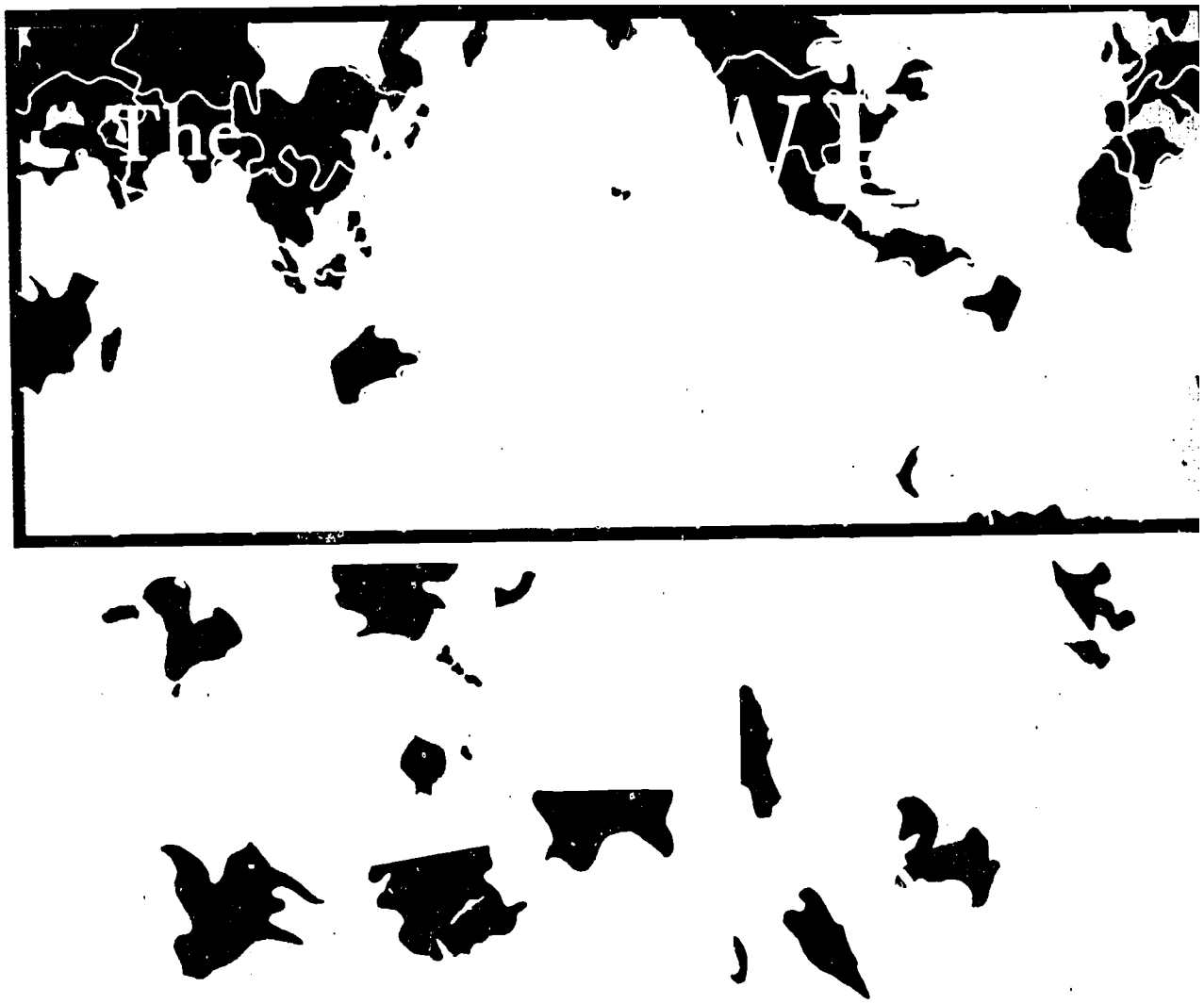
ABSTRACT

Detailed are the proceedings of the 1976 Bicentennial Symposium Series held under the general title of Mounting Pressures on Planet Earth. This event, co-sponsored by the Maryland State Department of Education and the NASA Goddard Space Flight Center, brought together researchers and educators to discuss solutions to the Earth's problems. The symposium was broken into four sessions; each session took a detailed look at a very fundamental question about the Earth's future. The questions investigated were: Can the Earth Feed Its People (Forum I); Can the Earth Provide the Energy and Other Resources for the Next Generation (Forum II); Can Science and Technology Solve the Earth's Problems (Forum III); and Can Existing Economic, Political, and Value Systems Cope With the Problems of the Earth (Forum IV)? An afterword by the editor concludes this publication. (BT)

MOUNTING PRESSURES ON PLANET EARTH



A FOUR PART
BICENTENNIAL SYMPOSIUM SERIES


The

MOUNTING PRESSURES ON PLANET EARTH

A Four-Part
Bicentennial Symposium Series

Edited by
David A. Anderton

Jointly Sponsored by

The Maryland State Department of Education

and

The National Aeronautics and Space Administration
Goddard Space Flight Center

CONTENTS

PREFACE

Mounting Pressures on Planet Earth is a Bicentennial Symposium Series co-sponsored by the NASA-Goddard Space Flight Center and the Maryland State Department of Education. The speakers and topics were selected to inform persons who make major political, environmental, and educational decisions affecting planet Earth. The audience included group-influencing individuals and organization representatives. Each symposium was held at the Goddard Space Flight Center in Greenbelt, Maryland.

The symposium series was broken into four sessions:

Forum I — April 29, 1976
Can the Earth Feed Its People?

Forum II — May 20, 1976
Can the Earth Provide the Energy and Other Resources for the Next Generation?

Forum III — September 30, 1976
Can Science and Technology Solve the Earth's Problems?

Forum IV — October 28, 1976
Can Existing Economic, Political, and Value Systems Cope with the Problems of the Earth?

Although this Symposium Series was designed to focus on the major problems facing the world during our Bicentennial Year, it is our hope that the fundamental questions raised by these forums will be discussed long after 1976 and that some of the ideas sparked by the lectures and discussions described in this report may guide all of us in an ***understanding*** which will lead to ***action*** to help reduce the MOUNTING PRESSURES ON PLANET EARTH in the future.

James W. Latham, Jr.
Jaylee Mead
Symposium Co-ordinators

February 1977

APOLLO 10 VIEW OF THE EARTH

INTRODUCTION

WHAT ARE THE PROBLEMS?

For as long as we have stood on the Earth and looked outward, we have not seen the problems. Earth seemed limitless. its distant horizons called us, made us explorers, settlers, a mobile population. The vast farmlands of the American prairies and the Ukraine, the great plains of Africa, the checkerboard rice paddies of the Orient offered the promise of food for all, forever.

And then, as in Archimedes' dream, we found a place to stand on, and we did move the world. The lever was the space program, American, European and Russian. It first emphasized, and then popularized, the true situation.

Earth is not limitless. It does not stretch toward distant horizons forever beckoning. It does not have infinite acreage for food production. It does not have constant ideal weather in the temperate zones.

Earth, seen from space, is a small and beautiful blue and white sphere, looking like the swirling glass marbles we played with when we were young.

And we have played with Earth the same way, as if it were ours to play with, one of our possessions that we could gamble with, and win or lose. When we were young, we only thought of winning at marbles. Age and experience have taught us that there were also losing times.

Now we have grown, and we know that all of our games —— and the games of our children and our children's children —— may be lost unless we do something now.

But what to do? Where to start? What influence can an individual have on the pattern of the whole Earth? And what really is the problem?

The problem is, perhaps, that we don't know what *the* problem is. We know what *many* of the problems are. But we don't know which is the key one, the one which, if tackled first and solved, would act like a catalyst to speed the solution of all the others.

There probably isn't any such single problem. There are, instead, a number, all demanding immediate attention and near-term solutions with long-term effects.

To start, we could use some more systems thinking, to use an engineering term. We need more people in every walk of life, from concerned individuals through corporate executives and Government officials at all levels, who are willing to consider the broad dimensions of the problem, horizontally and vertically, and not simply single out one tiny vertical strip whose solution will return personal prestige and power.

For these problems are staggering. The Earth is running out of everything. It has to, and you must realize that. There is no infinitely renewable anything. Every day that goes by reduces the total water supply of Earth, subtracts some of its productive acreage, contaminates the air a little more, adds thousands of people who will have to compete for the bounty of Earth.

There are two easy solutions, and both are false. One is pessimism. Accept the gradual running down, call it fate, and sit on your hands to wait for the end. And be smug, because you are not going to live long enough to see the complete rundown of fuel stocks, or of grain supplies. You'll make it. But your children will have a tougher time. And your grandchildren may wish they had never been born, and they will learn to curse the generation that left them such a legacy.

The other easy solution is to be optimistic. Export some of that good old American know-how, bolster some economies here and

there with money for dams and water supplies, develop nuclear reactors to take the burden off fossil fuels, and all will be well again in the brave new world bought by science and technology.

The true solution lies between those two, and has some elements of both. It is a complex and well-hidden solution, and it will be very difficult to find, and perhaps more difficult to execute.

But we must find it, and we must follow it to a conclusion, because we have no alternative.

It reduces to this: Do we want to leave life, or death, to our children and their children?

Ask anyone that question, and the obvious answer comes right back: Life, to our children. But there is a lot of undiscovered oil, isn't there? Life, to our children. But isn't there still enormous acreage that could be used for growing food? Life, to our children. But won't agricultural technology develop new fertilizers and plant strains that will increase our food production? Life, to our children. But there are cubic miles of coal just below the surface there, and do we really need that much undeveloped land for parks anyway?

Yes, but. . . The answer always comes back that way. There is always the bright promise of some neat, new solution, some technological advance, some discovery waiting to be found, that will put everything to rights. After all, it has happened before. Coal was found as wood supplies ran low. Oil took over as coal veins were worked out. Nuclear power is the answer to the current energy crisis.

Haven't we learned yet? There is no infinitely renewable anything. Earth is finite. Its resources are limited. What can we do?

The first steps toward the solution of any problem are simple. First, define it, so that you solve the correct problem, and solve all of it. Second, study the problem to understand it, so that you don't try non-productive approaches, or half-understood steps.

When the problem is something as important and as big as the future of Earth and its people, it takes a combination of interested

forces to look for solutions. The National Aeronautics and Space Administration, and the Maryland State Department of Education, have combined to look in depth at these problems, and it is a happy conjunction.

NASA has the proven ability to stand back and see the Earth, and has been doing so for nearly two decades, studying Earth and its dynamics from the vantage point of space. In a sense, NASA has been the primary source of problem definition. Educators will have to be responsible for its understanding. Not that NASA can't understand, or that educators can't define the problems. It works out as the best use in synergistic combination of the primary assets and abilities of two groups, united in their concern for the future of our fragile home, Earth.

And so these forums, and this symposium, were evolved. Our goal is to look at the truly major problems facing future life on Earth, and to try to understand them. Then, we must work —— you and I to the limits of our strengths —— to help others to look at these problems realistically, and to understand them.

If we succeed, each of us can live out the years to come in happiness and peace. Our children will follow along the same paths, and go further. And so will their children.

And Earth will remain, blue and white and beautiful in the velvet black of space, a tiny sphere held and loved and protected by the people who call it home.

THE SYMPOSIUM SERIES

The Bicentennial Symposium Series, under the general title of *Mounting Pressures on Planet Earth,* was co-sponsored by the Maryland State Department of Education, and the National Aeronautics and Space Administration at its Goddard Space Flight Center, in Greenbelt, Maryland.

Two of the symposium sessions were held in the spring of 1976, on April 29 and May 20; two more were held in the autumn, on

September 30 and October 28. Together, they constitute a detailed look at four very fundamental questions, with one forum devoted to each.

- Can the Earth feed its people? (Forum I)
- Can the Earth provide the energy and other resources for the next generation? (Forum II)
- Can science and technology solve the Earth's problems? (Forum III)
- Can existing economic, political and value systems cope with the problems of the Earth? (Forum IV)

The concern of educators with these subjects is an obvious one; whatever the answers are to those questions, educators must transmit that information objectively to the next generation and the ones after that. But perhaps the concern of NASA is not so obvious.

From the space agency's manned and unmanned spacecraft have come millions of data points describing the behavior of Earth, its winds and tides, seas and storms, crops and forests and waters. Through its ability to stand off at a distance and look at, study and monitor the Earth, NASA has information needed by the educators.

Through this symposium series, the Maryland State Department of Education and NASA's Goddard Space Flight Center meet on common ground, seeking with our varied skills to do something about mankind's future. It is this purpose —— the improvement of the circumstances of our citizens —— which has made this joint venture a natural alliance, a partnership of researchers, who acquire knowledge, and educators, who disseminate knowledge.

FORUM I

CAN THE EARTH FEED ITS PEOPLE?

Can the Earth feed its people? That's such a simple and easy question to ask, and it begs for a yes or no answer. It has been answered both ways, by a number and variety of experts, from instant experts on the campaign trail to acknowledged experts in the science, technology, and business of agriculture. You can find almost any answer you want to hear, from a confident "Of course!" to a sepulchral "Not at all."

Clearly, there is no single answer, but, as a prologue, John Muir, the great naturalist, said it simply: Everything in nature is connected to everything else. The question then is: What is the epilogue?

Translated into today's terms, John Muir's statement says you must use a systems approach to the problems facing the world, and not simply single out one for detailed consideration. That is because one problem can't be solved in its own independent environment; its solution depends on simultaneous solution of other problems as well.

In response to the Forum I question "Can The Earth Feed Its People," the symposium speakers' answers ranged from "Yes, but ——" (Dr. W. H. Mosley), to "only if population growth is curtailed" (Dr. Quentin M. West), to "the world is being carried to the brink of ecological disaster not by a single fault, which some clever scheme can correct, but by the phalanx of powerful economic, political, and social forces ——" (Dr. Barry Commoner).

Excerpts from the talks given by the Forum I speakers follow, along with the views of a panel of experts.

POPULATION GROWTH/FOOD AND HUNGER

W. Henry Mosley

Dr. Mosley is Professor and Chairman of the Department of Population Dynamics and Director of the Population Center at the Johns Hopkins University School of Hygiene and Public Health in Baltimore, Maryland. His research interests include the dynamics of human reproduction in developing countries and the epidemiology of infectious diseases. He was Head of the Epidemiology Division of the Cholera Research Laboratory, Dacca, Bangladesh, for six years before taking his present position in 1971. His current research relates to the interaction of nutrition and disease on reproductive performance and fertility control technology in rural underdeveloped societies.

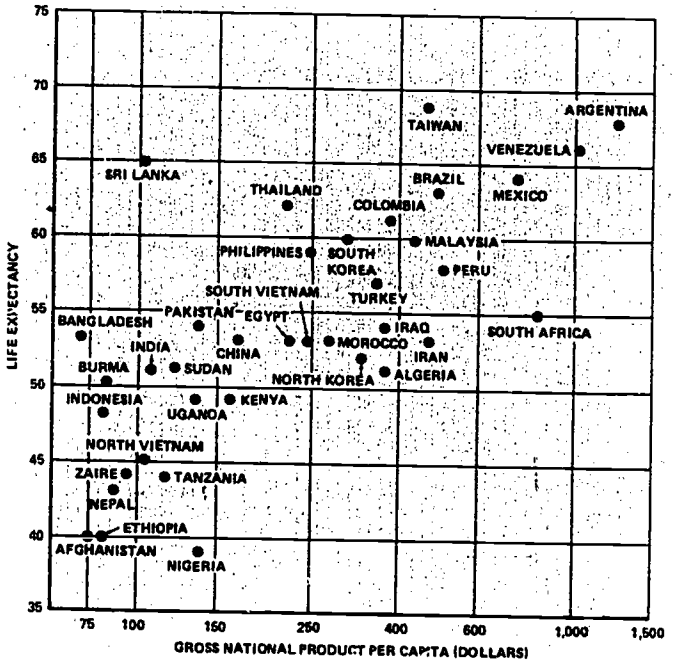
We are living in the most abnormal time in the history of mankind. The population is growing at the rate of 200,000 persons per day, or 80 million persons a year, primarily because technology and economic development have resulted in a decline in death rates unmatched by a decline in birth rates.

The gap indicates a population growth of two to three percent in most developing countries, and below one percent in developed countries. If sustained for a century, a population growth of one percent per year would increase the population by 2.7 times. At three percent, by 19 times.

The developed countries were able to pass through their rapid population growth at a relatively leisurely pace, because of technological and political circumstances. But the developing countries are unable to relieve their internal population pressures through migration, and they are further handicapped by a growing global scarcity of resources.

The cause of the improvement in life expectancy in a country as large and as poor as India, for example, has been the sustained avail-

ability of food. The famines of the 19th century have been eliminated. The availability of food is related to the level of economic development in any population; since the poor and the rich are competing at the same marketplace, the poor will eat less than the rich.



How Life Expectancy is Related to Economic Development

Further, the types of food eaten are influenced by income; meat consumption, for example, increases with increased income. Food availability also varies with social custom; in poverty-stricken areas, the adult males eat first and what is left goes to the women and children. Even then, food may not be available for energy and growth if the population is ill with diseases or infections that interfere with absorption and metabolism.

In 1970 the world food production was 2.6 million tons, about four pounds per capita per day, or about three times the requirement

for adequate nutrition. In that year, 400 million people suffered from malnutrition.

That was because not all the food was available to people; about one-third of it was eaten by another third in the form of feed to animals. The average American consumed about five pounds per day; one-half pound directly as food grain and the other four and one-half pounds as meat products, eggs and milk. In India, the average consumption is about one pound per day, 90 percent of it directly as food grain.

It is not an adequate solution for Americans to change their diet and make more grain available. Indians are already spending 90 percent of their income on food, and they simply cannot buy any more food. That marginal economic situation illustrates why an abrupt rise in food prices can lead to sharp changes in the death rates.

If famine is to be averted, population must be controlled, and that control will require societies to exert strong pressures on those social factors that control reproduction. The developing countries have taken the lead; the developed countries have been the most reactionary. It might be argued that the developed countries don't need population control policies. Consider this: Annually, the United States adds 1.3 million persons to the world population, and Bangladesh adds 1.9 million. Yet every added American is five times as much of a food problem and 500 times the energy resource drain as each added Bangladeshi.

Technology can relieve, temporarily, the food crisis, but society's view of human reproduction must be adaptive to the needs and priorities of the times.

But the problem of hunger is primarily due to poverty. A concerted effort at raising agricultural productivity within the poor countries, if approached with a focus on income distribution and equity, can be the initiating force in the simultaneous solution to the global problem of food, hunger and population. The key is a parallel commitment to this effort in the developed world.

THE GAP BETWEEN AGRICULTURAL TECHNOLOGY AND THE DEMAND FOR FOOD

Quentin M. West

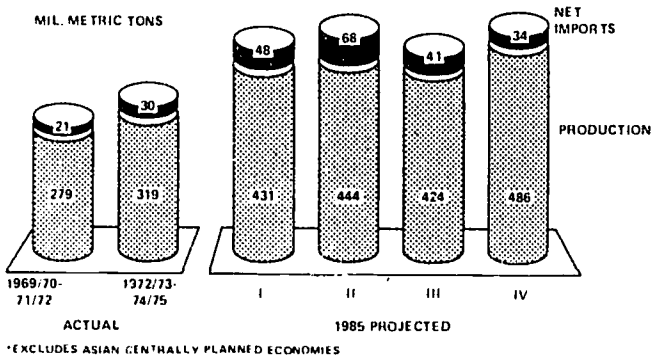
Dr. West is the Administrator of the Economic Research Service of the United States Department of Agriculture, and is closely involved in world food problems. He represented the United States at the World Food Conference in November of 1975. His agency recently published a major study, "The World Food Situation and Prospects to 1985." He is chairman of the Agricultural Committees of the Joint Commissions for Economic Cooperation for Iran, Saudi Arabia, and Egypt, and is a member of the Joint Committee for US/USSR Agriculture Agreement. Prior to coming to USDA, he served as land use economist with the Organization of the American States in Costa Rica and Peru.

In the long run, the Earth can feed its people at a satisfactory level only if population growth is curtailed. Efforts to increase food production only buy time for population adjustments to be made.

The central food problem facing the world is the growing gap between food production and demand in the developing countries. At current population and food production growth rates, the developing countries face increases in their food import deficits through the remainder of the century. That deficit could reach 48 million tons of cereals by 1985, or less if the economic growth were slower. But it could increase to 68 million tons if economies accelerate and stimulate the demand for grain-fed livestock. Current net imports of grain by the developing countries average about 30 million tons per year.

At current grain export prices, it would cost more than $10 billion annually to finance the 68-million ton deficit mentioned. There is doubt that the developing countries could finance that level of imports from increased export earnings alone.

The reduction of potential food-import deficits in developing countries must come through some combination of major increases in the rate of growth in food production within those countries, and reduced rates of population growth.



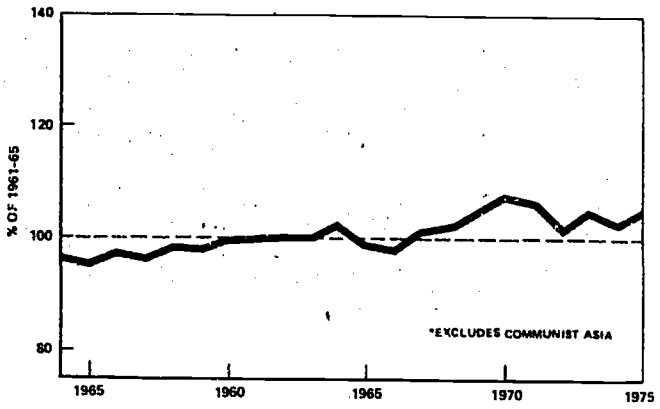
Grain Production and Demand in the Less Developed Countries*

There is a large potential for increased food production, partly from cultivating additional acreage, and partly from yield-increasing inputs and production technologies. Recent increased grain yields in developing countries have followed the adoption of high-yield varieties of grain and associated inputs, including fertilizer, insecticides, pesticides, water control and improved farm management.

But the developing countries which have adopted these elements have, as yet, obtained only a fraction of the possible benefits. Inappropriate farm size, lack of credit, and inhibiting tenure patterns have stopped some farmers. Uncertainty and risk with respect to both economic and agronomic factors have stopped others.

To exploit the potential of new technology requires a commitment from developing nations to increase agricultural productivity, including reassessment of food, agricultural and economic policies. Recent developments also have raised policy issues for developed countries. For example, the days of large U.S. stockpiles are gone.

Prices of farm products in the U.S. are moving in line with price changes in the world. U.S. farmers and consumers can expec greater swings in domestic prices, and this instability will increase as weather conditions around the world change from year to year.

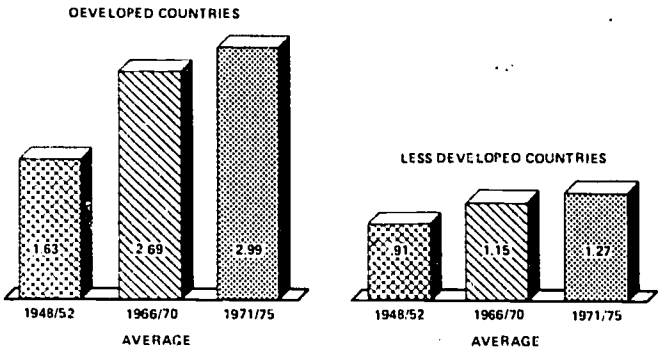


Food Production Per Capita for the Less Developed Countries*

Establishing food and fiber reserves could be used to reduce price uncertainty, to stimulate production, and to provide a warehouse of food for times of acute shortages. However, U.S. government stocks alone are not the answer; significant buildups would operate to drive down farm prices and discourage other nations from stockpiling. Perhaps serious consideration should be given to incentives to private business to carry stocks.

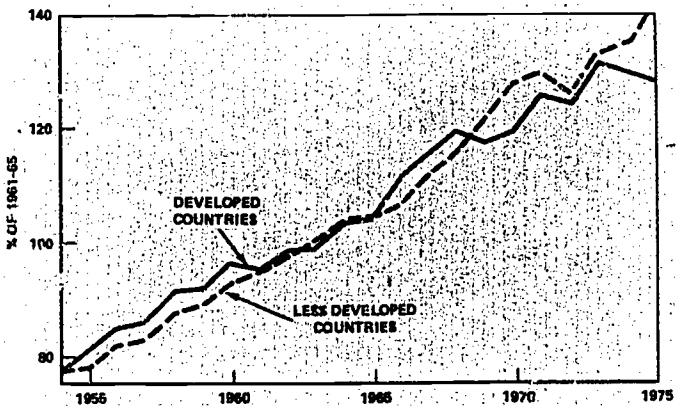
Policymakers are examining food aid closely. Public Law 480 food programs for developing countries have been scaled down significantly recently. Farm export price rises, shrinkage in export supplies, and domestic demand left no other choice. But the U.S. still has a commitment to filling the food gap of the poorer nations.

Over the past several decades, food production in the developing countries advanced as fast as in the developed countries. But the poorer nations did it by bringing new land into production, and their



Grain Yields (Metric Tons Per Hectare) for Developed Countries Compared With the Production by Less Developed Countries

population growth ate up most of the gains. Their per capita food output rose at an annual rate of only 0.4 percent, and their crop yields are well under those of the industrialized world.



Growth in Food Production by Developed Countries and by Less Developed Countries 1954 - 1975

The developed countries can make a crucial contribution to the development, transfer and adaptation of new and existing technologies to the developing countries. This will require a greater flow of investments, both within developing countries and from the developed ones.

MOUNTING PRESSURES ON PLANET EARTH

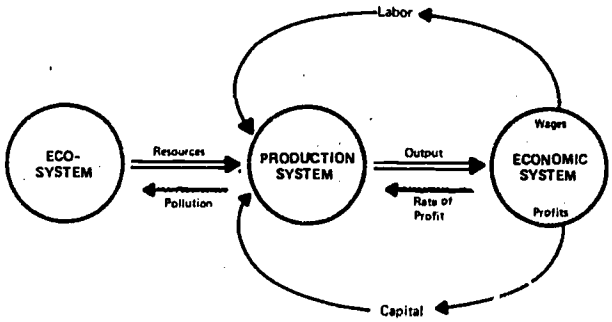
Barry Commoner

Dr. Commoner is Director of the Center for the Biology of Natural Systems at Washington University in St. Louis, Missouri. His current research deals with the origins and significance of the environmental and energy crises, especially in relation to transformations of production technology, and their economic consequences. He is also researching the development of strategies to reduce the vulnerability of United States agriculture to disruptions from energy shortages and price increases. Dr. Commoner received the Phi Beta Kappa Award in 1972 and the International Prize for Safeguarding the Environment in 1973 for his book, The Closing Circle.

Our assaults on the ecosystem are so powerful, so numerous, so finely interconnected, that although the damage they do is clear, it is very difficult to discover how it was done. By which weapon? In whose hand? Are we driving the ecosphere to destruction simply by our growing numbers? By the greedy accumulation of wealth? Or are the machines which we have built to gain this wealth at fault?

The world is being carried to the brink of ecological disaster not by a singular fault, which some clever scheme can correct, but by the phalanx of powerful economic, political and social forces that constitute the march of history. Anyone who proposes to cure the environmental crisis undertakes thereby to change the course of history.

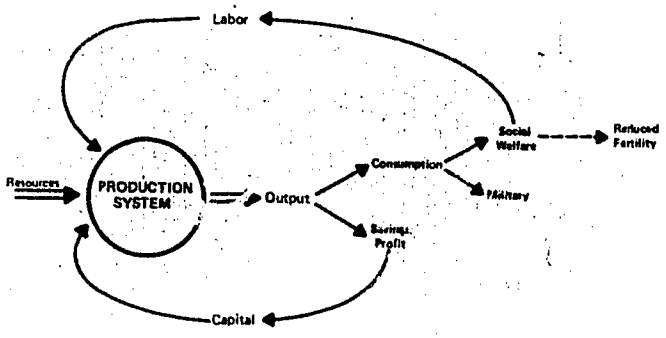
All the resources that support human life and activities are derived from the global ecosystem —— the dynamic network of processes in the planet's thin skin of air, water and soil —— and from the mineral deposits that lie beneath it. These resources are finite, and the ecological cycles that produce them are finite. The natural ecological cycles are self-limited, so that the pressures on the Earth's resources arise only from human activities —— chiefly the production of the numerous goods and services that support human societies —— and from the consequent growth of the human population.



Dependencies Between the Ecosystem, the Production System and the Economic System

The basic dependencies are clear: The production system depends on the ecosystem for its resources; the economic system depends on the output of the production system for the wealth which it manipulates. In any logical arrangement, the design of the production system should be governed by the requirements of the ecosystem; for example, resources should be renewable, and production processes should not interfere with the essential ecological cycles. In actual fact, the governing influence largely operates in reverse: The design of the production system is often incompatible with the environment or with efficient use of energy and other resources and, as a result, it has a powerful influence on the ecosystem —— by polluting it. And what usually governs the design of the production system are economic considerations.

What can bring these processes into balance? Extensive evidence shows that populations tend to reduce their fertility, and to approach balance, when they reach a certain level of material welfare, achieved in social circumstances that foster expectations of a secure future. If this process is to occur in developing countries, then these countries must achieve the necessary level of social welfare. In turn, this depends on how the economic system governs the use of the production system's output. The output is divided between capital and consumption, which may, in turn, be devoted either to military expenditures or to expenditures which improve social welfare. An economic system which directs consumed wealth toward social welfare rather than to military expenditures, and total output more into consumption than capital, will optimize this goal. This means that the production system must be designed to maximize the productivity of capital rather than of labor; it should be labor-intensive, therefore.

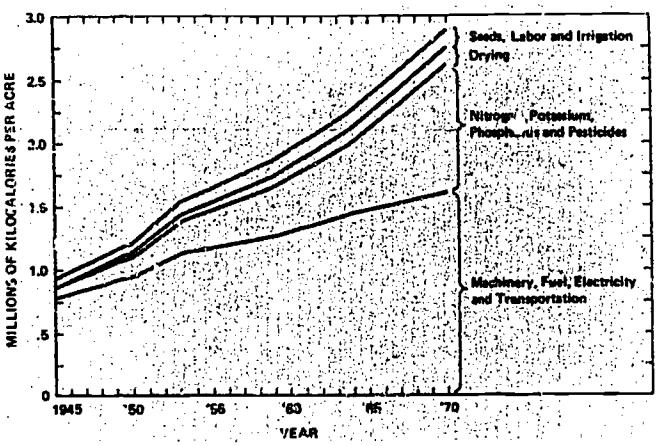


How the Economic System Governs the Use of the Production System's Output

While the global growth of population is concentrated in developing countries, the global growth of production —— and the resulting demand for resources —— is concentrated in industrialized countries. If the performance of such a production system is measured by its socially useful output, then its pressure on the available resources will depend not only on the size of this output, but

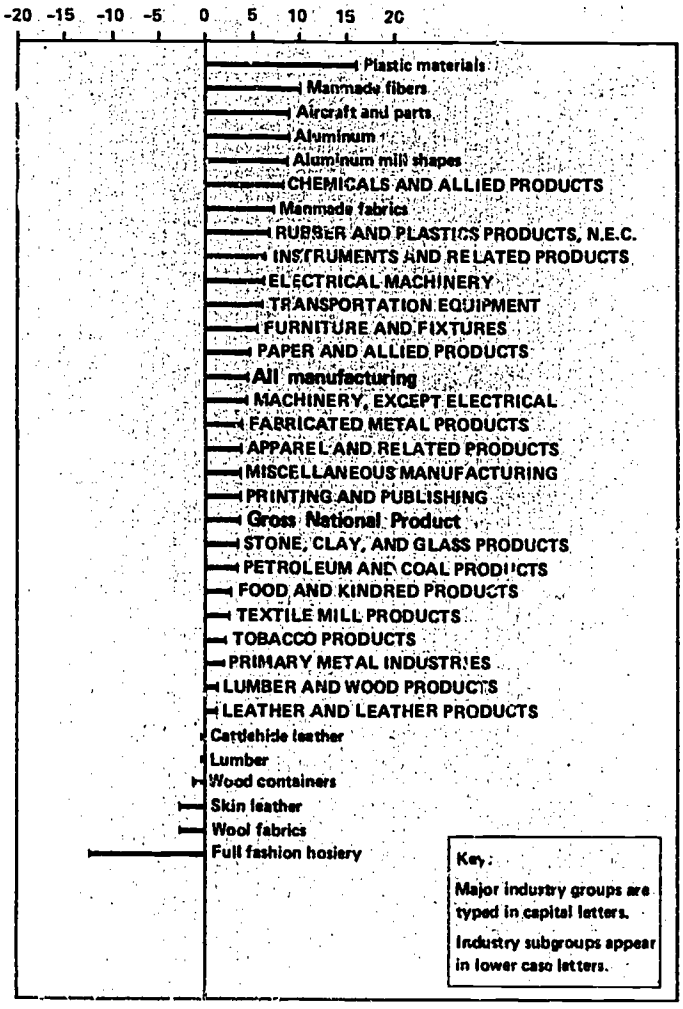
also on the efficiency with which the resources are converted into output. Of particular importance is the productivity of energy, the resource common to all production processes, and most limited in its supply. The productivity of capital and of labor also is relevant.

Sweeping changes in the U.S. production system since World War II have greatly altered the productivities of energy, capital and labor. In agriculture, inputs which depend on solar energy (such as biological nitrogen fixation) have been displaced by those which depend on fossil fuels (such as inorganic nitrogen fertilizer). These changes and the intensified use of machinery have increased the productivity of labor, but have reduced that of energy and capital. In manufacturing, natural products have been displaced by synthetics, sharply reducing the productivity of energy and capital, and increasing the productivity of labor. Similar changes have occurred in transportation.



Energy Inputs in Corn Production, 1945 – 1970

Source: Pimentel *et al.*, "Food Production and the Energy Crisis," in *Science*, vol. 182 (1973), p. 443. Cited as reprinted in P. H. Abelson, ed.: *Energy: Use, Conservation and Supply* (Washington, D.C.: American Association for the Advancement of Science: 1974) p. 41



Average Annual Growth Rates of Federal Reserve Production Indexes for Industries (1948–1969)

Source: *Long-term Economic Growth, 1860–1970,* U.S. Bureau of Economic Analysis (Washington, D.C.: U.S. Government Printing Office: 1973)

Thus, the present design of the U.S. production system results in an excessive drain on energy and capital relative to the amount of resultant output. It is notably efficient only in its use of labor. For these reasons, the U.S. production system is poorly designed to serve either the purposes of developing countries, which have labor to spare, or the need to relieve the pressure on global resources.

Nearly all of the numerous decisions which have altered the design of the U.S. production system since World War II have been governed by the single factor which dominates the behavior of the U.S. economic system: The effort to maximize profits, rather than social use-value. This is the operative fault, and therefore the locus of the remedy. To relieve the heavy pressures on the Earth's limited resources, and promote the natural self-limitation of the world population, we must confront the momentous task of creating systems of production that yield goods which are designed, not for private profit, but for social value, and systems of economics that are devoted to this purpose.

PANEL DISCUSSION – CAN THE EARTH FEED ITS PEOPLE?

MODERATOR

Walter J. Bogan, Jr.

Walter J. Bogan, Jr., is Director of the Office of Environmental Education at the U.S. Office of Education. He has also served as Director of the Division of Educational Technology and Environmental Education at U.S.O.E., Executive Director of the Scientists' Institute for Public Information, and consultant for an adult education environmental film series. He also participated in the Federal Power Commission Task Force on Energy Systems Research, the U.S. National Commission for UNESCO, the Conservation Foundation, and the American Association for the Advancement of Science Commission on Secondary School Science Education.

In the format of this symposium session, the first two speakers were followed by a panel discussion that included them, three specialists in the same fields, and Walter J. Bogan, Jr., who was the moderator for the Forum and the leader of the panel discussion. The specialists at Forum I were Dr. Benjamin Daniel White, Assistant Secretary for Health of the Maryland State Department of Health and Mental Hygiene; Honorable Young D. Hance, Secretary of the Maryland State Department of Agriculture; and Dr. Gordon M. Cairns, Dean of the College of Agriculture of the University of Maryland at College Park.

The panel began with statements by each panelist either extending or arguing with the views presented in the first two talks. After brief discussions of opinion whether or not it really was wasteful to feed food stocks to animals, Dr. West pointed out that right now the only U.S. grain reserve is corn for livestock. In a real drought, he said, we would have no time to grow wheat, and so we would consume more animal food, thereby eating our only reserve of grain as well.

Dr. White expressed some disappointment that the environmental component had been missing from both speakers' presentations. As an example, he cited the presence of Kepone in the James River and its threat to the $90-million seafood industry in Maryland. "You can't divorce environmental protection from food production," he said.

But the question is, can the Earth feed its people, Mr. Bogan reminded the panel. And these were the answers:

"It depends on incentives to food producers." —— ***Hance***

"'Can' is a technical problem; 'will' is crucial and involves a political issue." —— ***Mosley***

"It is an economic issue; the cost per acre of production is tremendous." —— ***Cairns***

"Mosley sums up my feelings. But it would help if we could untangle the bureaucratic process." —— ***White***

"We'll be no worse off until the end of this century, but there will be a greater disparity between the rich and the poor, and there will be a lot of hungry people. Over the next decade, there will be more years of surplus than of food deficits." —— ***West***

CAN THE EARTH FEED ITS PEOPLE? – SUMMARY

Can the Earth feed its people? That was the question posed at Forum I of the Bicentennial Symposium Series. The answer was generally a common, "Yes, but. . ."

Population control was one of the qualifications. Social, political, and economic changes were others.

"Yes, but. . ." is an answer, and yet it may be no answer at all. For it implies that things have to be done which are different from what we now do. Pursue that point, and you discover that it may require you —— you, personally —— to change your lifestyle. You might have to cut down on your consumption of meat and eggs and milk, not to the point of malnutrition, but to the point of nutrition without waste. You might have to give up one of the two cars in the garage. You might have to take a plane to your vacation site, instead of piling the family into the car or recreation vehicle.

Can you do that? Yes, you can. Will you do it?

That is the question. And that is the answer.

FORUM II

CAN THE EARTH PROVIDE THE ENERGY AND OTHER RESOURCES FOR THE NEXT GENERATION?

The Earth is running out of resources. That statement generally is accepted as factual. And to a serious degree, it is fact. But look deeply into what resources really are. Then you might believe that the world is not running resources out to a vanishing point, but that it needs to adapt to a new set of constraints on the use or the exploitation of those resources.

For example, the Earth will not run out of solar energy until the Sun itself, and our solar system, is hanging on the edge of extinction. There probably will be water for those millions of years, also, although it may become "too thick to drink and too thin to plow."

But with finite amounts of most resources, and multiple uses and populations competing for their energies, the problem does threaten to get worse before it gets any better.

Some probable solutions were presented by the speakers at this Forum. Dr. M. King Hubbert is somewhat optimistic. He believes, basically, that we will naturally —— and, with luck, not catastrophically —— arrive at a stable period of long-term non-growth with the implication that mankind will lean more toward natural ecosystems than toward synthetic ones. Dr. William E. Cooper feels it should still be possible to establish a system for the achievement of personal goals. But it will take some doing, and some acceptance of "less-than-now" by future generations. The final speaker, Dr. Charles J. Hitch, points out that we cannot escape nature's limits, and more and more people are grasping both the challenge and the beauty of that truth, and with that understanding there is hope.

Excerpts of these Forum II talks follow, along with the summary views of a panel of experts.

OUR EVOLVING ENERGY ECONOMY

M. King Hubbert

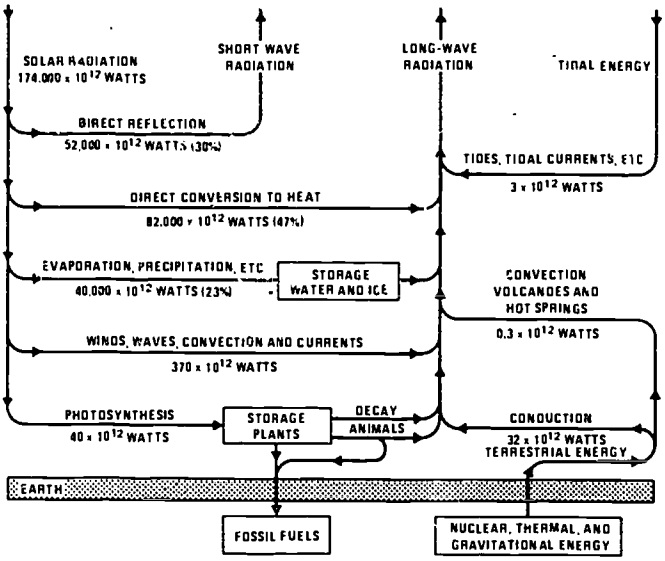
Dr. Hubbert is a research geophysicist with the United States Geological Survey. He has served as Research Geophysicist, Associate Director for Exploration and Production, and Chief Geology Consultant for Shell Oil and Shell Development Companies in Houston, Texas. His research interests include: geophysical exploration for petroleum and other minerals, the mechanics of geologic structures, the physics of underground fluids, and the significance of earth's mineral resources in human affairs. Dr. Hubbert is the author of more than 70 journal articles and two books on ground water, structural geology and energy resources.

In 1776 we were thirteen British colonies of 2.6 million people, extending thinly along the Atlantic seaboard from present-day Maine to Georgia. We subsisted upon agriculture, fisheries, marine trade, and handicraft industries. Our energy sources were human and animal food, firewood, and small installations of water power and wind power for windmills and sailing vessels.

Subsequently, we have spread geographically from the Atlantic to the Pacific coast, and into Hawaii and Alaska. Our population has increased 86-fold to approximately 222 million in 1976. During the same period, there was developed the steam engine, the internal combustion engine, and the generation and distribution of electrical power. We now are witnessing the initial stages of power production from the atomic nucleus, from the geothermal energy of volcanic steam, and from the Sun.

For two hundred years our society has been immersed in continuous growth, usually increase. We have come to regard this growth as being the normal order of things and capable of being continued indefinitely. Our social institutions, our system of finance, our legal system, and our most cherished folkways and beliefs are all based

upon the premise of the desirability and possibility of sustained growth. We have evolved an exponential-growth culture, with the word *growth* itself one of the most sacred shibboleths in our vocabulary.



The Energy Flow Sheet for the Earth

The energy sources upon which the world's industrialization has been built are the fossil fuels, coal and petroleum. The world's supply of those fuels has required several hundred million years to be accumulated by geological processes; the time required for their exhaustion by human activity is but a few centuries.

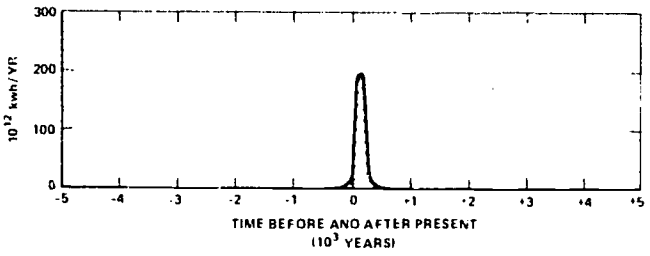
Coal mining as a continuous enterprise began near Newcastle-upon-Tyne in northeast England about nine centuries ago. However, the coal mined since 1940 exceeds somewhat all the coal mined during the preceding nine centuries.

Petroleum, including both liquids and natural gas, accounts for more than half of the world's current consumption of industrial

energy. World production of oil as a continuous enterprise began in Romania as recently as 1857, and in the United States in 1859. The ultimate amount of crude oil to be produced in the world is now estimated to be about 1,800 to 2,000 billion U.S. barrels. The time required to consume the middle 80 percent of the world's oil will be only about the 56-year period from 1967 to 2023 —— less than a human lifetime.

For the United States, the peak rate of crude-oil production occurred in 1970, and the time required to consume the middle 80 percent will be approximately the 67-year period from 1933 to 2000 A.D. A child born in the 1930s will see the United States consume most of its oil during his lifetime.

Consider a time span from 5,000 years ago to 5,000 years in the future. On such a scale the entire epoch of the fossil fuels is represented by a spike near the middle of this range, with a time span of only about three centuries. Yet, brief as this period is, the exploitation of fossil fuels has been principally responsible for the rise of the present industrial civilization, and has exercised the greatest influence ever experienced by the world's human population during its entire existence.



The Epoch of the Fossil Fuels in Human History

The growth that we have experienced during the last two centuries is the most abnormal development in human history. The last 200 years and the immediate future is a period of transients and

of rapid change of only about three centuries duration between a past and a future characterized by very slow rates of change.

We are now entering a transition from a period of nearly uniform exponential growth to a period essentially of non-growth. This poses no insuperable biological or technological problems; but it does confront us with not so much an energy crisis as a cultural crisis. A culture based upon exponential growth must inevitably undergo a fundamental alteration to adapt itself stably to a state of non-growth. How to make such a transition by a non-catastrophic progression is perhaps the foremost problem confronting mankind today.

STRESSES ON OUR AIR, LAND AND WATER RESOURCES

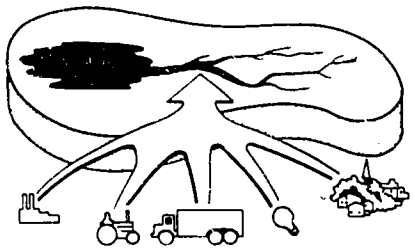
William E. Cooper

Dr. Cooper is Professor of Zoology at Michigan State University and Co-Director of the Design and Management of the Environmental Systems Project, sponsored by the RANN Section of the National Science Foundation. His research interests include the application of ecological concepts to planning, urban ecosystem dynamics, pest control management systems, and the dynamics and structure of freshwater animal communities. Dr. Cooper is Chairman of the Governor's Environmental Review Board for the State of Michigan, Member of Meridian Township Planning Commission, and Lecturer for the Brookings Institution in Washington, D.C.

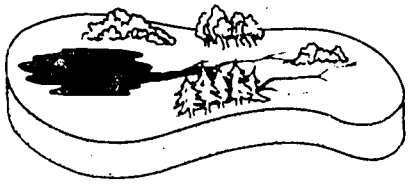
The value of natural resources to human societies is generally expressed as opportunities to benefit from their utilization now or in the future. Fulfillment of these expectations requires matching the goals with the resource constraints imposed by the nature of the man-environment system.

Ecological systems have evolved as systems whose criteria of success are oriented toward survival, with physical features dominant over individual expectations.

To allow individuals the opportunity to seek fulfillment of personal goals, one must augment resources to match the goal constraints through the engineered substitution of synthetic materials, energy or information in the form of technological development. The rapid growth in economic development since the 1940s has been associated with the development and expansion of the synthetic chemical industries. Anticipated resource limitations have been relaxed through the substitution of man-made alternatives.



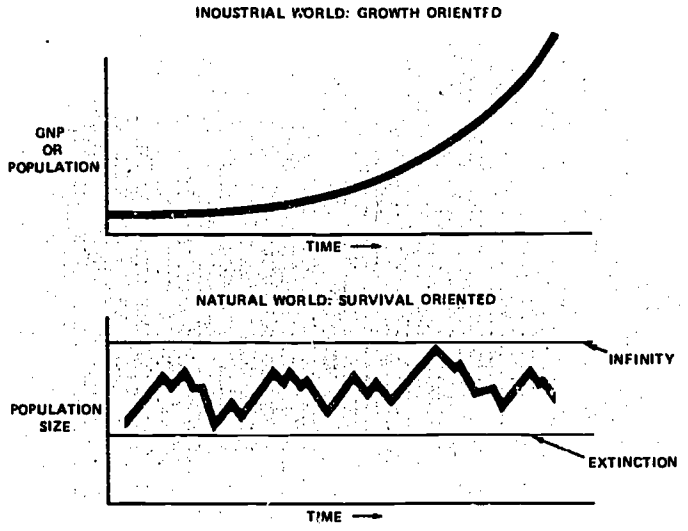
NATURALLY DESIGNED COMPONENTS



The world system is a complex system, naturally designed components have resulted from millions of years of evolution; they are in balance and successful. The industrialized system of recent development has been superimposed upon the natural system; its components use up energy and other resources.

A similar pattern of dependency exists with energy. Since energy is utilized primarily to pump chemicals through our man-made ecosystem, there are inescapable thermodynamic implications to the trend of increasing populations and increasing per capita consumption.

Future scenarios impose demands for ever increasing inputs of new information in the form of new technology. To continue to postpone the social constraints of resource limitations, one strategy has been suggested: Continue to decrease the energy and material requirements of individuals by substituting information in the form of more efficient technologies. There is no limit to growth in this resource dimension, but one cannot live on a diet of information.



The industrial world and the natural world have entirely different goals; the former is growth-oriented, the latter is survival-oriented.

In order to understand the natural limitations which the laws of thermodynamics and evolution impose, one must scrutinize the assumptions associated with synthetic ecosystems engineered to fulfill human expectations. The most critical is that energy and water are abundant and cheap. Not so; the validity of alternative futures depends to a great degree on the availability and energetic price of these two items.

The assumption of the availability of technological fixes for emerging problems depends on the resources committed to research and development. The only adequate buffer to the uncertainty of future problems is to develop and maintain a disproportionately large amount of our resources in scientific occupations.

The final assumption is that synthetic materials and energy are manageable. But it has become increasingly obvious that the problems of safe handling of the residuals from the synthetic material and energy industries are creating a major threat to the health and welfare of both the natural and the human ecosystems.

So societies may become increasingly dependent on natural, ecological resources. There are very significant changes in a society which attempts to exist by ecological principles. The dominant characteristics are:

Diseconomies of scale. The basic design concept in most physical systems is that the cost per unit output decreases as the size of the operation increases. But if one includes a biological component, the processing efficiency is just the opposite. Biological systems are most efficient at low rates of material processing.

Controllability of the system. It is essential that societies design and operate adequate control strategies. But biological systems are inherently difficult to control. The only feasible recourse now is to decentralize and replicate critical processes, so that one is not unduly dependent on failsafe controls.

Regionality of constraints. Ecological systems adapt to the physical characteristics of a region. The natural limitations of maintaining an urbanized existence in a tropical rain forest or a desert environment are fundamentally different. The energy, material, and technological maintenance costs per person will vary tremendously depending on the type of resident ecosystem.

Spatial specificity of opportunity. A most radical change in human lifestyles would result if consumption patterns reflected the production opportunities of the natural processes existing in any given ecosystem.

Preservation of genetic information. If society seriously considers living off natural resource production and reprocessing capabilities, the concept of wealth will shift from a predominantly monetary metric to one of genetic diversity.

Even if one attempts to evolve ecologically-determined engineered alternatives, the basic constraints of thermodynamics and evolutionary laws will continue to confront human societies. As long as we continue to grow with materials and energies confined in a closed system, the solutions to future uncertainties will continue to plague us.

WILL THE NEXT GENERATION HAVE ENOUGH ENERGY AND OTHER RESOURCES?

Charles J. Hitch

Dr. Hitch is President of Resources for the Future —— a non-profit institution devoted to research and education in the conservation, development, and use of natural resources, and the improvement of environmental quality. From 1968 to 1975 he served as President of the nine-campus University of California. He has been Assistant Secretary of Defense; Head of the Economics Division and Chairman of the Research Council of the Rand Corporation; and a Fellow in Economics, Queens College, Oxford. Dr. Hitch is Chairman of the General Advisory Committee to the Energy Research and Development Administration.

The 19th century classical economists —— Malthus, Ricardo, John Stuart Mill —— looked out on a world of finite resources and expanding population and predicted a future of diminishing returns, stagnation, and decreasing levels of social welfare. Given their world, their predictions were understandable.

Of course, change confounded their portrait of things to come. Wherever nations have had economic and educational systems which have permitted technological advances, both industrial and agricultural productivity have increased steadily and dramatically despite the pressure of a rapidly growing population.

There is, however, a very large "if" in this generally rosy view of the future: Energy. These are the bare facts behind the coming energy crisis:

Oil and gas reserves are finite and will be sufficient for only a few more decades.

Coal supplies are more plentiful, but extraction and use present long-term difficulties.

Nuclear fission has several serious present and future problems associated with it; nuclear fusion may not work at all.

The so-called exotic sources —— geothermal, wind, ocean thermal gradient, etc. —— do not appear to offer a potential supply in keeping with projected demand.

A ray of hope comes from solar energy. It cannot solve all of our problems, but it can make sizable inroads on part of the problem, starting now. One fourth of all our energy use is for keeping people warm, and a large portion of this requirement can be met by solar energy.

Why is the energy problem so tough? Besides the scientific and technological obstacles, conflicting values are perhaps the fundamental reason for our lack of progress so far. We want to live well now, which means affordable gasoline prices and unspectacular utility bills.

Higher prices to stimulate discovery and spur conservation? We also want to dampen inflation.

How about developing hydroelectric power? A worthy goal, but it runs headlong into the movement to preserve wild and scenic rivers. Almost every possible energy source would degrade the environment in some way.

There are social problems —— political, economic, subjective problems —— and they will have to be solved, if at all, through the evolution of public opinion and the arrival at some kind of consensus.

There are institutional problems. One of the most serious is how to achieve the kind of government-industry cooperation which is necessary to tap the great research and development resources of private industry.

Cooperation is an attractive concept, but there are more than a couple of thorny problems concealed in the word. Many of the most resourceful companies want no part of government R&D partly

because they fear that the government will end up with the patents on innovations that industry originates and develops.

What is to be done about industries which are notoriously not research- or innovation-minded? Perversely, these include some of the most relevant industries: Automobile, coal, and railroads.

How is an industry created where none exists? A case in point is that of synthetic fuels. A modest proposal which would provide the equivalent of 350,000 barrels of oil a day, using a wide range of off-the-shelf technologies, is stuck in Congress, blocked by a combination of strange political bedfellows. The liberals don't want to support even the appearance of a bonanza to the oil companies, and the conservatives are alarmed by the prospect of government interference with the free market.

During a Resources for the Future Forum on Conservation held almost two decades ago, Luther Gulick, president of the Institute of Public Administration, said: "The shortage mankind needs to guard against is not the exhaustion of the limited resources on this small planet. The shortage to fear is the lack of brains, character, spirit, leadership, and political competence."

That was 18 years ago. Do you think we have learned anything? Thoroughgoing changes in attitude take time, and perhaps the amazing thing is how far many persons have come in so short a time. We cannot escape nature's limits, and more and more people are grasping both the challenge and the beauty of that truth. For we are an inextricable part of the whole; we may dominate, but our dominion is limited and decidedly not self-sufficient. Indeed, we are parasites.

PANEL DISCUSSION – ARE THERE SHORTAGES IN MARYLAND'S FUTURE?

The panel discussion focussed specifically on the question of shortages in Maryland's energy future. For that reason, all four panelists were from Maryland government and education.

Moderated again by Walter J. Bogan, Jr., the panel for Forum II included: Dr. John Cumberland, Professor of Economics at the University of Maryland; Spencer Ellis, Assistant Secretary of the Maryland Department of Natural Resources; William Sakowski, Energy Policy Analyst with the Maryland Energy Policy Office, and Dr. Peter Wagner, Director of the Center for Environmental and Estuarine Studies, University of Maryland.

These were some of the salient points from the panel discussion:

"Economists are not generally concerned with the runout of resources. The price system is a way of coping with temporary shortages; substitution and technological change help to deal with the longer-term problem. But some things are just not so well managed by the price system, and that's one reason we see taxes on pollution, for example, as one remedy to one specific problem." —— *Cumberland.*

"Decisions now are at best educated guesses. We are short right now of energy in Maryland; it is an energy-dependent state. All our oil is imported; we pipe in a small amount of natural gas, way under our requirement. We have two hydroelectric plants, no geothermal plants, no wind systems, and an unknown nuclear power potential.

"One of the constructive things we are doing is the recycling of solid wastes. We will soon have a plant on line in Baltimore, producing about 1,000 tons per day as useful fuel for other purposes. That could meet eight percent of our fuel demand by 1980." —— *Ellis.*

"We use the price system in Maryland with the primary goal of conservation. A utility surcharge is used for research and develop-

ment on energy systems. Pollution and emission charges would be useful if we could do that. And I think we should be subsidizing solar energy." -- *Cumberland.*

"The surcharge seems like one way out. It's a quarter of a mill per kilowatt-hour, and it probably means 30 cents to 40 cents on the average consumer's power bill. It is currently producing about $5 to $7 million per year for assessing the environmental impact of electrical power plants in the state." -- *Wagner.*

"You have to remember that these individual energy savings are small; but they add to a big total." -- *Sakowski.*

So once again, the problem has been seen to require approaches from a number of avenues, doing a little here and a little there: a tax on pollution, a surcharge for uncontrolled emissions, a little extra on the light bill to study environmental effects. These are the kinds of solution which can be imposed by legislation.

But the solutions that must be self-imposed by social change due to awareness are more difficult.

CAN THE EARTH PROVIDE THE ENERGY AND OTHER RESOURCES FOR THE NEXT GENERATION? – SUMMARY

Yes, as Charles Hitch stated, we are parasites! Parasite is a word with an ugly connotation. But, perhaps, it is an accurate description, and maybe that is one reason it is so hard for people to accept the true relationship of humans to Earth.

We are living off the Earth's bounty, and there are too many of us. We are consuming that bounty too fast, and searching for more, always more.

In our quest for more energy, we can so thoroughly deplete -- and pollute -- the Earth that we will seriously degrade the lifestyles of generations to come.

Those generations include our children and the generations of their children. Have we the right to leave them such a shabby heritage? Dare we leave them a battered Earth, its surface scarred with strip mines, its atmosphere stinking with smog, its waterways fouled with oil spills its beaches buried in human waste?

Is more energy now worth that price? Will our descendants admire us for having owned two cars? Or will they have contempt for our stupidity? Will they applaud our leisurely life around a heated swimming pool, or will they not have enough water to drink, let alone to swim in? Will they look by candlelight at pictures of our all-electric homes, with gleaming and colorful appliances to wash, dry, mix, cook, bake, roast, blend, slice and open?

It is, finally, a very human question that reaches to the heart of the problem: Can I do this to my children?

Yes, I can.

Will I do this to my children?

FORUM III

CAN SCIENCE AND TECHNOLOGY SOLVE THE EARTH'S PROBLEMS?

Can science and technology solve the Earth's problems? *Or are they the problems, rather than the solutions?*

These questions face squarely one of the major human conflicts of the past decade. That conflict has been so polarized that science and technology are often seen as on one side, with humanism on the other.

But that is the view from the extremes, and it is, of course, not altogether true. There is an increasing number of scientists and engineers who not only believe in humanism, but practice it. And there are some humanists whose suggested solutions to problems are coldly mechanistic.

Two of the Forum III speakers -- Dr. Eugene B. Skolnikoff and Dr. Henry Margenau -- answered the question with a negative. The third speaker, Dr. Leonard Hayflick, suggested that there was at least one problem area where science might be able to do something. But he then turned the question right back: Should science intervene in this area?

Their three presentations are summarized below, and are followed by a report of the panel discussion that was a feature of Forum III.

NEW WRINKLES ON OLD AGE

Leonard Hayflick

Dr. Hayflick joined the Medical School of Stanford University in 1968 as Professor of Medical Microbiology. He received his B.A., M.S. and Ph.D. degrees from the University of Pennsylvania, where he studied cell biology and microbiology. His specialties include the cell biology of human aging, cancer research, and the study of the smallest free-living micro-organisms, the mycoplasmas. He was the first to isolate and identify a mycoplasma as the cause of a type of human pneumonia. He has published over 125 scientific articles and books.

The processes of aging are responsible for the only affliction to which all of us are destined to succumb. Yet the fundamental causes of biological aging are almost as much a mystery today as they have ever been. Despite the universality of the problem, it has occupied, and does occupy, the attention of very few scientists.

For the first time in history, significant numbers of people alive today are already aged by usual standards, but can anticipate at least another decade or more of life. Through advancements in medical care and hygiene, industrial societies have produced a large new group of aged individuals. But the same culture which created them has not learned how to incorporate them effectively into the social structure.

Since 1900 the percentage of the population aged 65 and over in this country has more than doubled (from 4.1 percent in 1900 to 9.9 percent in 1970); the actual number has increased more than six-fold (from three to 20 million). The 65-and-over population constitutes the fastest growing age group in the country. A child born in 1900 could then expect to live an average of 48 years. A child born in 1974 now can expect to live an average of 22 years longer, to 70 years old, primarily because of reduced death rates for children and young adults. While the entire population 65 years old and over will

rise 43 percent (to 29 million) between 1970 and 2000, persons 75 to 84 will increase by 65 percent and those 85 and over by 52 percent.

These impressive figures have often been erroneously interpreted to mean that the human life span is increasing. But as far as can be determined, human life span has not changed in recorded history. What has changed is life expectancy, that is, the number of people able to reach what appears to be the fixed, immutable end point. With improvements in medical care and hygienic conditions, more of the younger members of our population are living longer, but the endpoint (life span) has remained fixed. The human lifespan, therefore, will not be significantly changed until the underlying, non-disease-related biological causes of aging are either slowed or stopped.

If the two leading causes of death in this country -- heart disease and stroke -- were eliminated, approximately 18 years of additional life could be expected. If the third greatest cause of death -- cancer -- were eliminated, about two years of additional life expectancy would result.

These concepts have forced gerontologists to conclude that the disease-oriented approach to medical research will do little to increase the human life span. The fundamental causes of death are not diseases, but are the age-associated physiological decrements that make their occurrence more likely. Only research into this area can lead us to influence materially the human life span.

If the control of aging is dependent upon an understanding of the basic biological processes, one profoundly important question arises: How desirable is it to be able to manipulate our biological clocks? The answer is not simple. Many different biological resolutions can be suggested, but each has an important potential side effect. If we were able to learn how to tamper with our biological clocks, at what time would one choose to reset his own clock? Surely one wouldn't choose to spend an additional ten years suffering the infirmities of old age. Yet that might, initially, be the only way to

intervene. We are presently hard put to deal with a maximum life span of 80 years, to say nothing of the further social, economic, and political dislocations that might occur if we added another decade to this figure.

Another consideration of clock tampering is the prospect of spending more years at a particular stage of our lives. Your clock might be made to stall for ten years at a chronological age of 20. Is this desirable? Each of us, after pondering this question, would likely agree that the time at which we would like our biological clocks arrested should correspond to those years in which maximum life-satisfaction and productivity occurred. Yet this is a decision one can only make retrospectively.

Of major importance in any such decision is whether the quantity of life is more important than its quality.

Finally, the finiteness of the human life span may be more desirable than the plethora of problems that could arise by significantly extending it.

SCIENCE AND TECHNOLOGY: THE ANSWER OR THE PROBLEM

Eugene B. Skolnikoff

Dr. Skolnikoff is Director of the Center for International Studies and Professor of Political Science at Massachusetts Institute of Technology. He studied electrical engineering at M.I.T. followed by politics and economics at Oxford University on a Rhodes Scholarship. He received a Ph.D. in political science from M.I.T. For five years he was on the White House staff of the President's Special Assistant for Science and Technology. He is author of Science, Technology and American Foreign Policy, The International Imperatives of Technology *and numerous articles.*

Can science and technology solve the Earth's problems? No.

The issues are basically social, not technological. They require and use science and technology; but it is our use and misuse of the technologies, and their effects on society, that are the problem. And those are social matters.

Social problems are not solved in the sense in which we solve a problem in mathematics. Rather, we bypass the problem, transform it, ameliorate it, or alter its impact. Science and technology can certainly help to do all those things, but there never is going to be any simple way out through science and technology.

The issue can better be put in a different way: How can we use science and technology to help, most effectively, to meet the problems we have and, at the same time, minimize adverse consequences and preserve the social values? The last part of that question, about values, is the key. Are we capable of developing social institutions that will be able to govern a world of incredibly growing complexity, scale and reliance on technology, without sacrificing the values that are important to the society?

There are several important current trends and relationships that lead to focus on governance as a central concern.

The first is the growth of interdependence among nations. Once we believed that interdependence would breed a sense of common purpose, and perhaps a community of values. But rapid growth in the relations and dependencies across national borders has not reduced strife, but rather has sharpened the divisions and distinctions between nations.

National political processes must cope with an enormously enlarged international agenda of issues. But nations all too often have little background or competence in the subjects they must deal with, have inadequate trained human resources, and often reflect a fragmented internal society. To top it off, the international environment generates few grounds for trust.

A second trend can best be called tribalism. Within societies, a process of fragmentation is under way, related closely to numbers, to new erosion of accepted assumptions and values, to new awareness of individual possibilities, to disappearance of old power blocs and sources of legitimacy, and to confusion in a new world of exploding technology.

Western democracies have relied on the market mechanism, a self-regulating device to provide for efficient allocation of resources and distribution of income, and to organize consumption and production. Shortcomings in the market mechanism have led to the need for new forms of regulation, and to modification of the market. This implies a need for central planning and economic direction by political authority.

But planning is a contentious political task, the information is necessarily inadequate, external events are not under control, regulatory agencies become independent sources of power, expanding bureaucracy is hard to move, and informed public debate is increasingly difficult.

Lastly are the problems that science and technology have posed for governance. They have made possible, or were the direct cause of, the population explosion, upheavals in international relationships, rural depopulation, totally new industries, changed resource uses and availability, drastic changes in communication patterns and knowledge, shortened decision time-scales, and innumerable other effects. The pace and the seeming autonomy of technological change have contributed critically to the sense of inadequacy and of alienation which have become significant hallmarks of advanced technological societies.

Those who foretell catastrophe should be distrusted, just as those with simple answers are simply wrong. But I find myself closer to the catastrophe school than I would like. It's not that we are headed for physical catastrophe (it is possible, but not inevitable), but that we are likely to see important values eroded as society comes to grips with large-scale social problems.

How well we can deal with these problems will depend on the ability of society to develop a sense of trust and confidence in itself and its leaders in government.

The change in attitude must be from the ground up, but the leadership and attitudes of government officials are critical in bringing this about. An open process, with adequate information and analysis, opportunities for debate, and genuine discussion, is a prerequisite. Whether that will be sufficient is not clear. It is, however, a necessary condition.

ETHICS, SCIENCE AND SOCIETY

Henry Margenau

Dr. Margenau is emeritus Professor of Physics and Natural Philosophy at Yale University, where he received his Ph.D. in physics in 1929. He has taught and written extensively in the physical sciences, especially in the areas of spectroscopy and nuclear physics, as well as in the philosophy of science. Among his books are The Nature of Physical Reality, Physics Principles and Applications, The Mathematics of Physics and Chemistry, *and* Ethics and Science. *He is a Consulting Editor for the Time-Life Science Series, in which he co-authored* The Scientist.

Science, in seeking understanding, begins its task with basic postulates, develops their logical consequences, and tests them against immediate experience. Ethics, in seeking human welfare and social harmony, pursues a parallel course. It starts with imperatives, generates values through living in accordance with them, and finally tests these values against certain ethical goals. Its success lies in the establishment of compatibility between imperatives and ultimate goals.

In view of the problems facing us today, what are our ultimate goals, and what are the most urgent imperatives that will lead us toward this realization?

Scientists have often claimed that scientific knowledge, when fully grasped, will generate rules for proper human conduct. They start with Socrates' dictum that knowledge is virtue, then squeeze the "is," hoping that it will yield the "ought to be." This is a futile undertaking.

Even if we could predict how humans will behave under all specifiable circumstances, we would still have no basis for judging the moral quality of their actions. This absence of affinity between the

substance of science and the substance of ethics should be recognized at the outset.

But the abstract methodology of science, which enables us to pass from universal law to particular fact, and vice versa, contains some important hints that relate to the passage between the factual, moral "is" and the regulative "ought to be."

While science and ethics are completely different in their substances and their languages, there is a similarity in their methodology.

At the base of science lie certain postulates or axioms, such as Newton's laws, or Euclid's axioms. From these, mathematics and logic are used to derive more particular theorems, such as the equations of motions, or the solution of congruent triangles. From this, further specialization produced numerical results or even more particular inferences, such as the fact that a stone will fall 144 feet in three seconds. These inferences can be verified and established as true or false by comparing them with observation and experiment.

There is an analogy with ethics. Our concern shifts from the goal of explanation to one of suasion, the suasive control of human actions. The fundamental stratum of ethics is not a set of vaguely defined values or human rights. Every viable moral system begins with imperatives; in our culture, and nearly every other, they are the Ten Commandments and the Golden Rule. They are postulated or, in the eyes of many, devinely inspired. A people living in accordance with these imperatives will engender a set of values and by incorporating them in their lives, they will follow a specific pattern of behavior. In science, implication is the link between the basic axiom and the inference; in ethics, it is the process of living, which requires many generations to link imperative and pattern of behavior. Above that behavioral pattern lies the level of observed behavior, which is defined as action in accordance with chosen primary values. These appear to be nearly the same in all modern civilizations, comprising such maxims as survival of society, and collective and individual happiness.

The parallelism points to two very fundamental needs. First is the need to attain the utmost clarity as to the meanings of the imperatives and the observed behavior. If the axioms of science were as vague as the Ten Commandments, much of science would fail. Vague talk about human rights must be replaced by the specification of duties.

The other requirement suggests a parallel treatment of the ethical imperatives and the scientific axioms. If the laws of arithmetic were taught in our schools as loosely as is the decalogue or its equivalent (which is not taught at all in U.S. schools), the success of science would match our moral chaos.

PANEL DISCUSSION – CAN SCIENCE AND TECHNOLOGY SOLVE THE EARTH'S PROBLEMS?

MODERATOR

George F. Pieper

Dr. George F. Pieper is Director of Sciences at the NASA-Goddard Space Flight Center. He directs a staff engaged in basic research in space science, ranging from purely theoretical to experimental work involving production of hardware for flights on sounding rockets, satellites and space probes. He received his Ph.D. in physics from Yale University in 1952. For the next eight years he served as a member of the Yale Physics Department faculty. In 1960 he came to the Applied Physics Laboratory of the Johns Hopkins Universi as Supervisor of the Experimental Satellites Project. Dr. Pieper joined the NASA-Goddard Space Flight Center in 1964 as the Deputy Assistant Director for Advanced Research.

PANEL DISCUSSION – CAN SCIENCE AND TECHNOLOGY SOLVE THE EARTH'S PROBLEMS?

After the three presentations, the speakers were joined by Dr. George F. Pieper, Director of Sciences at the NASA - Goddard Space Flight Center, in a brief open discussion.

The first question asked what education could do to help solve the Earth's problems.

"It's one of many routes, but it has limitations due to local control and the depth of knowledge of the instructors." —*Skolnikoff.*

"Our system lacks central control. Moral education suffers from the separation of church and state. Understand that morals and ethics do not equal religion. In spite of that, we don't teach moral principles." —*Margenau.*

"I don't believe that moral and ethical education belongs in the schools; it should be done at home. And I take issue with Dr. Margenau's point about breakdowns of morals and of family life; it is not the fault of education." —*Skolnikoff.*

A questioner in the audience asked for a comment on the ability or the desirability of schools to teach the things that could be taught at home.

"Teaching moral and ethical values involves telling students what's right and wrong, and I don't like that." —*Skolnikoff.*

"Teach the Ten Commandments. When we teach that two plus two equals four, we use dogmatism that would not be acceptable otherwise." —*Margenau.*

CAN SCIENCE AND TECHNOLOGY SOLVE THE EARTH'S PROBLEMS? – SUMMARY

Can science and technology solve the Earth's problems? This Forum said, in essence: "No." Hayflick said that it could, perhaps, but you probably wouldn't want it to. Skolnikoff said no, that science and technology were part of the problem, and that the solutions needed were social ones. Margenau argued for a return to the teaching of moral and ethical principles in the schools as a way to help solve the Earth's problems.

And yet these negative answers seem to miss one of the essential values of science and technology. You can have a vague feeling about a problem, and sense that it is a problem. But when you try to define the problem, in order that you might seek a solution, the first steps you use are scientific. You must employ some kind of scientific approach to begin to grasp a problem.

Statistical data on crime, for example, correlated scientifically with a number of human factors, can give a better understanding of the problem than a simple fear of going out into the streets, or a denunciation of sin from the pulpit.

It is one thing to say that you shall love your neighbor. It is quite another thing to show how you injure your neighbor with your pollution, your waste, your crime, your consumption. The first thing is a moral imperative: Love thy neighbor. The second can only be demonstrated with numbers, with experiments, with statistics, with the tools of science and technology.

Science and technology certainly have a role to play in the solution of the Earth's problems. To ignore or to dismiss them is to overlook probable solutions and positive help.

FORUM IV

CAN EXISTING ECONOMIC, POLITICAL AND VALUE SYSTEMS COPE WITH THE PROBLEMS OF THE EARTH?

Can existing economic, political and value systems cope with the problems of the Earth?

That is a loaded question, and answers to it can range from an endorsement of the status quo to advocating a revolution.

But the reason that the question is raised in the first place is because there is a feeling —— probably a minority feeling, but not to be ignored —— that the existing systems cannot cope with the existing problems, let alone future problems. That feeling is extended to consider the modification or replacement of existing systems of economics, politics, or social values.

The extent of the modification, or the degree of replacement, has generated much political heat, if not light, over the twenty decades of the existence of our country. The purpose of Forum IV was to shed some light on the questions, and perhaps to suggest some answers.

"A lot of our problems are social traps," said Dr. John Platt. "And we can get out of them with some new approaches to social reinforcers."

"Many of our problems are the result of scientific success," said Dr. Willis W. Harman. "Science is changing to recognize the realm of human experience."

"Go right back to the Constitution and work from there," said Dr. Robert Theobald. "It's a pretty good document."

The presentations of each of those speakers at Forum IV are summarized below, followed by some excerpts from the most lively, fastest, and argumentative discussion of the entire Symposium.

SOCIAL INSTABILITIES AND DEMOCRATIC FEEDBACK DESIGN

John Platt

Dr. Platt is a former physicist who has worked for several years on general systems theory as applied to the problems of science and society. He has been Associate Director of the Mental Health Research Institute at the University of Michigan since 1965. His publications include articles on scientific creation and the great social changes through which the world is now passing. Many of these essays have been collected in his books: The Excitement of Science; The Step to Man; Perception and Change: Projections for Survival; *and* On Social Transformation.

Social traps are situations where men, organizations, or whole societies get started in some set of relationships or directions that later prove to be unpleasant or lethal, and in which they see no easy way of retreat or avoidance.

A classic example is the situation of the Commons, the public grassland of old New England villages. Anyone could graze his cows freely and, since it was free, every owner could make money faster by increasing the number of cattle he grazed there. But as the numbers increased, the grass got scarcer and finally was destroyed entirely. The trap is that each owner continued to do something for his individual advantage that collectively was damaging to the group as a whole.

Another example is the decay of railroad service, as people began to prefer their cars. As the railroad service deteriorated, more people used cars. The process was self-accelerating, ending with no railroad services, and traffic jams on the highways, in which everyone involved would prefer to be riding on the railroad.

The process of inflation is another self-accelerating process. When we look at such examples, we see that many of our trouble-

some social and political problems today are made difficult by a trap component.

A number of social trap and counter-trap situations can be formalized in a reinforcement language. This leads to a classification of traps, with parallels between what seem like very different problems. This leads to several suggestions of personal and social methods of self-control for getting out of these traps.

There seem to be three major classes of traps: The one-person or self-trap, the group traps of the Kitty Genovese type or the missing hero type, and the group trap of the Commons type, where the common pursuit of individual goods leads to collective bads.

The most important subgroup of one-person traps seems to involve the simple reversal of reinforcers after a time delay. Such delayed reversals are exemplified in smoking, where there is both a biochemical and a social reinforcement at first, but which later may lead to cancer.

A second subgroup of one-person traps is ignorance of the unexpected or reversed outcome. This is the case of the man who shoots himself or a friend because he ". . .didn't know it was loaded."

Another subgroup is that of sliding reinforcers. These are reinforcers that change steadily as you repeat a behavior, so that they become less and less rewarding and more punishing. This is one aspect of drug addiction.

Today global changes confront us with many sliding reinforcers. Once large families were good for survival; now they have contributed to overcrowding for everyone. More consumption of natural resources and electric power gave us consumer goods and liberation, but now we see them turning into destructive forces, with pollution and waste.

When group profit is blocked by punishment for any personal action, we have the missing-hero trap. The willingness of people of goodwill to play the hero in such a case depends a great deal on the

level of personal danger. We see this in the reluctance of anyone in Sicily or America to testify against the Mafia.

The third major category is that of purely collective traps, like the trap of the Commons. This dilemma and its alternative outcomes are parallel to some aspects of international relations in situations of mutual economic dependence or mutual threat. The U.S. and Canada have locked-in cooperation; the U.S. and Russia have locked-in hostility.

Specific changes of reinforcers can get us out of various social traps; some are in use today for solving one problem or another. These major ways stand out:

First, convert long-range consequences into immediate ones. The highways of Indiana and Ohio once were jammed and ugly. But some entrepreneurs persuaded legislators to set up toll road corporations, which sold bonds and paid construction companies and workers to build new highways. The short-range pay and return on investment was a conversion of the long-range benefit that did accrue to the state and to the drivers.

Second, change the nature of the long-range consequence. There are many large-scale social problems where improved design and planning can change the nature of the long-term consequence. Today, for example, social security is law; new cities are designed and built; and an international monetary system is established.

Third, set up a super-ordinate authority. The organization of fish and game commissions serves as one example. It represents the democratic creation of new super-ordinate authority able to manage and correct social traps that were leading to collective bads.

THE CHANGING ROLE OF SCIENCE AND TECHNOLOGY: Its Implications for Our Ability to Cope with the Problems of the Earth

Willis W. Harman

Dr. Harman is Associate Director of the Center for the Study of Social Policy at Stanford Research Institute (SRI), and Professor of Engineering-Economic Systems at Stanford University. He has been on the faculty of Engineering at Stanford and other universities since 1949 and has authored several engineering texts. He entered the field of social policy analysis and joined SRI in 1966. The insights from his work in futures research are summarized in his new book, An Incomplete Guide to the Future.

Our social decisions have been dominated by economic logic to an undesirable, maybe even a pathological, degree. Economic logic says the Hell with the future. In response, we discount instead of husbanding. And along the way, we have lost track of human goals. Efficiency, economics, and productivity loom too large.

But happily, there are indications that some things are changing. Specifically, there is a changing role for science and technology. The nature of the problem is different; public attitudes are different; and the paradigm of science and technology is undergoing change.

Science and technology have been particularly successful at solving problems and exploiting opportunities in areas such as agricultural and industrial productivity, communication, transportation, public health, synthetics, new tools for service and knowledge industries, military systems, and geological, oceanic and space exploration.

But the problems that give most concern for the future appear to rise from, or are associated with continuation of, a number of contemporary trends. These include environmental impact of human activities, depletion of non-renewable resources, use of potentially hazardous synthetic substances, dependence of the individual on the

technical order, industrialization of an increasing fraction of all human activities, isolation from nature, increasing levels of anxiety, and increasing need for control of technology.

That second list is related to the first; the second list names trends that are partially consequences of, or reactions to, the technological successes of the first list. To date, the problem-solving role of science and technology has been one of response to the challenges and limitations of the natural environment. The future role may be much more one of dealing with the consequences of the technological environment.

The first strong signs of public disenchantment with science and technology appeared in the 1960s. They involved an awareness that the social costs of some technological applications might outweigh the benefits, and a distrust of Big Science and its involvement with the military-industrial complex. By the 1970s these signs had evolved into three attitudes of significance for the future: a reassessment of priorities; an appreciation of the need for technology assessment; and a gradually growing insistence on public participation.

The reassessment of priorities first became clearly evident with the anti-ballistic missile and the supersonic transport controversies. Somewhat simultaneously, national science policy underwent a significant change, resulting in a de-emphasis on basic research. Within the scientific community arose a protest against the prediction-and-control physicalistic emphasis carried over into the human sciences, and a call for "humanistic science" in the social science areas.

This kind of reassessment led to widespread recognition of the need to do a better and earlier job of assessing future consequences of technological developments.

Perhaps the most significant change in attitude is the growing insistence on public participation in decisions on major scientific and technological issues. Public interest groups have shown a willingness to acquire and analyze detailed scientific knowledge and to challenge

the opinions of experts with those of other experts. They have raised issues of broad social consequences. They have made it clear that the public is to be reckoned with in future scientific and technological decisions.

It's hard to believe that science and technology could have grown differently. They were shaped by an industrializing society, and they took on the values of that society, that is, prediction and control. But they have lacked consideration for individual development and for social values. But now, that dominant science-technology paradigm is being challenged.

The challenge is to recognize the realm of human experience, and to develop methodologies for exploration and conceptualization that are appropriate to the full range of that human experience.

As one beginning, we now have the emergence of a science of consciousness research, and we are reaffirming that there are other realms to explore.

Because of the nature of the problems we face, brought about through changing attitudes toward the role and requirements for science and technology, we see the possible emergence of a new science and technology, as different from the old as the old science was different from philosophy and religion in the Middle Ages.

AMERICA'S ROLE IN CREATING AN ALTERNATIVE FUTURE

Robert Theobald

Dr. Theobald is a British citizen, a socio-economist, author, consultant and lecturer, who is traveling the country widely during 1976 because he thinks that the combination of the Bicentennial Year and the Presidential Election provides opportunities for redefining the appropriate directions for America. He has worked with the United Nations on the problems of the first and second development decades. His primary books include Futures Conditional; The Failure of Success; Teg's 1994; Middle Class Support *plus two volumes published this year:* Beyond Despair *and* An Alternative Future for America's Third Century.

The issue we confront now is what precisely is going on in the United States and the world.

One viewpoint is that we have come through a bad period, and that things are now well on their way to getting back into order again. Those who make this case are arguing, in effect, that there is ". . .nothing to fear but fear itself."

There is a polar opposite to this point of view, which argues that the process of economic, social and political disruption is still proceeding with immense rapidity, and that there is little hope that we shall come to grips with the various changes in the field of energy, environment, and economic growth that are causing the disruption. The true pessimists today are arguing against the use of nuclear power.

A third popular view is that the problem is a breakdown in personal and social relations. Those who make this point argue for a revival of religious values. This point of view is made visible in such movements as transcendental meditation, transactional analysis, parent-effectiveness training, EST, and many others.

My own viewpoint combines all of these three views, accepting some aspects and rejecting others. First, it is necessary to have some faith in the prospects for the future, because despair leads to inaction and ensures the continuation of present trends to disaster. However, I don't believe that there can be any effective change in our patterns of behavior within present values, for they force us to exclude the religious values which are necessary for intelligent and moral action.

My viewpoint might therefore be called a management viewpoint. This is quite different from our present bureaucratic styles of activity, for these lead to inertia and inaction rather than to the changes we so urgently desire. The process of management is designed to perceive a desired future, to determine how the direction which is necessary can be grafted onto present attitudes and ideas, and to help people to see why change is indeed necessary if they are to meet their own desires and hopes.

This implies a profound change in our present culture. This often seems shocking, or impossible, or both, to people today. But the founding fathers would be at home with these ideas, for they always believed that a country could only be governed if each person aimed for the good of the whole. The "balance of powers" doctrine was meant to deal with residual disagreements after people had struggled to the best of their ability to understand the desirable direction of the country. It was never believed that it would be possible to govern a country in which each group struggled for its own narrowly defined self-interest.

In many senses, then, we should be searching to understand the wisdom of the founding fathers and to comprehend how far we have strayed from it during the last two hundred years. Their deep concern was the development of factionalism and this has now become the central governing principle of the United States and other countries. The two-party principle, which we installed so clearly in our processes of funding presidential elections, and in the presidential debates, is a pattern which cuts against the grain of the Constitution.

What changes would we need to develop?

We need to move away from a control model to a communications model. Instead of requiring people to do what they are told, we should provide them with enough skills to determine what they believe they should do in a given situation in the light of reality.

We need to move away from a situation where decisions are made by the ability of the most powerful person to determine the decision, to a situation where decisions are based on the competence and knowledge of those involved.

We need to move away from the present situation where people are valued in terms of their level of income, to a different set of values where people are judged on their quality of life. In other words, we need to move from a culture based on the attainment of more, to one which encourages living on enough. Only in this way can we possibly live within, and on, our finite planet.

We need to move away from our erroneous belief in the possibility of "equality" between people to an acknowledgement of the importance of "diversity." It is only diversity which can give us the chance to meet the needs of different people for developing a life style which will be effective for them, and which can give us the range of skills which will permit us to solve our various problems and to seize our possibilities.

We need to recognize that the classical religious values of honesty, responsibility, humility, love and a respect for mystery are requirements for the existence of any functioning culture. For many decades, we have been steadily downgrading the importance of religion; it is ironic that the latest system thinking proves that these values are necessary to survive. Indeed one can today argue either that religion is primitive system theory or that system theory is primitive religion. The point of view one adopts depends on one's biases.

We are at a crossroads. If we continue to act within our same cultural norms for many more years, our problems will become insolvable. We know how to act differently, and many of us would like to do so; but we lack the will.

This, in the end, is the issue that this series confronts. Have we lost our will, our nerve, our courage? The problems that we confront are not insolvable. The possibilities have never been so great. But they will not be seized without the redevelopment of imaginative, moral drive. Can we rediscover this in the immediate future?

PANEL DISCUSSION – CAN EXISTING ECONOMIC, POLITICAL AND VALUE SYSTEMS COPE WITH THE PROBLEMS OF THE EARTH?

MODERATOR

Carol Randolph

Carol Randolph joined Washington's WTOP-TV station in 1969 as co-hostess of the show "Harambee," which won a Peabody award for excellence. Since January 1975 she has also co-hosted "Nine in the Morning," a daily hour-long news and interview program. Earlier she was co-hostess of "Everywoman," which won both an Emmy and Peabody award. She received her B.S. degree in Biology from Fisk University in Nashville and her M.A. in Science Education from Washington University in St. Louis. She is currently a law student at Catholic University in Washington, D. C.

PANEL DISCUSSION – CAN EXISTING ECONOMIC, POLITICAL AND VALUE SYSTEMS COPE WITH THE PROBLEMS OF THE EARTH?

The moderator for the discussion that followed the three presentations was Carol Randolph, of Washington's WTOP-TV station. The first question was hers: How do we get things turned around, especially with minority groups?

"You start on a very small scale with people you know and trust." — *Theobald.*

"Communication systems have a powerful effect; in many ways they are the key to equality." —— *Platt.*

From an educator in the audience came this one: It's almost impossible for teachers to keep up with things, and there is no pressure for their continuing education. Where do you begin?

"I went to lecture in Alabama, expecting the worst, and found instead one of the most rewarding reactions I'd ever experienced. People are ready to learn. One thing I'd like to see is the teaching of a crash course in social reality." —— *Theobald.*

It seems to me, said another questioner, that vested interests in ideas are far more dangerous than vested interests in food, industry, and the like. Your comments?

"Ideas are indeed dangerous. But I feel that it is always in your own selfish self-interest to tell the truth in communications." —— *Theobald.*

"The underlying inequity is in the access to information, and happily, that is the easiest of the inequities to remedy." —— *Platt.*

I'm ambivalent about the idea of super-ordinate authorities, said another questioner. Aren't you?

"The answer is in The Federalist Papers. You govern by the people, with a system of checks and balances." —— *Platt.*

What communications systems improvements are suggested by the experts?

"Television is stage one, with a central station broadcasting to individuals. Then you move to interacting systems as the next step. Two-way cable television could change the patterns of shopping and education. Satellite television links the world, and it's a new mode of the joining of human intellects." —— *Platt.*

"CB radio is a major social phenomenon, and right now it is a major communication system of the United States. But one problem

with all these changing and new communications is that of information overload. How much more do we need?" —— *Theobald.*

"Television is a revolutionary system of communications, literally. It has changed the consciousness of people, and it has changed their modes of protest. There has never been this number of social reversals before in history." —— *Platt.*

CAN EXISTING ECONOMIC, POLITICAL AND VALUE SYSTEMS COPE WITH THE PROBLEMS OF THE EARTH? — SUMMARY

So the systems must change, at least to some degree. The old ones are running out of solutions. We have patched them and propped them too long. Change is vital, and the sooner, the better.

But wait. Isn't that what has been said, over and over again, since the beginning of recorded history, and probably since the beginning of mankind?

Stone Age people solved their problems by new tactics. They learned how to hunt in groups, how to live in small communities, because the single life was infinitely riskier. And from those earliest times to the present, humans have adapted to their environment or their fellows in a variety of ways, always changing.

But perhaps it is the very speed of change now that makes it seem as if it is the time to call for change again. For the pace of the modern world leaves all of us panting once in a while, and longing for a slower speed or a more stable place. And so we call for change, change to give us more time to think, to react to people, to solve some of the problems we have ignored as we sped by. And that is not at all bad, because in thinking, and feeling, and understanding, we begin to confront the ultimate enemy —— ourselves.

AFTERWORD

In the four parts of this Bicentennial Symposium Series, we have faced four very profound issues, stated as questions.

"Can the Earth feed its people?" The answer was a qualified yes. Yes, if population growth is somehow controlled. Yes, if some major social, economic and political changes take place. Yes, if we work to make it so. Yes, if. . .

"Can the Earth provide the energy and other resources for the next generation?" The answer was maybe. Maybe, if some social changes are made. Maybe, if we accept non-growth instead of continued expansion of industry. Maybe, if. . .

"Can science and technology solve the Earth's problems?" This time the answer was no. No, because the problems are not seen to be technical ones, but social ones. No, because science and technology have been a part of the problem rather than a part of its solution.

"Can existing economic, political and value systems cope with the problems of the Earth?" Not without change, was the answer.

These answers point to the central culprit: Ourselves. Ourselves, and the level of our awareness. If we continue to believe that increased consumption, increased affluence, increased industrial growth is the answer, we shall surely watch the world flicker and perhaps die, if we live that long. If we continue to believe that electricity should be used to open a tin can, or to ignite a barbecue, we shall watch all our lights grow dim. If we believe that bigger automobiles are better, we shall be in continued thrall to the parochial interests of a few industries and a few countries.

If the enemy is ourselves, the victor can also be us. The solution to these problems of Earth is not to be found in governments, or industries, or universities. It is to be found within. It is to be found in the increasing awareness of the world around us, recognition that it is finite, that it needs care, that it must be nurtured and nursed back to health.

It must work only that way, because society is nothing more than the sum of its parts, the billions of individualistic human beings. To try to change the views of an entire world is a formidable task, perhaps even impossible, and certainly unlikely to be done in a short time, or by one person alone.

But one of us can make a start with the approach that really counts. One person can begin to change one person: Himself, herself. As I change and as you change, then the world we know changes also.

We change, and our children change. Their children change, too, and the process spreads. The world can change. But it has to start with the simplest, and the most difficult, change of all.

Where it will end, we will never know. But we can grow older, calm in the thought that we helped to start the process, and that we helped to nead it in the right direction.

Where does it start? When? It starts with me. It starts with you. Now!

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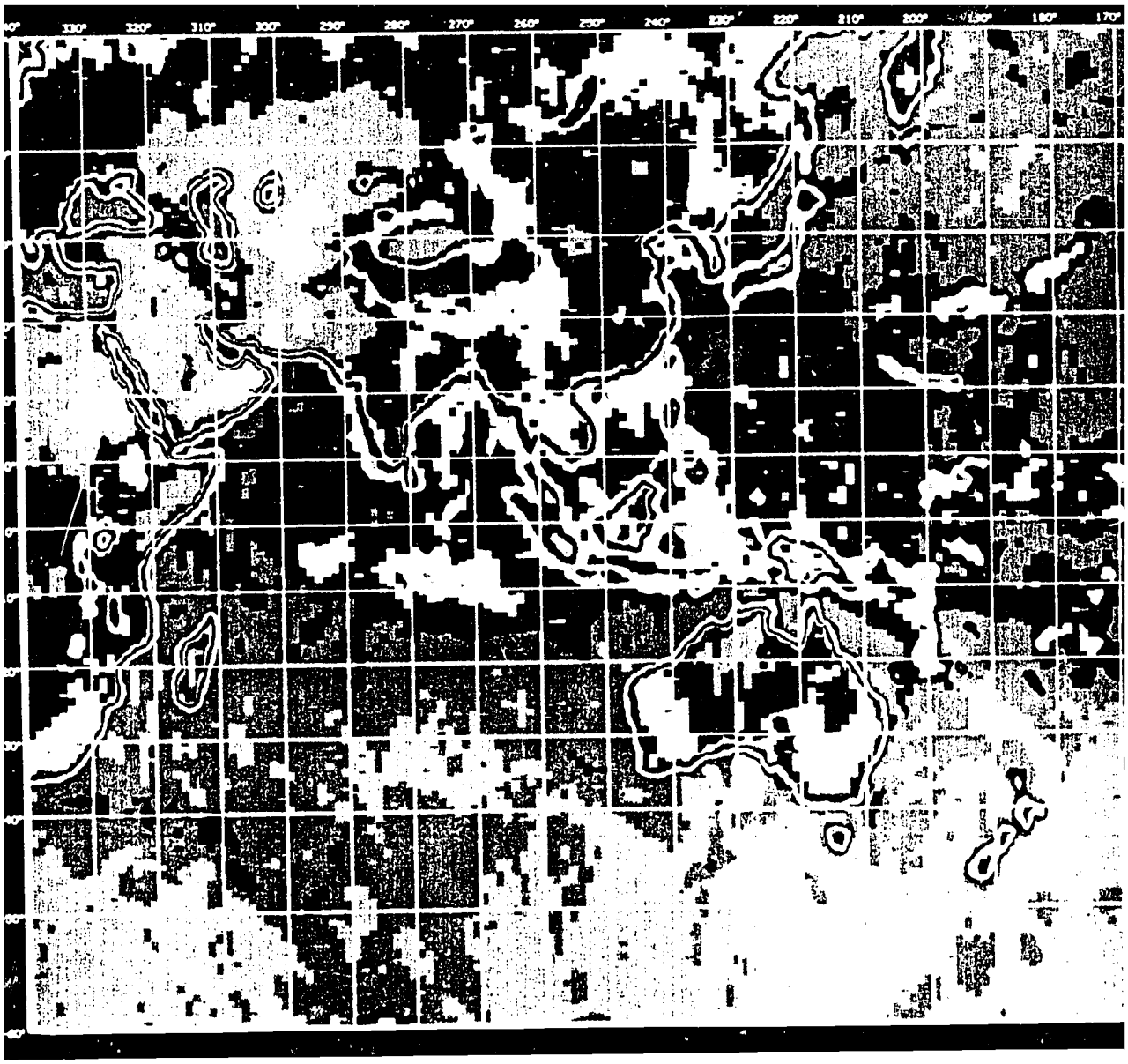

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