A POTOMAC ASSOCIATES BOOK

OF WITS TO

A REPORT FOR THE CLUB OF ROME'S PROJECT ON THE PREDICAMENT OF MANKIND

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INTRODUCTION

I do not wish to seem overdramatic, but I can only conclude from the information that is available to me as Secretary-General, that the Members of the United Nations have perhaps ten vears left in which to subordinate their ancient guarrels and launch a global partnership to curb the arms race, to improve the human environment, to defuse the population explosion, and to supply the required momentum to development efforts. If such a global partnership is not forged within the next decade, then I very much fear that the problems I have mentioned will have reached such staggering proportions that they will be beyond our capacity to control. **U THANT, 1969**

The problems U Thant mentions the arms race, environmental deterioration, the population explosion, and economic stagnation—are often cited as the central, long-term problems of modern man. Many people believe that the future course of human society, perhaps even the survival of human society, depends on the speed and effectiveness with which the world responds to these issues. And yet only a small fraction of the world's population is actively concerned with understanding these problems or seeking their solutions.

HUMAN PERSPECTIVES

Every person in the world faces a series of pressures and problems that require his attention and action. These problems

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affect him at many different levels. He may spend much of his time trying to find tomorrow's food for himself and his family. He may be concerned about personal power or the power of the nation in which he lives. He may worry about a world war during his lifetime, or a war next week with a rival clan in his neighborhood.

These very different levels of human concern can be represented on a graph like that in figure 1. The graph has two dimensions, space and time. Every human concern can be located at some point on the graph, depending on how much geographical space it includes and how far it extends in time. Most people's worries are concentrated in the lower left-hand corner of the graph. Life for these people is difficult, and they must devote nearly all of their efforts to providing for themselves and their families, day by day. Other people think about and act on problems farther out on the space or time axes. The pressures they perceive involve not only themselves, but the community with which they identify. The actions they take extend not only days, but weeks or years into the future.

A person's time and space perspectives depend on his culture, his past experience, and the immediacy of the problems confronting him on each level. Most people must have successfully solved the problems in a smaller area before they move their concerns to a larger one. In general the larger the space and the longer the time associated with a problem, the smaller the number of people who are actually concerned with its solution.

There can be disappointments and dangers in limiting one's view to an area that is too small. There are many examples of a person striving with all his might to solve some immediate, local problem, only to find his efforts defeated by events occurring in a larger context. A farmer's carefully maintained



Figure 1 HUMAN PERSPECTIVES

Although the perspectives of the world's people vary in space and in time, every human concern falls somewhere on the space-time graph. The majority of the world's people are concerned with matters that affect only family or friends over a short period of time. Others look farther ahead in time or over a larger area—a city or a nation. Only a very few people have a global perspective that extends far into the future.

fields can be destroyed by an international war. Local officials' plans can be overturned by a national policy. A country's economic development can be thwarted by a lack of world demand for its products. Indeed there is increasing concern today that most personal and national objectives may ultimately be frustrated by long-term, global trends such as those mentioned by U Thant.

Are the implications of these global trends actually so threatening that their resolution should take precedence over local, short-term concerns?

Is it true, as U Thant suggested, that there remains less than a decade to bring these trends under control?

If they are not brought under control, what will the consequences be?

What methods does mankind have for solving global problems, and what will be the results and the costs of employing each of them?

These are the questions that we have been investigating in the first phase of The Club of Rome's Project on the Predicament of Mankind. Our concerns thus fall in the upper righthand corner of the space-time graph.

PROBLEMS AND MODELS

Every person approaches his problems, wherever they occur on the space-time graph, with the help of models. A model is simply an ordered set of assumptions about a complex system. It is an attempt to understand some aspect of the infinitely varied world by selecting from perceptions and past experience a set of general observations applicable to the problem at hand. A farmer uses a mental model of his land, his assets, market prospects, and past weather conditions to decide which crops to plant each year. A surveyor constructs a physical model—a map—to help in planning a road. An economist uses mathematical models to understand and predict the flow of international trade.

Decision-makers at every level unconsciously use mental models to choose among policies that will shape our future world. These mental models are, of necessity, very simple when compared with the reality from which they are abstracted. The human brain, remarkable as it is, can only keep track of a limited number of the complicated, simultaneous interactions that determine the nature of the real world.

We, too, have used a model. Ours is a formal, written model of the world.* It constitutes a preliminary attempt to improve our mental models of long-term, global problems by combining the large amount of information that is already in human minds and in written records with the new information-processing tools that mankind's increasing knowledge has produced—the scientific method, systems analysis, and the modern computer.

Our world model was built specifically to investigate five major trends of global concern—accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment. These trends are all interconnected in many ways, and their development is measured in decades or centuries, rather than in months or years. With the model we are seeking to understand the causes of these trends, their interrelationships, and their implications as much as one hundred years in the future.

The model we have constructed is, like every other model, imperfect, oversimplified, and unfinished. We are well aware of its shortcomings, but we believe that it is the most useful model now available for dealing with problems far out on the space-time graph. To our knowledge it is the only formal model in existence that is truly global in scope, that has a

^{*} The prototype model on which we have based our work was designed by Professor Jay W. Forrester of the Massachusetts Institute of Technology. A description of that model has been published in his book *World Dynamics* (Cambridge, Mass.: Wright-Allen Press, 1971).

time horizon longer than thirty years, and that includes important variables such as population, food production, and pollution, not as independent entities, but as dynamically interacting elements, as they are in the real world.

Since ours is a formal, or mathematical, model it also has two important advantages over mental models. First, every assumption we make is written in a precise form so that it is open to inspection and criticism by all. Second, after the assumptions have been scrutinized, discussed, and revised to agree with our best current knowledge, their implications for the future behavior of the world system can be traced without error by a computer, no matter how complicated they become.

We feel that the advantages listed above make this model unique among all mathematical and mental world models available to us today. But there is no reason to be satisfied with it in its present form. We intend to alter, expand, and improve it as our own knowledge and the world data base gradually improve.

In spite of the preliminary state of our work, we believe it is important to publish the model and our findings now. Decisions are being made every day, in every part of the world, that will affect the physical, economic, and social conditions of the world system for decades to come. These decisions cannot wait for perfect models and total understanding. They will be made on the basis of some model, mental or written, in any case. We feel that the model described here is already sufficiently developed to be of some use to decision-makers. Furthermore, the basic behavior modes we have already observed in this model appear to be so fundamental and general that we do not expect our broad conclusions to be substantially altered by further revisions.

It is not the purpose of this book to give a complete, scientific description of all the data and mathematical equations included in the world model. Such a description can be found in the final technical report of our project. Rather, in The Limits to Growth we summarize the main features of the model and our findings in a brief, nontechnical way. The emphasis is meant to be not on the equations or the intricacies of the model, but on what it tells us about the world. We have used a computer as a tool to aid our own understanding of the causes and consequences of the accelerating trends that characterize the modern world, but familiarity with computers is by no means necessary to comprehend or to discuss our conclusions. The implications of those accelerating trends raise issues that go far beyond the proper domain of a purely scientific document. They must be debated by a wider community than that of scientists alone. Our purpose here is to open that debate.

The following conclusions have emerged from our work so far. We are by no means the first group to have stated them. For the past several decades, people who have looked at the world with a global, long-term perspective have reached similar conclusions. Nevertheless, the vast majority of policymakers seems to be actively pursuing goals that are inconsistent with these results.

Our conclusions are:

1. If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity. 2. It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential.

3. If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success.

These conclusions are so far-reaching and raise so many questions for further study that we are quite frankly overwhelmed by the enormity of the job that must be done. We hope that this book will serve to interest other people, in many fields of study and in many countries of the world, to raise the space and time horizons of their concerns and to join us in understanding and preparing for a period of great transition the transition from growth to global equilibrium.