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Global Models And the Real World

E. Pestel*

IIASA's recent 9th Global Modeling Forum looked at "Global Modeling at the Service of the Decision Maker". Professor Pestel, scientist as well as politician, outlined his views on the "usefulness" of such models. Much of what he said about global models, reproduced here, is true for models in general.

Since 1968 we have been engaged in the construction of global models. We have published — through the Club of Rome — reports, such as "The Limits to Growth" and "Mankind at the Turning Point". These reports have had tremendous impact, but did we manage to convince people actually to make use of our models?

What is the meaning of our work to political decision makers, parliamentarians, and politically engaged ordinary citizens? Before I take this point up, permit me a few remarks from the standpoint of a scientist who for four-and-a-half years held a ministerial post in government but at heart always remained a professional scientist in his rational approach to public affairs (although I am quite aware of the fact that subjective emotional irrationality probably plays a larger and more active role here and is politically more effective than objective rationality). As such, I should like to direct a question to other scientists, particularly to those who in the past have regarded our efforts, if not with contempt, at least with hardly concealed scepticism. These I should like to ask: What has science done to give the political decision maker rational instruments that would, for example, enable him to explain to the general public, that is, to his electorate, why for the long-term benefit of society certain decisions have to be taken now, although they may entail disadvantages and considerable costs in the short term? Let us not be in doubt that such help is expected from science, since for the first time in human history we live in a civilization that is based — at least materially — entirely on science and technology. I, for one, firmly believe that scientists ought to make a strong attempt to provide such aid. Analysis and, when all goes well, understanding of the problems, although necessary prerequisites that are quite difficult to attain, are not sufficient, particularly because even understanding alone requires the linkage and close cooperation of many — including widely diverging — scientific disciplines.

*Professor Eduard Pestel, from the University of Hannover, FRG, member of the Club of Rome and co-author of "Mankind at the Turning Point", has also been Minister for Science of Lower Saxony (FRG) from 1976 to spring 1981. Although never a formal member of the IIASA staff, Professor Pestel has visited IIASA on many occasions and has in many ways contributed to the work of the Institute.

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Fearful Scientists?

Now, why have scientists in the past persistently shrunk from serious attempts to develop useful instruments as aids for the planning of future policies? Surely not only because of a "natural" aversion to interdisciplinary work or out of fear of becoming contaminated by "dirty" politics? Is Professor Mesarovic possibly right when he says that "the ultimate fear of a scientist is to be proved wrong"? Of course, a futures scientist has to learn to live with the fact that he might be proved wrong when he undertakes the challenge of developing a new methodology for policy research and the investigation of the future. Normally, scientists are used to sticking their necks out when promulgating a new scientific hypothesis, but in futures research the success of their work is not measured by its validity under the test of controlled laboratory experiments, but by its relevance to societal and political developments; and ultimately it depends on the appreciation and understanding of the general public. Otherwise, their effort is in vain, particularly if it remains disregarded by political and economic decision makers as well as by parliamentarians.

This has generally been the case in the past, especially with regard to the political application of global models, except for the occasional reference to certain results of global modeling in inconsequential "Sunday speeches". For this negative attitude of politicians in general there exist quite a number of reasons.

The "Real World"

The establishment of the budget constitutes the central responsibility of government. This is an annual exercise accompanied by a rather detailed four-year budget forecast that is rewritten every year. If you study consecutive budgets over the years, or, even more so, when you have to draft the budget for your own ministry, you find that nearly all items are firmly prejudiced by existing legal obligations or earlier established financial practices. Only a small proportion of the budget, say five percent, constitutes a disposable sum for the realization of new policies, but even this small proportion would not be available if the government refused to increase the public debt in order to balance the budget. It would be wrong to assume that the government could freely dispose of this in order to bring about certain political changes or to carry out new policies in pursuit of their political goals. This is because there are pressures from the parties in parliament and various social groupings, such as unions or civil disobedience groups. The parliamentary parties, for example, demand from the government the fulfillment of their election promises and the satisfaction of wants and needs as they perceive them for their electorate, in anticipation of the next election. Of course, in this way considerable change can be brought about gradually, if a party or a coalition of parties stays in power long enough. But this change definitely does not take place in the direction of solving the sort of problems that we consider in global modeling; quite the contrary. Hence the results of global modeling have practically no influence whatsoever in the budgeting process.

Now let me point out a few more reasons why governments have so far paid little attention to global modeling.

- In the competition for office and power the focus is usually on immediately pressing problems. Hence, as a rule, the political forces, at least in our Western democracies, suffer from some sort of permanent shortsightedness. Although it is well known that many problems of today obviously have their root in political decisions made a long time ago, politicians appear to be unwilling to draw the conclusion that they should always carefully assess the long-term consequences of their political decisions, in which computer models might be helpful.
- In the competition for votes there is a tendency in the public debate to simplify problems that are actually highly complex. This involves the temptation also to attempt the solution of these problems on the same low level of rationality, although actually they need to be understood in all their complexity before they are dealt with accordingly.
- It is because of the competition for approval that governments find it difficult to postpone the solution of a local or national problem in favor of making a strong effort to deal with matters of grave international concern. Thus rather little interest can be expected for the study and application of global modeling results.
- Let me also mention, with particular emphasis, my grave concern with regard to the structure of our political institutions *vis-à-vis* the really great problems that our world faces today and in the future. These problems are — from a structural point of view — horizontal problems, in the sense that they cut across a number of different dimensions; for example, the task of increasing food production in the populous countries of the "South" is not just a problem of agriculture, but also of education and vocational training, of research (biological, genetic, soil, etc.), of ecology, industrial infrastructure, energy supply, transportation, food storage, distribution, and processing, income of the masses, of international cooperation and environmental protection, etc., thereby demanding the simultaneous interest of many different agencies. Contrary to this, government structures are essentially vertical in nature, each governmental department guarding jealously against intrusion into its competence, and as a consequence, focusing only on one aspect of the problem concerned. Therefore a holistic view of the problem area, and correspondingly a comprehensive approach to its solution, is the exception to the rule. Instead, just a cure of symptoms is attempted, which usually leads eventually only to a further aggravation of the situation.

It would be incorrect and unwise alike to consider only the political as well as structural constraints responsible for the politicians' hesitancy to use global models as instruments that could be applied to the search for suitable alternatives to their present governance. We have to take a close look also at the shortcomings of models presently available as far as their utility in policy making is concerned, not to speak of the great variety of critical objections to such models and their applicability on philosophical, sociological, economic, and ecological grounds. Let me confine my observations here to the Mesarovic—Pestel model in its latest version, called the APT (Assessment of Policy Tools) System, because this model was expressly designed to serve the political decision maker.

I shall try to formulate my critical remarks from the standpoint of a political decision maker in a Western democracy who wants to know what long-term consequences an envisaged action in, say, the economic field might have. Let us assume that this political decision maker is good-natured in the sense that he or she does not try to raise questions to which answers simply cannot be given by this model, such as what would be the political, military, and economic effects of shipping, over the next 10 years, hundreds of millions of US dollars or rubles worth of armaments to certain countries in the developing world. Rather, let him want to know, for example, what development aid his country, together with the rest of the industrialized nations, would have to produce in order to ensure that the GNPs in such countries would rise annually by at least, say, five percent. He would soon find out that the model could not yield such an answer in a forthright convincing manner. He might then be told that he could instead gain information from the model on the effect of doubling the public development aid there. What good would this answer do him, as far as his decision making and the realization of such decisions is concerned, leaving aside all the doubts about the relevance and validity of these answers? The really hard political questions still remain unanswered, because "the devil is in the detail". For example, what would the consequences of such a rise in development aid be for the economy of his own country; what other priority projects would have to be postponed in favor of this increase in development aid; should this additional program be financed by new taxes or savings in other government departments or by increasing the public debt; etc.? Furthermore, is the economic theory embedded in the computer model relevant for the calculation of the effect the transferred investment goods would have on the labor market, on the increase in the GNP, on the income distribution, etc., in the developing countries?

Too High Expectations

Without continuing to raise ever more questions, it is — in my opinion — really not astounding that political decision makers have not so far been persuaded actually to work with global computer models, meant to be decision-aiding tools. It was possibly a mistake that in the euphoric beginnings of global modeling, expectations were nurtured — not necessarily by the model builders themselves — that eventually the ramified consequences of political decisions in all their important aspects could be evaluated by such computer models, if only enough financial support and scientific manpower were available for their further development. Consider in this respect that the financial support for the research, the construction, and the experimental application of our model was less than half a million US dollars, which is equivalent to the world's military expenditure in 45 seconds.

Even if the far horizons of earlier expectations can never be reached, which seems the most likely final outcome of the global modeling effort, was the exercise therefore completely futile? When Professor Mesarovic said three years ago, "the aim of the APT System should be to augment the power of reasoning as practiced in prevailing decision making processes, rather than to substitute for the process", he stated clearly, in my opinion, what it is possible to achieve with these models. Even if the complexity and the variety and number of parameters and relationships in such models were to be increased many times over, that would still be all that politicians could and should expect from such tools. This is not the place to go into the details of the APT System — that has been done elsewhere by Professor Mesarovic. Suffice it to state that I have no doubts about its usefulness in the aforementioned sense. Five years ago my group in Hannover at the Institut für Systemanalyse und Prognose (ISP) developed on the same conceptual grounds a national model of the Federal Republic of Germany embedded in the APT System. It was never used directly by the government, although it has been put on one of the government computers in Bonn. Even the fact that politically relevant results, for example concerning unemployment and the development of energy demand, were predicted five years ago — contrary to the then prevailing opinion — has not had the effect of inducing the government to use the model as a testing instrument for alternative policies. And this will remain so, as long as political decision makers continue to expect direct "custom-tailored" answers to their questions: questions such as, for example, what policy measures, such as tax increases, tax benefits, subsidies, etc., should be employed to stimulate or finance, respectively, investments, so that in two years the number of unemployed would be decreased by at least 400,000. Such misconceptions and misunderstandings are chiefly the result of a lack of contact and cooperation between scientists and politicians.

Limits to Science

I consider it most improbable that a research group of scientists, even though in the majority they happened to be familiar with real-life political processes, could construct on their own an instrument to aid political planning, in the hope of handing it over for ready use to the political decision maker who himself would be completely ignorant of the components of the model and of their most intricate interrelationships; who at best will recognize this instrument as a large number of interconnected black boxes, each with numerous entries and exits; who is not informed about the facts and data, built in the models, and their provenance and reliability; who might ask himself the doubtful question, whether ideological distortions might have warped the structure of the model; and so on. With regard to the different roles of scientists and politicians, and in order to avoid misunderstandings from the very beginning and as far as possible, those who are in charge of the political and economic decisions have to take an active part in the construction of tools to aid planning, and they have to introduce their vision of the future, formulated in scenarios, reflecting their values and goals. This procedure will help the political decision makers to recognize more precisely the limits of their own possibilities, while becoming more acutely aware of the challenge to their political and economic creative powers.

Of course, mathematically formulated quantitative models and the scenarios in which the users of the model lay down their considered view of the perceived situation as well as their vision of the future to be tested by means of the model, can never reflect the complex totality of the political, economic, and social reality. Incidentally, it is here that a certain attitude prevalent among many modelers (but certainly not limited to this brand of scientists), which one might perceive simply as jealousy, contributes a great deal to defeating the purpose of our modeling efforts. For, unfortunately, it has already become a more or less normal routine in the critical public review of models depicting social, economic, and political processes to point out that just those aspects that were left out by the fellow-modelers are the most important and the most relevant for the problems under consideration, and that therefore, alas, an otherwise most commendable effort was utterly useless for practical application in "real life". This cannot but have a most discouraging effect upon our political clientele, and furthermore has contributed to the low esteem of the social sciences in general, as far as their usefulness in the solution of "real problems" is concerned. Hence let us all practice a little more tolerance between ourselves, since every one of us knows quite well that it will never be possible to consider more than a sector of reality, which, however, should not be done without taking sufficient notice of the possible influence emanating from the interfaces with those parts of reality that are not expressly considered. Here the help of experienced politicians and economists is indispensable. And even when regarding only limited sections of reality, a considerable simplification of the phenomena to be investigated is necessary for the construction of usable models, just as every scientific analysis — also in the "hard" natural sciences and in engineering — needs to employ abstract, i.e. simplified, models of reality.

Some Fantasy Can Help

In any case, in however much detail the model depicts the perceived reality, those who are working with it have to apply their political and economic experience, their intuition, their fantasy in the transformation of their values, their

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goals and their view on future developments into quantitative scenarios as well as in the interpretations of the results of the model runs and in the evaluation of their political importance.

There must also be the will on the part of the politicians to use the potential of the different sciences, when they are properly combined for the treatment of politically relevant problems. A cook, used to his old kitchen stove, will not even touch a new microwave oven unless he has the desire to change his way of cooking, and in addition can be convinced that the new way will yield more satisfactory results. On the other hand, the scientist who firmly believes that scientification of politics is possible is surely the wrong partner for the politician. Conversely, this holds also for the politician who rejects on principle the notion that ways for a more rational shaping of the future can be found by a tenacious and intelligent pursuit of system science. Of course, such rationality in handling our public affairs will become reality only if the majority of the citizens come to withdraw their support from those who — regardless of the medium- and long-term consequences — play the old political game of instant satisfaction of what they conceive to be their voters' desires. Without reason and rational moderation on the part of the people, reason cannot prevail among their political leaders. Also here, the role of publicly accessible computerized planning instruments can be most beneficial by inducing the people to go beyond their mostly mere emotional participation in political life to play instead an active rational part in shaping our political future. A first beginning should be made by acquainting parliamentarians with our work. A few years ago we had a heartening experience with a dozen members of parliament from OECD countries, who played scenarios on our global model for several days. At the end they suggested that parliaments should have access to these models with their vast data base in order to restore some balance in "weaponry" between the executive branch of government and the legislature, which was feeling more and more helpless and at the mercy of the executive "expertocracy" in dealing with global and international problems. Of course, the group that came to us was certainly exceptional, but such groups could possibly serve as strong multipliers in governmental circles, paving the way eventually for a more rational approach in global politics.

A Long Way to Go

I would be a profound pessimist if I did not firmly believe that politics in the future can be founded more on realism and rationality than in the past, and that here, in the rational pursuit of the truth and thus in the defeat of petty selfish opportunism, lies the chance to overcome the presently conceived limits to effective governance. As the late Dennis Gabor, the well-known winner of the Nobel Prize for Physics and an early member of The Club of Rome, once remarked: "Man cannot predict the future, but he can invent it".

But do not kid yourselves into believing that such change in the conduct of our political affairs could be achieved (through our and similar efforts) in the very near future. Politicians are not as yet able or willing to anticipate or hence to respond to catastrophic pressures that are possibly decades away. Our research indicates that, barring the — in my opinion — unlikely event of a third world war in the next 20 years or so, no major catastrophes will take place in the industrialized countries that would in the next few decades force a radical change in values, goals, and strategies upon our societies and consequently on those responsible for running our governments. Of course, they will always be confronted by new problems, most probably more difficult to cope with than those already prevailing, which will also remain with us. But, I fear, we shall muddle through for a few more decades, probably at the expense of what we should and actually could do for the very poor majority of mankind living in the developing countries. It is the likely success of such muddling-through policies in the short- and medium-term that I consider most dangerous for the long-term development of rich and poor alike. We must therefore not be deterred from continuing our work, even if for the time being we hardly have a chance of exercising a direct influence on the political decision maker. Hence for some time to come we shall have to be content with making ordinary citizens more and more aware of the importance of sacrificing short-term gains for long-term benefits in order to avoid the catastrophes that lurk for all of us in the future. This will eventually force political leaders to look further ahead far beyond their term of office, and to act accordingly.

Topology and (

On Qualitative Structure in Social and Behavioral Pheno

Laws, Models, and Methods

According to the ancient Greeks, the observed phenomena of daily life are only imperfect images, or "shadows," of certain ideal forms, and it is the business of philosophy to study the structure of these forms and the natural laws governing the change of one form to another. Given such a world view, it is not surprising that Greek mathematics heavily emphasized the *geometric* properties of the ideal forms and focused upon the qualitative (i.e., topological) rather than quantitative (i.e., algebraic) aspects of their nature. Mathematical system theory is the modern embodiment of this ancient Greek ideal; namely, the study of the properties of ideal representations (models) of real phenomena and the determination of the laws which such models must obey. Just as in Grecian times, modern system theorists emphasize topological aspects of observed phenomena, especially in modeling for the social and behavioral sciences, where principles analogous to the "laws" of physics cannot be invoked to provide a basis for credible quantitative models.

The main idea underlying the use of topological tools in system modeling is to map a given real-world situation onto a standard geometrical form and to use the presumably well-understood mathematical properties of the form to say something meaningful about the original problem. A very familiar but rather trivial example of this idea is linear regression analysis, where the real-world data is mapped to a straight line, the mapping usually being defined by some optimality criterion like least-squares. The properties of the line are then used to predict the behavior of the process which generated the original data.

The realization of the above general idea can be carried out in many different ways, depending upon the modeler's tastes and mathematical sophistication. For example, in singularity theory and its sub-branch catastrophe theory, we begin with a certain collection of variables $\{x_1, x_2, \ldots, x_n\}$ describing the problem and a function $f\{x_1, x_2, \ldots, x_n\}$ which measures some aspect of the system. For example, in an economic context the x_i's may be quantities such as money supply, interest rates, unemploy-

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ment rate, and so on, while f may measure GNP. Often we are interested in the number, nature, and relative location of the critical points of f and how these points change as we change the variables. Singularity theory tells us how to change the physically meaningful variables (the x_i's) to more mathematically convenient variables in order to transform f to a standard form (which can be geometrically represented and) for which the answers to the questions of interest have already been obtained. Such a change of coordinates is a needless luxury when the number of essential variables n is small and all interactions can easily be kept in mind. However, when n is of the order of several dozen, or even several thousand, then the systematic procedures provided by singularity theory cease to be a luxury and can be employed to reduce the original problem to one of a small number of standard, i.e, canonical, forms whose geometry and qualitative structure has been well studied in differential topology and algebraic geometry.

Thus, singularity theory enables us operationally to associate ideal geometrical forms with tangible human situations in such a manner that certain qualitative aspects of the real problem are preserved in the process of passing from the problem to the form.

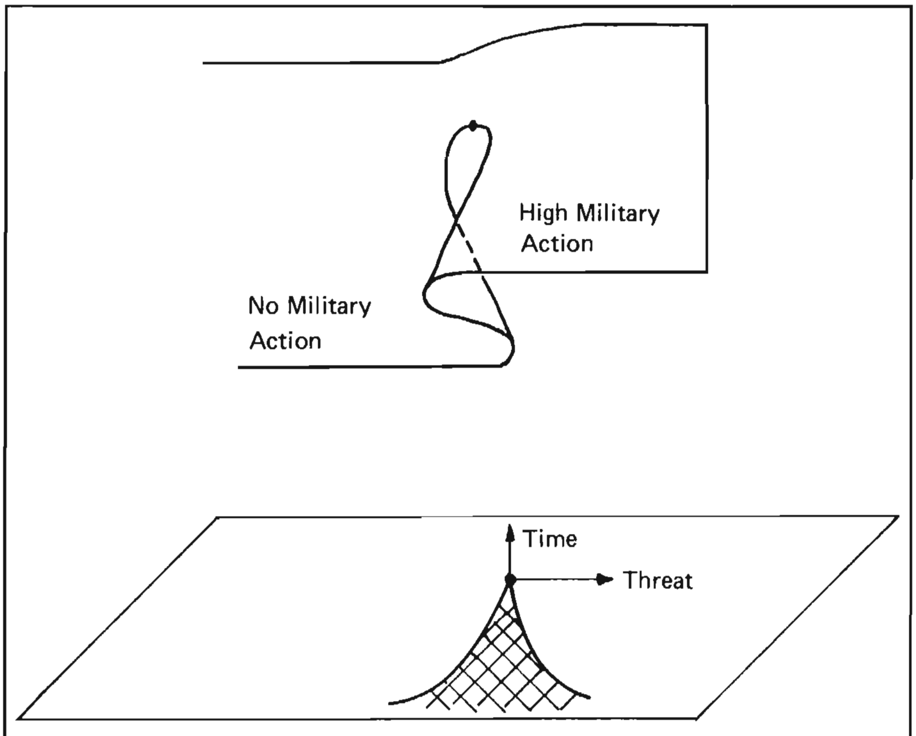

Figure 1. Cusp model of crisis situations.

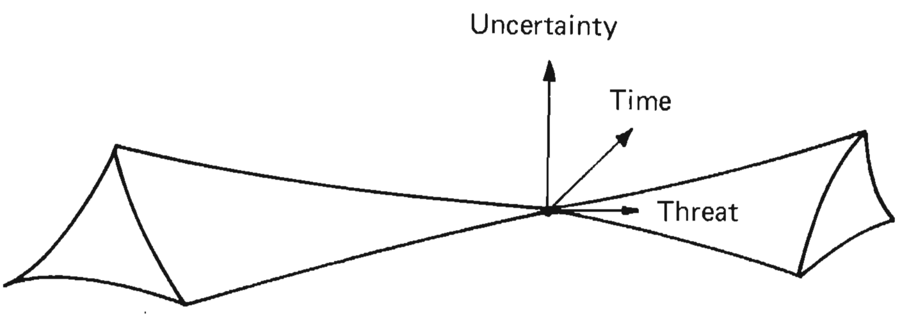

Figure 2. Catastrophe manifold for elliptic umbilic.

Singularities and Crises

International crisis management is an area in which singularity theory ideas hold promise for shedding light upon the way in which the interrelationship of many problem variables determines the manner in which hostilities are either escalated or defused.

To illustrate the basic idea, assume that there exists a function $f\{x_1,x_2,\ldots,x_n, a_1,a_2,\ldots,a_r\}$ which measures the level of tension, with the variables $\{x_i\}$ being various factors such as economic climate, political disagreements, cultural conflict, and so on, while the $\{a_i\}$ are parameters affecting the x's. For instance, the a_i could be perceived threat, available decision time, degree of uncertainty, etc. We are interested in how the variables x_i vary when we change the "environment" measured by the a's. To make contact with singularity theory, we assume that for a given setting of the a's, the x's move so as to achieve a state which is a local minimum of f, i.e., the system shifts to a state of minimal tension consistent with the current environment.

If we had knowledge of the precise form of the "potential" function f, then the standard mathematical machinery of singularity theory would enable us to carry out the following steps: (1) separation of the variables x_i into two classes: the "essential" variables carrying the intrinsic nonlinear behavior of the situation and the "inessential" variables for which no variation in the a's could produce discontinuous jumps or *catastrophes* in tension level. (2) Identification of a standard, or "canonical" form for f whose geometry is well understood and which can be obtained from f by relabeling and combining the variables $\{x_i\}$ and $\{a_i\}$. Roughly speaking, this standard form, which contains all qualitative information about f, is fixed once we know the number of essential variables in f and the number of parameters a_i. The problem with the above set-up is that in the social sciences, where there are no "laws" as the term is normally used in physics, we usually do not know the explicit form of such a function f.

The way out of the foregoing quandary is to *assume* that the number of essential variables is small (usually 1 or 2) and furthermore to *assume* that the essential variables consist of one or more elements from the original list $\{x_i\}$. In addition, it is *assumed* that for the canonical

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Topology and Crisis

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model the coordinate system used to label the parameters $\{a_i\}$ is the same coordinate system as that used to label the a's in the original problem statement. The result of these assumptions is that we can then pretend, for purposes of analysis, that the original system can be qualitatively described by its canonical model and that conclusions from the model can be transferred back to the original system.

To see how this works in the international conflict setting mentioned earlier, assume that the potential function f underlying the crisis mechanism is such that there is a single essential variable x = level of military action. Let there be two environmental parameters in the problem a_1 = perceived decision time, a_2 = perceived threat. In this case, the canonical model is the well-known cusp whose geometry is depicted in Figure 1.

On the other hand, if we had assumed a second essential variable, say, y = operational preparedness, and introduced an additional environmental factor a_3 = degree of uncertainty in the situation, then the main classification theorem of singularity theory would have forced us to conclude that the "elliptic umbilic" is the canonical geometry of the situation. While it is impossible to draw this 5-dimensional behavior-parameter space, the region of potential catastrophe in the 3-dimensional parameter space is depicted in Figure 2. This region should be compared with the analogous shaded region in Figure 1 for the cusp.

To enter the catastrophe region is to create potential crises, while to leave is to create a shift in behavior space, i.e., a crisis. Note, however, that the above model distinguishes between a crisis and a crisis situation. A crisis is an instantaneous change in behavior, while a crisis situation places the system in a state of "alert." Basically, any point in the catastrophe region corresponds to a crisis situation, while crossing the boundary of the region *may* bring on the crisis.

Another way of looking at the role of singularity theory in model building is to note that no property of a system which depends upon the chosen coordinate system can make any claim to being an *intrinsic* property of the system. So, we need to focus upon coordinate-free, i.e., qualitative, aspects of the system, and singularity theory provides a vehicle for formalizing these ideas and for the construction of a standard model for each class of systems which are equivalent under coordinate changes.

Topology and Paradigms

Singularity theory is one mathematical method that can play an important role in constructing predictive models by elucidating the qualitative structure of a system. Another such method is polyhedral dynamics, by which the connective structure of a complex social system can be studied. For instance, New York's Manhattan can be described in a way linking the various geographical locations of the area with the different human activities taking place in them, as discussed in Casti 1981. Tools such as singularity theory and polyhedral dynamics allow us to predict when there will be a qualitative change in the system behavior and/or structure as we vary features of the system (parameters, vertices, relations). In addition, the topological methods enable us to *compare* structures in a systematic fashion, a technique with a venerable history in the social sciences (e.g., comparative anthropology, comparative religion, etc.).

One of our main conclusions from the study of "topology in human affairs" is that qualitative mathematical language is the natural language for expressing the governing "laws" of social science. Qualitatively invariant terms such as cusp point, bias factor, divergence, etc. enrich the modeling language to the point that scientific statements can be made using them and that perhaps, since the terms have no familiar translation into everyday language, new insights and syntheses can take the place of the paradigms from classical physics in social science modeling.

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Professor C.S. Holling, widely respected expert in ecological systems from the University of British Columbia in Vancouver (Canada), will be the new Director of the International Institute for Applied Systems Analysis. This was announced following the November meeting of the Institute's governing Council, held at Laxenburg on November 16 and 17.

Professor Holling, whose three-year term will start on December 1, 1981, succeeds Dr. Roger Levien, who has been Director of IIASA for the past six years and is now returning to the United States, where he will be Director of Strategic Systems Analysis at the Xerox Corporation. Under Dr. Levien's leadership the Institute has gained international recognition as a center of scientific excellence, whose work has significance for major international problems.

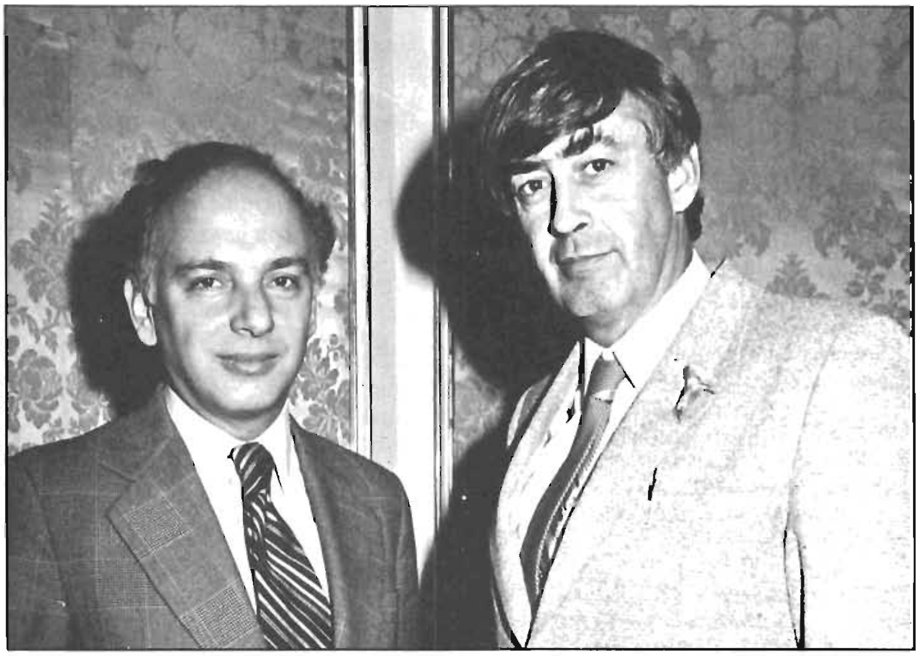
Also leaving the Institute is Professor Wolf Häfele, who has served at IIASA as Leader of the Institute's Energy Systems Program since 1973 and as Deputy Director since 1975. Professor Häfele, whose team's recently published global energy study *Energy in a Finite World* has attracted worldwide attention, has assumed his new responsibilities as Director General at the Nuclear Research Center Jülich in the German Federal Republic.

At its two-day meeting, the IIASA Council expressed its deep appreciation for Dr. Levien's and Professor Häfele's "outstanding contributions" and their "exemplary dedication to the ideals" of the Institute and decided to confer upon them the title IIASA Honorary Scholar.

Professor Holling was the leader of one of IIASA's first research groups in the years 1973 to 1975. Together with his colleagues, he has developed the new method of "adaptive environmental assessment and management", which has already been adopted in several countries for such environmental problems as salmon breeding, pest control, and the economic development of an alpine region (Obergurgl in the Austrian Tyrol). Professor Holling's main research interest now lies in the "dynamics of surprise" that are at the heart of today's challenging transformations as society,

News from IIASA

The November Council Meeting: A New Director for IIASA...



Professor C.S. Holling, IIASA's new Director (right), and Dr. R.E. Levien, Director of IIASA from 1975 to 1981.

The IIASA Council invited the staff of the Institute together with members of the larger IIASA family in Austria to participate in an open session. At this meeting Dr. Levien, in a valedictory address, gave his impressions of IIASA after six years of directorship, and Academician Gvishiani, Chairman of the IIASA Council, expressed the Council's appreciation to both Dr. Levien and Professor Häfele. As he pointed out, the past six years were particularly fruitful and important for IIASA. "The Institute has become a well-respected research institution in its own right, a voice that does not go unheard in the international arena", he said.

technology, and the environment interact in an increasingly interdependent world. He wants to take IIASA into its second decade with a strong focus on the risks, uncertainties, and opportunities facing society. "IIASA is now entering a new phase in its development", said Professor Holling. "The increasing potential for conflict on both the national and international level calls for an institution able to act as an independent pool of expertise able to provide the factual basis for discussion of difficult issues when the need arises. IIASA has reached a degree of maturity that might well qualify it to take up such a role. This will inevitably make the Institute more visible in the political arena – a situation both challenging and daring. It is my intention to make full use of the opportunities arising from these new demands while at the same time avoiding the perils of politics", he added.

Professor Holling nominated Dr. Allan Hirsch, Deputy Assistant Administrator for Environmental Processes and Effects Research at the Office of Research and Development of the US Environmental Protection Agency, as Deputy Director of IIASA. This appointment was approved by the IIASA Council. Dr. Hirsch was mainly dealing with the implementation of innovative concepts and methods in operating agencies and industry, an experience he will now apply in an international setting.

. . . and a Dutch Honorary Scholar

At its meeting the Council also awarded Professor Pieter de Wolff the title IIASA Honorary Scholar. Professor de Wolff has been the Council Representative of the Foundation IIASA–Netherlands since this Dutch National Member Organization joined the Institute in 1977. He was instrumental in bringing the Dutch scientific community to IIASA and has played a key role in the Council's work during the past five years.

Although he is formally leaving the Council, Professor de Wolff will remain a member of the "IIASA Family": he will continue to give the Council and the Institute his advice and will be involved in investigating new research directions for IIASA.

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