

© The United Nations University, 1981
Printed in Japan

ISBN 92-808-0258-5
ISSN 0379-5764

HSDRGPID-51/UNUP-258

GLOBAL MODELLING . . . WITHOUT MODELS?
Theory, Methodology, and Rhetoric in
World Modelling

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Acknowledgements

The authors wish to acknowledge the assistance of Mr. John Ackerly and Ms. Lucia Ivanovici in preparing the English version of the manuscript.

This paper by Mihai C. Botez and Mariana Celac was presented at the GPID V Network Meeting, Montreal, 27 July to 5 August 1980. It can be considered as a contribution to the Visions of Desirable Worlds sub-project of the GPID Project.

Geneva, December 1980

Johan Galtung

It is being circulated in a pre-publication form to elicit comments from readers and generate dialogue on the subject at this stage of the research.

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INTRODUCTION

In the few years that scholars have sought to describe the dynamics of the world system – and implicitly to assign goals and to devise strategies able to respond to the challenges of the 'world problématique' – their efforts have centred on building models. In doing this, attention has been given to producing truthful images both of the world as a whole and of its evolution over time. Occasionally, these images – which we shall call "global" – intended to offer theoretical substance to the critical assessment of the contemporary world, and to the political and ideological debate that originated in the global issues.

In this essay we shall try to depart from this traditional perspective. Therefore, we shall neither examine in detail the existing models nor attempt to introduce a new one;¹ our attention will be focused on the inquiry into the process of global modelling itself. We believe that viable avenues for thinking about global problems might be identified in the process.

Actually, the scheme advanced in this paper could be outlined as follows:

1. First, we shall consider the global models elaborated up to this day primarily as the result of a definite process. In our view, the modelling process embodies several parts linked together by numerous interdependencies; among these parts, we shall name first the model-builder, who injects into the modelling process his background, his specific aspirations, and his political and ideological positions; then, the methodology chosen for exploring the global problématique,

and finally the addressee, to whom the conclusions of the model are presumably destined -- and thus wrapped in an appropriate rhetoric.

2. We shall turn then to the identification of the key attitudes in handling the problems of the world today. Evidently, only few such attitudes have been incorporated in real models. The whole range of such attitudes, if explored systematically, could allow for a more nuanced description -- and may be more rigorous, too -- of what the "white spots" on the map of the debates around global problems could conceal.

In fact -- surprisingly enough -- up to this day there are no models of the global problématique based on the theory of scientific socialism, nor any explorations of the paths of a possible transition toward communism on a global scale. Simultaneously, the Third World postpones making a decisive statement on development, though many scattered efforts have been made in order to find new ideas for alternative development.

3. The detection of empty spaces in the field of the production and dissemination of global models is not the unique purpose of such an enterprise. This perspective also allows for a dialectical approach to the study of societal evolution. The fact that the different images of the world as a whole (viewed from various perspectives and built using different methodologies for different addressees) may assert contradictory statements is in no way disturbing. One will always discover behind the deployment of succeeding alternatives the necessary premises for a genuinely dialectical approach to the plurality of the world at large.

This scheme was prompted by an attempt to go beyond the "image paradigm" -- which assumes a representation of global problems by a single image (or a single model) -- as happens in the case of research developed under the aegis of the Club of Rome.

The fierce criticism aroused by such "arrogant" models is partly due

to the basic assumption of the validity of "One World -- One Model." If the world is seen as a social configuration in which different actors (as nation-states, IGOs and INGOs transnational companies and other non-territorial organizations, social classes, political, ideological or religious movements, territorial associations and even some small groups of people or individuals) are involved in a network of mutual interdependencies, at least some of these actors will try to produce an image of the world seen in its entirety, of the partners, of what should be done in order to achieve a certain goal, of what such a goal must look like, and to act consistently with the particular images they produced. If as many partial images as possible are taken into consideration, the world becomes representable not by a single "correct" model, but by a multitude of models issued by different actors who are themselves involved in negotiations on matters of common concern.

This essay has four parts. Part I shows how the "inquiring approach" can be used for the comparative analysis of global models elaborated so far. Part II explores the findings of this analysis in order to generate new global models. An outline of a global model based on the Marxist theoretical hypotheses of the dialectics of world politics, developed by S. Brucan, is presented. In Part III, the process of global modelling and its components are analysed. The interrelations between the theoretical foundation and the methodological assumptions underlying the modelling process are investigated. As an example, a methodology generated in connection with the socialist view on global dynamics as a transition toward world-wide communism is introduced. Part IV tackles the problem of participatory world management on the basis of alternative controversial global models.

As a conclusion, some proposals for future research to be carried out within the Goals, Processes, and Indicators of Development Project are presented.

1. GLOBAL MODELS: SOME SUGGESTIONS FOR COMPARATIVE ANALYSIS

In the field of social and political sciences the description of a problem (particularly of the dynamics of a social system) is often conducted using a set of indicators, which are considered relevant for the problem at hand.² The inquiry approach developed here follows a different path: we shall assign to the given problem a set of questions³ and (implicitly) the alternative answers to these questions, regarded as pertinent both for defining the problem and for exposing the author's attitude to that problem.

1. In short, the procedure is as follows.

1.1. A set of questions $\{Q_i(P), i=1, \dots, n\}$ referring to the problem P and taken as relevant, is put forth; one shall perceive as relevant the questions whose potential answers provide a sufficient image (or knowledge) of the problem P .

1.2. To each question, a logically comprehensive set of possible answers is attached. The array of answers should encompass the actual state of knowledge of the problem (as it appears in the literature), but also ought to express the genuine view developed by the author (or authors) of the study. Thus exhaustive families of answers to every question that has been chosen are formed. As a final result, the matrix of answers $\{A_{ij}(P), i=1, \dots, n, j=1, \dots, m_i\}$ is obtained.

1.3. The matrix of answers is handled the way a "Zwicky box"⁴ is used in morphological analysis. In this particular case, a definite configuration of answers

$$\{A_{1i_1}(P), A_{2i_2}, \dots, A_{ni_n}; 1 \leq i_k \leq m_i\}$$

circumscribes a specific point of view (or a peculiar attitude) in the study of the problem P. The exploration of the whole range of the possible configurations may be helpful, for instance in identifying: the point of view most often expressed in literature in general or by a certain group of experts on the problem; the points of view which are shared by an equivalent number of people; the points of view which are missing; or those which are more or less lacking specificity, among other things. Furthermore, if the topological analysis based on the Hamming distance⁵ is applied to the morphological space generated by the matrix $\{A_{ij}(P)\}$, more rigorous assessment of the relative "position" of different points of view can be performed. One can thus estimate which points of view are "closer" to a given point of view, which are more "distant" and which are equally departed from.

1.4. In fact, dialogue and the controversies among various points of view might be simulated. Panels of experts or working groups provide an environment in which different viewpoints can compete. In the field of international affairs, such an approach proves to be highly useful; it assists prediction of the possible behaviour of certain actors challenged by yet unknown circumstances in the world game (if the established structure of this behaviour is preserved); it also is of help in the assessment of the differences existing between the actors' viewpoints — a sensitive area in the field of research on peace and conflicts.

We shall not include the details of these topics. Nevertheless, let us mention that an alternative to the theory of games is suggested by the above approach. If the partners are assigned, in place of strategies and gains, sets of questions, answers, and pairs of costs and benefits associated to each configuration of answers, the simulation of the partner dialogue could be (theoretically at least) brought to a point where a computer can be used.

The inquiring procedure replaces the description of a problem through the polar problem-solution (or problem-model of the solution) with a different approach — the description of the problem through the

incessant dialogue between alternative points of view. What we gain in the process is a systems perception or approach to the problem under study.

This sort of inquiry can be applied both in the course of the analysis of the already expressed positions and for devising new ones.

Obviously, if the initial package of questions is accompanied by new answers, theoretically possible but which have never been formulated before (like those that take into consideration some assumptions regarding the future), it is thus possible to sketch, and sometimes even give a comprehensive formulation of, new points of view on the given problems.

2. Let us now apply the above described procedure to the comparative study of the global models elaborated up to this day. We shall call global those models which describe the world as a dynamic whole within a certain span of time.

In order to carry out our analysis, we shall introduce the following set of questions:

Q₁: Who produces the given image-model of the world?

Q₂: What are the motivations behind the decision to take up the burden of such an effort?

Q₃: What objectives have guided the modelling process?

Q₄: What are the parts which constitute the image of the world dynamics and are perceived as essential for the model?

Q₅: What methodology has been used in the process of modelling?

Q₆: For what reason has the author chosen that particular methodology?

Q₇: To whom had he intended the model to be addressed?

Q₈: Who are those who will recognize in the image shaped by the model their own image, whether pre-existing or shaped by the exposure, and thus will rely upon the model's accuracy and adhere to its conclusions?

Q₉: Who are those who will claim that the results of the modelling process are unacceptable because they are not conforming to their image of the world? Would they rather reject the model than renounce what their intuition suggests to them?

The reader has probably noted the subjective character of the range of questions developed here. This is partly due to the fact that the present analysis of the global models is linked to the conceptual and theoretical perspective on these issues developed within the GPID Project, considered in a subjective/objective dialectic.

Obviously, questions Q_1 , Q_2 and Q_3 – and the potential answers to them – are inspired by a specific philosophy of the modelling process, which directly links the ideological and the methodological aspects.⁶

The answers to question Q_4 should be sought among the processes (economic, demographic, environmental), the goals (economic, social, technological on global, regional and national levels) and the indicators (economic, social, human) involved in the development. To put it in more precise terms, one should probably look at the images the model's author is producing on these issues and is using in the modelling process. Any selection performed at this level – of the component parts considered relevant (and implicitly, any omission of other components) – implies a commitment to a definite point of view concerning the world's dynamics, and also concerning the key forces which set into motion the mechanisms of world evolution, and the ways in which they appear in real life.

The answers to questions Q_j , $1 \leq j \leq 4$ allow for the examination of the theoretical hypotheses (the explicit and, primarily, the implicit ones) underlying the process of global modelling.

The answers to questions Q_5 and Q_6 pertain to the domain of methodology. Of course, to repeat that the results of any modelling process depend upon the techniques and the methods used in the processing of the data, the facts, the information, and in the exploitation of the theoretical hypotheses is a mere platitude. However, it is often ignored that different methodologies sometimes embody a series of latent assumptions – which are rarely enunciated, but which can significantly affect the results.

Let us introduce, as an example, the well known "systems dynamics" methodology, employed by Dennis Meadows and his colleagues for the design of the global model which explored the limits to growth. Taking the standpoint developed in "systems dynamics,"⁷ we can see that any complex system is shaped by a certain number of interconnected feed-back loops $\{L_i, 1 \leq i \leq m\}$. The links between the pairs of loops are described by couplings $\{C_k, 1 \leq k \leq m\}$. A feed-back loop is defined as a triplet $\langle X, k, \mathcal{M} \rangle$, where X is the level, k the rate of variation, and \mathcal{M} the specific mechanism of loop functioning. This mechanism can be only of two types: the "positive" type \mathcal{M}^+ , described by the equation:

$$\frac{dX}{dt} = kX$$

and the "negative" type \mathcal{M}^- , described by the equation

$$\frac{dX}{dt} = k [X^* - X]$$

where X^* is a given constant. The coupling (C) between two loops $\langle X_i; k_i; \mathcal{M}^+ \rangle$ and $\langle X_j; k_j; \mathcal{M}^+ \rangle$, for instance, transforms the separate functioning of the two loops into a joint functioning, described by the equations:

$$(C) \begin{cases} \frac{dX_i}{dt} = k_i X_j \\ \frac{dX_j}{dt} = k_j X_i \end{cases}$$

As perceived by "systems dynamics," the entire architecture of the system results from the couplings between the loops forming that system. All the couplings are subject to a constraint imposed by the "rule of J.W. Forrester": the level of an element can be influenced only by the rate of variation of another element. Simple calculus shows that, under general conditions, from the above mentioned hypotheses it follows that the trajectories $x_i(t), x_j(t)$ remain within a bounded region of the plan (x_i, x_j) — defined by a quadratic form dependent upon k_i, k_j , and more generally upon $\mathcal{M}^+, \mathcal{M}^-$. The resulting behaviour, particularly the growth of certain levels, happens to be somehow limited a priori and therefore is incompatible with the variation of the levels within the entire plane (X_i, X_j) . The state of general equilibrium as expressed by system dynamics methodology can thus be seen

as a particular form of homeostasis and results directly from the specific methodology used.

If Forrester's rule is replaced by some different coupling procedure, for instance with the form⁸

$$\frac{dX_i}{dt} = k_i X_j + \lambda_j X_j$$

the results will also be different: the trajectories $\{X_i(t), X_j(t)\}$ would possibly outgrow any limited domain in the plan (X_i, X_j) , thus allowing for "unlimited growth." The confinement of growth within certain limits appears, not as a compulsory consequence of the systems self-regulation in general, but rather as a natural follow-up of a particular type of regulation, governed by the "coupling rule." Some other type of self-regulation would lead — at least in principle — to an unlimited growth or even to homeorhesis.⁹ In fact, the controversial conclusions set forth by the Limits to Growth Report to the Club of Rome should be viewed to a great extent as a result of a specific methodological assumption, brought about by the theoretical paradigm underlying the whole project.

Let us now proceed further. The answers to questions Q₇, Q₈, Q₉ introduce, implicitly or explicitly, the addressee (the client, or the beneficiary) of the modelling process. Considering the specific goals of the analysis developed here, the answers should make use of the notions currently employed within the GPID Project in the descriptions of social groups (respectively, researchers, researched, people, élites, capitalists, bureaucrats, intelligentsia, etc.). This section of the analysis permits the assessment of the foreseen impact of the model, its degree of representativeness and also the possible consequences of the action and decision-making potentially generated by awareness of the global problématique. We shall be able to examine systematically the reactions caused by the given global model when exposed to public debate. We shall identify also the assumptions underlying the specific rhetoric used in order to communicate the results of the modelling effort. These factors seem to play a particularly important role in the field of global modelling.¹⁰

3. For the sake of clarity, we shall illustrate our conjectures by some answers to the questions Q_j , $1 < j < 9$, synthesizing the opinions most frequently expressed in the current literature on the subject.

Here are some well known answers to the question Q_1 :

A_{11} — a team of researchers from the First World,

A_{12} — a team of researchers from the Third World,

A_{13} — an international team of researchers, lead by moderators from the First World.

To the question Q_2 , the answers are:

A_{21} — the commendation of a group or an organization which also finances the modelling,

A_{22} — commitment to the idea of raising the public awareness facing the global problématique,

A_{23} — eagerness to achieve professional success,

A_{24} — in response to other global models seen as being incomplete or even harmful.

To the question Q_3 , one can consider the following answers:

A_{31} — building up a realistic image of the world in its dynamics — which should prove useful in the decision-making process,

A_{32} — the systematic exploration of some theoretical hypotheses concerning the dynamics of the world system,

A_{33} — stimulating debates around the global problématique, by building and disseminating images which are deliberately distorted (such as catastrophes or idealized utopias).

To question Q_4 , the alternative answers are:

A_{41} — the global socio-economic processes,

A_{42} — the regionalized socio-economic processes, governed by political will,

A_{43} — local, regional, and global objectives (in the fields of economy, politics, social relations),

A_{44} — economic processes and the regional indicators, linked by relationships of the balance type,

A₄₅ — the global objective of establishing a better "new order."

To question Q₅, the existing answers are:

A₅₁ — trend-extrapolation techniques (involving alternative corrections),

A₅₂ — computer simulation using "system dynamics" methodology,

A₅₃ — partial computer simulation using the methodology of multi-level, multi-goals hierarchical systems,

A₅₄ — simulation using multi-sectorial econometric techniques,

A₅₅ — simulation using balance-type techniques,

A₅₆ — techniques of sociological inquiry (polls, surveys, etc.).

To question Q₆, the alternative answers could be:

A₆₁ — the confidence in the consistence between the methodology used and the subject of the study,

A₆₂ — the deficiencies of other methodologies used in the exploration of the subject at hand,

A₆₃ — the presumptive prestige gained through using a sophisticated methodology whose meaning is inaccessible for people not initiated in its secrets,

A₆₄ — the dissemination of a certain methodology in a popular form, with a view to subsequently exploiting the prestige derived from its use in global modelling,

A₆₅ — the attempt to verify, through use of certain methodological instruments, some findings and conclusions obtained by other means.

The possible answers to the question Q₇ are:

A₇₁ — first, to the team recommending and financing the research, and afterwards to the public at large,

A₇₂ — to the scientific élites (belonging respectively to the First, the Second, the Third or the whole World),

A₇₃ — to the political élites (belonging respectively to the First, the Second, the Third or the whole World),

A₇₄ — to people in general.

To the questions Q₈, the alternative answers are:

A₈₁ — the élite, belonging to the same class as the authors of the model,

- A₈₂ — the people and the élites, equally relying on the virtues of modelling (belonging respectively to the First, the Second, the Third or the whole World),
- A₈₃ — the people and the élites, who are confident in the authors' professional prestige,
- A₈₄ — the people and the political élites, whose opinions happen to be in concordance with the conclusions expressed by the model.

To the question Q₉, the alternative answers are:

- A₉₁ — the élites who do not share the (theoretical, methodological, etc.) convictions of the authors of the model or are competing with them,
- A₉₂ — the people and the élites, distrustful of models which do not allow for control by "common sense,"
- A₉₃ — the people and the élites, distrustful of the experts' objectivity,
- A₉₄ — the people and the political élites whose opinions are opposite to the conclusions expressed by the model.

The morphological box associated to the questions Q_j, 1 ≤ j ≤ 9 and pertaining to the problem P — "global models" — forms the following table:

Q ₁ :	A ₁₁	A ₁₂	A ₁₃			
Q ₂ :	A ₂₁	A ₂₂	A ₂₃	A ₂₄		
Q ₃ :	A ₃₁	A ₃₂	A ₃₃			
Q ₄ :	A ₄₁	A ₄₂	A ₄₃	A ₄₄	A ₄₅	
Q ₅ :	A ₅₁	A ₅₂	A ₅₃	A ₅₄	A ₅₅	A ₅₆
Q ₆ :	A ₆₁	A ₆₂	A ₆₃	A ₆₄	A ₆₅	
Q ₇ :	A ₇₁	A ₇₂	A ₇₃	A ₇₄		
Q ₈ :	A ₈₁	A ₈₂	A ₈₃	A ₈₄		
Q ₉ :	A ₉₁	A ₉₂	A ₉₃	A ₉₄		

The various "paths" which can be devised in the "space of the answers" define the "points of view" already expressed, as well as the points of view on global modelling which have not yet been formulated (but are possible in principle). Actually, we are dealing with a space able to produce (theoretically) 345,600 alternative points of view: some of

them have already been investigated in literature, some not.

For the sake of simplicity, we shall write:

$$C(i_1, i_2, \dots, i_9) = \{A_{1i_1}, A_{2i_2}, \dots, A_{9i_9}\}$$

In this notation, the configuration $C(1, 3, 2, 1, 1, 4, 4, 3, 1) = \{A_{11}, A_{23}, A_{32}, A_{41}, A_{51}, A_{64}, A_{74}, A_{83}, A_{91}\}$ describes the "point of view" of Herman Kahn and Anthony Wiener, as it results from their work entitled The Year 2000 (published in the 1960s).¹¹ (Almost the same viewpoint has been developed in a more recent work — The Next 2000 Years — published in 1976.¹²) The configuration $C(1, 1, 3, 1, 2, 1, 1, 1, 1) = \{A_{11}, A_{21}, A_{33}, A_{41}, A_{52}, A_{61}, A_{71}, A_{81}, A_{91}\}$ approximates the "point of view" of the team of D. Meadows and his fellows, who wrote the report on Limits to Growth, submitted to the Club of Rome in 1971.¹³ The configuration $C(3, 4, 1, 3, 6, 2, 3, 4, 4) = \{A_{13}, A_{24}, A_{31}, A_{43}, A_{56}, A_{62}, A_{73}, A_{84}, A_{94}\}$ describes the "point of view" developed by E. Laszlo in his report on Goals for Mankind submitted to the Club of Rome in 1976.¹⁴ The configuration $C(1, 1, 2, 4, 5, 5, 1, 4, 4) = \{A_{11}, A_{21}, A_{32}, A_{44}, A_{55}, A_{65}, A_{71}, A_{84}, A_{94}\}$ describes the "point of view" of the team led by W. Leontieff, expressed in the report The Future of the World Economy, elaborated under the aegis of UNO in 1977.¹⁵ The configuration $C(2, 2, 3, 2, 4, 5, 3, 4, 4) = \{A_{12}, A_{22}, A_{33}, A_{42}, A_{54}, A_{65}, A_{73}, A_{84}, A_{94}\}$ describes the point of view of the South American team working at the Fundación Bariloche and published in the volume Catastrophe or New Society?¹⁶ The configuration $C(1, 1, 1, 2, 3, 1, 1, 1, 1) = \{A_{11}, A_{21}, A_{31}, A_{42}, A_{53}, A_{61}, A_{71}, A_{81}, A_{91}\}$ describes the point of view developed by the group led by M. Mesarović and E. Pestel in their report Mankind at the Turning Point submitted to the Club of Rome in 1974.¹⁷

4. Let us now examine what advantages such an inquiring scheme could possibly provide, and its potential benefits for the comparative analysis of a set of global models.

First, apparently, it allows for a sort of "multidimensional" commentary. The various models are understood in terms of the processes of modelling.

In this perspective, the analysis of the theoretical assumptions, the methodological hypotheses and the "rhetorical" peculiarities of the model-making, along with the possible differences displayed by the results, are conducted simultaneously. Thus, the inquiring scheme introduced in this paper puts forward an extension of the procedures commonly employed for comparative analysis which as a rule concentrates on a single area — either the results, the methods or the rhetoric. In particular, one can also obtain an assessment of the existing global models, performed in the perspective of the GPID Project. The answers to questions Q₄ and Q₅ allow for the identification of those "points of view" which result from the analysis of the processes (socio-economic, technological, political, etc.), of those which take into account primarily the objectives (economic, social, human, etc.), or of those which make use of indicators.

The different existing models (together with the respective modelling processes) no longer appear as competing and opposing each other (thus demanding a firm pro or con decision), but reveal complementary traits.

Seen under the (formalized) perspective developed within this paper, the models could appear as somewhat equivalent, in that they are regarded mainly as "answer-givers" to a set of definite questions.¹⁸ Thus, the (formal) measure of the standard achieved by a model is established merely in connection with the "quality" of the answers.

Let us note that this approach confines the analysis within the boundaries delineated by the set of questions. It is also true that some commentators may judge certain models more adequate, more useful, or at least less dangerous than the others, according to their respective stand-points. Being given two definite models, it might be interesting to know not which one "is better," but rather what foundations the models rely on, what the results are that each of them produce, and what the advantages and disadvantages are of the specific way in which each of them analysed the global problématique (even if the stand-points expressed do not exactly overlap the commentators' points of view).

For example, manifestly, the Mesarović-Pestel model is less aggregated and in a sense more "faithful" to the actual world conjuncture than the image introduced by Meadows' team. But from the point of view of long-term feasibility, the disaggregation may prove less advantageous. In fact, if the problem is to give a suggestive picture of world evolution, the model proposed by Meadows' team seems more suitable for the purpose, due to its internal coherence. As this model is to a lesser degree exposed to local or accidental fluctuations, it could better fit the description of global dynamics.

Nevertheless, the Mesarović-Pestel simulation appears more advantageous for operational purposes, when compared to the self-regulated Meadows model. In a sense, the two models complement each other: this is more evident when one looks at the fairly closed results the two models produce.

An analysis of this sort can be performed so as to produce a more sensitive valuation of the models under examination, not only in respect to their final results, but also taking into consideration the modelling processes themselves, and the points of view that generated them.

This perspective, based on the concept of complementarity and developed in the "space" of the viewpoints generating global models, could be made operational by means of a topological analysis.

Thus, let

$$c(i_1, \dots, i_9) = \{A_{1i_1}, \dots, A_{9i_9}\},$$

$$c(j_1, \dots, j_9) = \{A_{1j_1}, \dots, A_{9j_9}\}$$

represent two distinct "points of view" in global modelling, with

$$1 \leq i_1, j_1 \leq 3 \quad 1 \leq i_2, j_2 \leq 4 \quad 1 \leq i_3, j_3 \leq 3$$

$$1 \leq i_4, j_4 \leq 5 \quad 1 \leq i_5, j_5 \leq 6 \quad 1 \leq i_6, j_6 \leq 5$$

$$1 \leq i_7, j_7 \leq 4 \quad 1 \leq i_8, d_8 \leq 4 \quad 1 \leq i_9, j_9 \leq 4$$

As distance in the space S let us take an expression of the form

$$d[c(i_1, \dots, i_9), c(j_1, \dots, j_9)] = \sum_{k=1}^9 f(i_k, j_k)$$

where the function f has evident properties derived from the axioms imposed upon any distance. For the particular case when¹⁹

$$f(i_k, j_k) = \begin{cases} 1, & i_k \neq j_k \\ 0, & i_k = j_k \end{cases} \quad 1 \leq k \leq 9$$

the distance $d[C(i_1, \dots, i_9), C(j_1, \dots, j_9)]$ gives the number of different answers which appear within the configurations under study and also estimates the relative proximity between the points of view. For instance, from the points of view found in the current literature, we get

$$\begin{aligned} d[c(1, 3, 2, 1, 1, 4, 4, 3, 1), c(1, 1, 3, 1, 2, 1, 1, 1, 1)] &= 6 \\ d[c(1, 1, 3, 1, 2, 1, 1, 1, 1), c(1, 1, 1, 2, 3, 1, 1, 1, 1)] &= 3 \\ d[c(1, 3, 2, 1, 1, 4, 4, 3, 1), c(1, 1, 1, 2, 3, 1, 1, 1, 1)] &= 7 \\ d[c(3, 4, 1, 3, 6, 2, 3, 4, 4), c(1, 3, 2, 1, 1, 4, 4, 3, 1)] &= 9 \\ d[c(3, 4, 1, 3, 6, 2, 3, 4, 4), c(1, 1, 3, 1, 2, 1, 1, 1, 1)] &= 9 \\ d[c(2, 2, 3, 2, 4, 5, 3, 4, 4), c(1, 1, 2, 4, 5, 5, 1, 4, 4)] &= 3 \\ d[c(2, 2, 3, 2, 4, 5, 3, 4, 4), c(1, 1, 1, 2, 3, 1, 1, 1, 1)] &= 8 \end{aligned}$$

That shows that the "point of view" developed by Kahn-Wiener is closer to that of the Meadows team than to the Mesarović-Pestel team and to the Laszlo team (to which it seems to be even "diametrically" opposed): the "point of view" of Meadows' team is closer to that of Mesarović-Pestel than to Laszlo's (to which it is "diametrically" opposed too); the "point of view" of the Fundación Bariloche group is closer to that of W. Leontieff's team than to Mesarović-Pestel's, etc.

A more sophisticated and rewarding approach could be obtained if the distance is defined as

$$d[\bar{\rho}, c(i_1, \dots, i_9), c(j_1, \dots, j_9)] = \sum_{k=1}^9 \rho_k \cdot f(i_k, j_k)$$

where $\bar{\rho} = \{\rho_k, 1 \leq k \leq 9\}$ is a system of weights

$$\rho_k \geq 0, \quad \sum_{k=1}^9 \rho_k = 1$$

showing the (relative) importance of the questions $\{Q_k, 1 \leq k \leq 9\}$ as seen by the scholar who is performing the comparative analysis of the global models. If, for instance, the question Q_1 appears as more relevant (in the eyes of the person who is developing the analysis) than the question Q_5 , one will take $\rho_1 > \rho_5$. The implications for the results are obvious. Of course, the weights can be established through some form of collective approach (a survey, a panel, etc.).

Let us finally mention the coherent outlook which develops along this inquiring procedure, when examining the attitudes and points of view which are in principle possible, but have still not been explicitly formulated. Among the configurations produced by the whole range of answers to the questions $Q_j, 1 \leq j \leq 9$, some are logically contradictory; some could prove to be currently non-existent, although they are perfectly coherent in regard to the obtained theoretical matrix. For example, let us imagine a group of scholars from the Third World (answer A_{12}); in response to some global model (answer A_{24}); in order to stimulate the debate around the issue of development (answer A_{33}); taking as a goal the installation of a new order (answer A_{45}); using a partial computer simulation based on the multi-level hierarchical systems methodology (answer A_{53}); aiming to verify the results obtained by other people (answer A_{65}); but rendering their results in a way which made them understandable for the masses (answer A_{74}); attempting to congregate around their model certain political or scientific élites (answer A_{84}); taking upon themselves the risk of "provoking" their adversaries (answer A_{91}). The resulting configuration $c(2, 4, 3, 5, 3, 5, 4, 4, 1)$ has not yet shown up in a specific report. Nevertheless, this configuration seems to be plausible and one could roughly foresee its results — and may separate its (possible) conclusions from the neighbouring points of view.

Let us make a final remark. The reader has probably already noticed that the whole argument developed here bears a subjective character. Actually the questions and the answers and the associations between questions and answers (which generate the "points of view") are profoundly marked by the particular outlook of the person who develops

the comparative analysis of the global models. One can argue that the proposed inquiring procedure is suitable only for exploring in a more "objective" manner the "subjective" premises of the modelling global processes. Is this of any use? We are convinced that it is. Obviously, such investigations are necessarily subjective; at the same time, the fact that the subjective character of the inquiry is explicitly acknowledged and taken for granted from the very beginning bestows in our opinion the necessary foundation on which the critical debate and the constructive dialogue could actually develop.

II. NEW DIRECTIONS IN GLOBAL MODELLING: A FEW SUGGESTIONS

The inquiring procedure described in Part I of this paper turns out to be useful mainly because it can assist, or at least suggest, some extensions of the procedure used before, beyond the simple combinational treatment of the given questions-answers morphological box.

1. Some interesting ideas could arise from adding to the initial set some new questions which actually do not appear when exploring the literature on the subject but which are logically (or theoretically) called for by the general context of the problem. In the following we will introduce some questions which seem to us relevant for the purpose of studying global models:

Q_0^1 : Is there any need for global models — i.e., for images of the whole world?²⁰ And if so, precisely who are those who ask for them?

In the same vein, some other questions of a similar type could be set forth as follows:

Q_{10}^1 : In what way can a citizen of this world "verify" the adequacy of a global model?

Q_{11}^1 : As for the citizen who desires to actively involve himself in the life of the community, does he really need information on the world dynamics — such as appears in a global model?

Q_{12}^1 : Is there any real opportunity for building a global model — i.e., an image of the world in its dynamics — which all the members of the planet's community could assess as being "adequate," which they will believe in and will agree to use in the management of the community's affairs?

The answers to such questions are not trivial. Using the GPID terminology once again, the alternative answers to question $Q_0^!$ could be:

- $A_{01}^!$: Global models are equally needed by all the inhabitants of this planet.
- $A_{02}^!$: Global models are needed by all; however, the élites (the capitalists, the bureaucrats and the intelligentsia) need them more than the people do, mainly because the élites gain direct benefits from correlating the policies they are devising.
- $A_{03}^!$: Global models are needed by all; however, the people need them more because in this way they gain an instrument for assessing and controlling the élites' policies.
- $A_{04}^!$: Global models are needed exclusively by the élites (and useless or even harmful for the people).
- $A_{05}^!$: Only the masses need the global models.
- $A_{06}^!$: Global models are useless (and even harmful) for everybody (except for their authors, interested in achieving professional success).

Evidently, any answer to the question $Q_0^!$, if associated with a certain "point of view" on global modelling of the kind presented in Part I, will eventually produce a somewhat fresh view on our problem.

The alternative answers to the questions $Q_{10}^!$, $Q_{11}^!$, $Q_{12}^!$ refer to some intrinsic characteristics of the modelling process, especially to the aspects related to the manipulation of and to the specific rhetoric involved in the global modelling. These issues will be tackled in Part III. Let us only mention here, anticipating the next section, that in our opinion a global model that is accepted by the majority of the planet's citizens is theoretically and practically inconceivable. In theory, due to the basic heterogeneity of the planet's society, a universal global model could be acknowledged by the élites, who are usually less divided and ideologically more homogeneous. Once again we rely on an observation formulated by J. Galtung, who analysed this in connection with what he calls "modernization."²¹ Sometimes, however, the nation-states could adhere to a certain global image concerning the behaviour of the world in its totality. This does not extend to

the values and structures which underlie global behaviour.

The essential problem is not so much the assemblage of a single global model, but rather the development of a participatory modelling process. This process — which entails a dialogue between several alternative global models — can be seen as being a basic feature of a new world order.

2. Aside from suggestions given by the extension of the package of questions related to the problem under study, some new aspects could arise when adding new answers to the initial set of alternative ones. If the general state of the art in the field of global modelling is taken into consideration, the following answers to question Q₁ could be considered as (at least theoretically) justified:

- A₁₄ — a group of people from the Second World who are committed to its ideological values and are concerned with devising a scenario of the advancement of the planet's society toward communism.
- A₁₅ — an international team of researchers moderated by people from the Second (or Third) World.
- A₁₆ — a group of researchers and "researched" belonging to different parts of the world, moderated by people from the First World, etc.²²

To question Q₅, the following answers could be added:

- A₅₇ — simulation, using cross-impact techniques (in particular of the KSIM-type).²³
- A₅₈ — techniques based on the catastrophe theory (R. Thom).²⁴
- A₅₉ — techniques based on the theory of chaotic regime (Li and Yorke).²⁵
- A_{5.10} — techniques based on the "generative grammars" models (Marcus).²⁶
- A_{5.11} — techniques based on fuzzy-type analysis.²⁷
- A_{5.12} — techniques using the dialogue between purely intuitive images.²⁸
- A_{5.13} — techniques based on the simultaneous simulation of the evolutions of each of the three worlds; the simulation should effectively take into account the specific logics and ethics pertaining to current reality.²⁹

Obviously, each such answer, if combined with other answers as sketched in Part I, may reveal a yet unexplored approach to global modelling.

The array of answers could be expanded even further. However, we shall not continue this list, in the hope that the innovative potential of the proposed procedure will make itself sufficiently convincing.

In conclusion, it is important to note that the inquiring scheme introduced in Part I (initially intended for the purpose of performing a comparative analysis) also allows for a creative treatment of the problem under study.

3. In the following we will try to outline a new point of view in global modelling, through associating the 'new' answers A_{14} , A_{58} with a combination of other answers — thus generating a point of view described such as $\{A_{14}, A_{22}, A_{31}, A_{42}, A_{58}, A_{61}, A_{72}, A_{84}, A_9\}$. Apparently it summarizes the Marxist point of view which introduces in the modelling process the technical apparatus of the catastrophe theory. Catastrophe theory assumes that the measured effect x , for some fixed setting of the causal or control parameters $(\alpha_1, \dots, \alpha_\tau)$ describing the environment, will normally be observed at a value where some potential function $f(x, \alpha_1, \dots, \alpha_\tau)$ has a local relative minimum. Thus, we study the whole function family $f(x, \alpha_1, \dots, \alpha_\tau)$; we find the critical points $x^x(\alpha_1, \dots, \alpha_\tau)$ where $df/dx = 0$ for each fixed setting of parameters $(\alpha_1, \dots, \alpha_\tau)$ and graph the variation of x^x with changes in $(\alpha_1, \dots, \alpha_\tau)$. Such a graph, called the critical manifold of x versus $(\alpha_1, \dots, \alpha_\tau)$ yields the locus of all critical points, including the local minima, maxima, and saddle points as well as new types known as elementary catastrophes (and called the fold, cusp, swallowtail, butterfly and wigwam according to the number $\tau = 1, 2, 3, 4, 5$ of the control parametry. The values of $(\alpha_1, \dots, \alpha_\tau)$ on the $(\alpha_1, \dots, \alpha_\tau)$ -parameter space we call control surface.

The use of catastrophe theory seems particularly suited to this context. It permits us to join the perception of continuity (on the level of the variations in the structure) to the study of discontinuity — as

observed on the level of the resulting variations in systems behaviour.³⁰ In our view, it provides a better methodological framework for coping with the Marxist evolutionary-revolutionary outlook than techniques based on pure trend extrapolation, or the techniques involving only self-regulating devices.

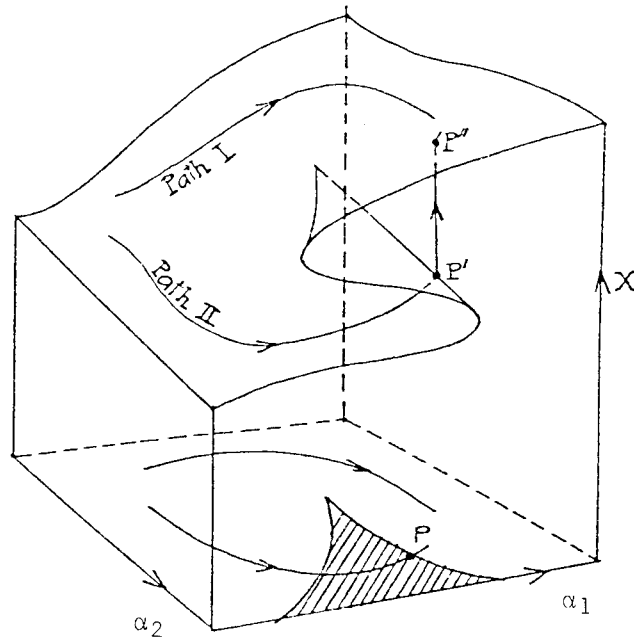
Silvia Brucan (a Romanian Marxist scholar) holds that the dialectics of international relations and, in particular, of the world dynamics, ought to be explained, and foreseen, in terms of two major types of social clashes: the conflicts occurring at the level of social classes and those occurring at the level of ethnic communities.³¹ This suggests clearly a model with two control parameters (α_1, α_2) where α_1 is a measure (estimated, in a first approximation, on an arbitrary scale) of the intensity of the class conflicts when α_2 is a measure of the intensity of contradictions on the international arena. The concept of measure has to be defined in relation to the "behavioural variable" under study.³²

Now let us concentrate on a particular problem, for instance, the future of global security. Let x be a behavioural variable, measuring the degree of conflict existing within the international system on an (abstract) scale ranging from "total war" to "total peace";³³ the middle point of this scale denotes the "passage" from war to peace. We shall appoint negative values to the state of peace and positive ones to the state of war.³⁴ Let us consider α_1 — the "measure" of the intensity of class conflicts and α_2 — the "measure" of intensity of international conflicts.³⁵ Let us also consider that α_1 is increasing when the conflicts between those who are exploited and those who exploit are heightening (within each nation, but evaluated on a global scale); α_2 is increasing along with the difficulties preventing the level of international co-operation between nations from rising (and taking various forms, for instance of new military alliances).

Obviously, we are facing a model with two control parameters (α_1, α_2) which reveals a behaviour of the cusp type described by the equation

$$f(x, \alpha_1, \alpha_2) = x^4 - \alpha_2 x^2 - \alpha_1 x$$

The figure below shows the variation x as a function of the points (α_1, α_2) belonging to the control surface:



This scheme explains how the sudden, or "catastrophic," passage from peace to war could possibly occur as a result of some slow (and relatively small) changes in the (joined) intensities of class, and international conflicts. Let us suppose that (α_1, α_2) take relatively low values and x is negative: that means that we are dealing with a state of peace. Let us now simulate two alternative evolutions in the concomitant variations of α_1, α_2 . In the first case, α_1 starts increasing, while α_2 remains steady for a time and increases gently thereafter: as a result x will rise gradually from peace toward war (the Path PI). But let us also consider an alternative situation, in which α_2 increases first (and quite rapidly) before α_1 starts to rise: the Path PII displays an abrupt bound from P' to P'' (i.e., from peace to war). The slow variation of the parameters α_1, α_2 leads to a dramatic ("catastrophic") change of x .³⁶

The scenarios developed by Holt, Job and Markus could be expanded further in order to explain the breaks, and the respective ends, of the First and the Second World Wars. Even more, they suggest the

following interesting remark (which appears counter-intuitive in many respects): if seen through the prism of the international conflicts and interests (and only afterwards through the prism of class-interests), world security seems less stable than when one looks at it mainly through the prism of class interests (and only afterwards of international conflicts). If we recall that class interests are usually stressed in East-West conflicts, whereas the international ones appear more frequently in connection with North-South conflicts, it follows that the North-South axis of conflict is potentially — by its very structure — much more capable of producing "catastrophic" imbalances than the East-West axis (in spite of the notorious fluctuations of détente!). Thus, in a world in which the intensity of North-South conflicts is rising impetuously, and at the same time the intensity of East-West conflicts is also rising (although more slowly), there appear to be possibilities of sudden, or even violent, modifications in the international situation. Speculating further on these topics, one could infer that the resolution of conflicts between North and South (and, in particular, the satisfaction of basic human needs through the implementation of some adequate strategies of socio-economic development) should be given absolute priority on the agenda of the decision-making relevant for the world-wide scale. That proves to be equally true if the analysis of international situations is centred on the problem of maintaining peace and avoiding war.

The model introduced above allows for an interesting simulation concerning the future evolutions of global security in regard to the function of the control parameters α_1 , α_2 . Taking the hypothesis developed by S. Brucan that each of the two factors (α_1 , α_2) will successively prevail over the other one, we ought to infer that global security will register the corresponding fluctuations (i.e., periods of "cold war" alternating with periods of détente).³⁷

We shall not continue with the analysis of these hypotheses. As a conclusion however, let us mention that some interesting findings could arise when simulating some other hypotheses about the simultaneous variation of the factors α_1 , α_2 .

A similar kind of analysis (performed above in the case of global security) could also be conducted with other variables of behaviour (the population, the economic situation, etc.). A Marxist scheme could be imagined aiming to describe all the dimensions of human and social development encompassed by the GPID Project in terms of class and international conflicts. Furthermore, some speculations could be developed concerning the (qualitative) variations of (individual's) survival, well-being, identity, and freedom; concerning production, distribution of goods, state of the environment, social structure, and culture (on the level of human groups and communities), all in connection with the variation in the intensity of class and international conflicts. Once again the theoretical possibility of certain irregularities occurring in the behaviour of specific variables (such as well-being of individuals, freedom, and cultural or social structures) does exist and seems rather closely linked to class conflicts and to conflicts between nations (or of ethnical character).

What we get when we try to introduce the techniques of catastrophe theory in the Marxist scheme developed by S. Brucan is not exactly a global model, but rather a specific sequence of qualitative analysis applicable to many social and political conjunctures and, in particular, to the global problématique. However, it seems obvious to us that to transform such a scheme into a global model requires a strenuous effort. That goes far beyond the purposes of the present paper. What we tried is only to convey the interest which may result in such an approach.

Catastrophe theory formally proves that, for the case of two control parameters, models which explore the simultaneous variation of several behavioural variables x_1, \dots, x_n (thus introducing functions of the form $f(x_1, \dots, x_n, \alpha_1, \alpha_2)$) could be reduced to the simpler scheme described before. Those who eventually will take over the burden of putting into operation the model with two factors inspired by the Marxist analysis developed by S. Brucan may bear in mind this interesting and somehow astonishing feature of the proposed scheme.

More sophisticated models could actually be built, proceeding from a variant with four key forces of the world dynamics. These forces are (once again in Brucan's vision³⁸) pressure of technological interdependence (α_1), power (α_2), national identity (α_3), and social change (α_4). Obviously, the last two factors show close resemblance to the parameters (α_1, α_2) involved in the previous scheme. In this case, the process leads to a catastrophe of the "butterfly" type, described by the following function:

$$f(x, \alpha_1, \alpha_2, \alpha_3, \alpha_4) = x^6 - \alpha_4 x^4 - \alpha_3 x^3 - \alpha_2 x^2 - \alpha_1 x$$

where the behaviour variable x depends on the four parameters $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ identified in the course of Brucan's analysis. The same arguments that Holt, Job and Markus used in their model can support the exploration of the variation of global security (and of other problems related to war and peace) on this expanded model too.

The more comprehensive case of a four key-forces model devised for assessing the dimensions of the vector of human and social development (as seen by the GPID Project philosophy) and using the apparatus of catastrophe theory outlines a possible future domain of research.

III. THE PROCESS OF GLOBAL MODELLING: SOME STRUCTURAL CHARACTERISTICS

When compared with other processes involving image generation-communication, those related to the world as a whole and its dynamics on a global scale display some peculiar characteristics.

In particular, this is true for those images in which some kind of amplifiers of human intuition and knowledge have been incorporated — and which are referred to as models in this paper. Even the writers reviewing the previous work done in the field of global modelling frequently neglect the specificity of the process. The traditional basic elements of the conceptual and technical apparatus recommended for use in global modelling remain in many respects similar to those used for the purposes of studying other socio-economic systems, developed on a smaller scale — such as urban areas, productive units or hierarchical organizations.

As we are concerned here mainly with the modelling of the global processes, there is a strong case for taking into consideration the fact that the object to be modelled — i.e., the world in its entirety — is unique and thus has no equal among other real-world phenomena. This influences all the compartments of the modelling process and affects both the activity of the model's author and the way the model is perceived by the users.

Part III is dedicated to these issues. We shall explore in the following how "globality" infiltrates the various compartments of the modelling process.³⁹

In the process of this discussion some of our own views as expressed

in Part II will be given larger theoretical substantiation.

1. In the task of representing the world in its entirety, the model maker faces a problem of a particular nature.

The "normal" procedure of modelling the functioning of an enterprise or of an urban area is no longer valid at the global level. In the "normal" case, the model maker can, and usually does, establish direct contacts with the subject of his study. In various ways, and at different points in time, frequently using samples (which he considers to be representative), the model maker "touches" the reality that he is attempting to model and acquires what he believes to be empirical information which, in his eyes, is sufficient for his purpose. The "hard" input in the modelling process — namely information, real data and knowledge of methods and techniques — is thus superimposed on the feeling that the model maker has acquired intuitive knowledge of reality which allows him to assess the degree of adequacy between the speculations developed within the model and reality at large (far before some critical appraisal of the model's utility or functioning has been expressed).

The representation of a large socio-economic system (a nation-state for instance) obviously raises some difficulties along the same lines. Although there are problems of scale in the direct relationship between the model maker and the system to be modelled, the author(s) can feel whether their speculations are meeting the modelled reality or not (before a rigorous assessment is performed).

But the model maker who confines himself to global problems is compelled to abandon this comfortable feeling from the very beginning. It seems obvious that the gap between the extent of one's direct experience and the actual dimensions of the "object" under study can hardly be bridged — even in principle. No one can claim that he is in possession of sufficient "knowledge" of the whole world. What does it actually mean — "to have direct experience of the world"? Contacts with other people during tourist or study trips and discussions with colleagues,

model makers at professional gatherings, seem to add only meagre contributions to what one is able to collect within the space of his personal life (and which remains the one and only truly tangible unmediated contact).

Thus, the model maker who sets himself to the task of modelling world dynamics is not producing an image of a known "original" (or prototype). The status of the global modeller cannot be compared with the status of the modeller of local enterprises which can be directly and empirically known. In this case, the meaning of the concept of modelling itself changes and is no longer definable as the representation of a prototype existing prior to modelling.⁴⁰

Before proceeding further, let us make precise what we mean by the "universe of direct knowledge." The problem is quite complex and the areas that could be associated with this concept might look very different.

In the field of social sciences, the scholar who applies himself to some sort of study can be the researcher and the researched at the same time. We shall thus define the "universe of direct knowledge" as the social domain to which a given scholar belongs as a "researcher" and as an ordinary citizen simultaneously — being therefore compelled to obey rules and laws, to deal with power centres, to participate in the life of the community, and to act in order to achieve some goals (of a political, economic, or even exclusively professional nature).⁴¹

In our opinion this is the very zone in which a realistic fusion occurs between the field of the interest of the researcher and the responsibility he bears for the possible direct or indirect use of the results of his research in the social life of his community. Consequently we shall expel (conceptually) from the sphere of direct knowledge domains which are frequently and almost exclusively academic exercises.

Any global approach requires for "intruding" upon what lies outside the

universe of one's direct knowledge (as we have defined this concept). Thus when a model maker undertakes the modelling of world dynamics, he first ought to develop an overall image of the world. The carrying out of this plan demands for an extension of the model maker's experience: the resulting image will help him during the modelling process in assessing the legitimacy of the speculations he puts forth.

But is it actually possible to step beyond the sphere of direct access and control? If so, how could this be done?

The first approach is to use the existing information about the "exterior" space which lies within the reach of the model maker. Therefore he must enter the realm of data and information concerning some large geographical areas — especially the Second and Third Worlds — which are generated almost solely by governmental sources (and adapted as such by international statistics) and thus are suitable for the study of (international or even national) politics rather than for scientific exploration.⁴² It follows that the model maker who gathers information about the state and the dynamics of the world finds himself in a different situation in comparison with his colleagues, who, e.g., may explore the functioning of a local enterprise. The "global" model maker is in many respects confined to a great extent to information which almost entirely escapes his control and whose adequacy cannot be assessed — not even by the means of simple intuition.

The theoretical theses concerning what is going on "outside" of our own reach (particularly, in the GPID outlook: what concerns the processes, the objectives and the indicators of world dynamics) which are to be incorporated as "raw" premises into any modelling process on global scale are thus deeply dependent on available information (and which often are incomplete and distorted).

Particular difficulties can arise when collecting and putting into use the information concerning the aspirations and the real goals set in spaces alien to the model maker's. In fact, one can hardly prevent the reduction of the real range of aspirations and goals to those brought

forth (or which could be brought forth) by a certain political actor — who is allowed to express himself freely (as can pluralist governments or political parties).⁴³

However, in all probability, apart from those who can formulate their aspirations, there are many others who are in some way prevented from doing so. People belonging to minorities, marginal groups of opponents to authoritarian regimes are not renouncing their desires to formulate their aspirations. They too have to be taken into account by any lucid inquiry.⁴⁴

A second approach for performing the "extension" of the image beyond the sphere of one's direct perception could be based on a particular set of ideological theses rather than on crude information. As seen by the partisans of this approach, the world at large — both within and outside the sphere touched by our own experience — obeys some general rules, or laws, which are cognizable and fit a certain theoretical scheme considered to be legitimate. It follows that the parts of reality unknown to the model maker ought to yield to the same general laws of history, leading mankind toward socialism and communism. The information referring to "what is going on" does not sink into a void, but joins a pre-existing theoretical framework. The available information is controlled, interpreted, reviewed or rejected in the light of the theory.

The particular ways in which the ideological conceptual schemes are put into operation are very diverse. We shall try to describe several canonical types, using — as elsewhere in this paper — the language of the GPID Project.

For many communists, for instance, the basic process in the contemporary world is the process of transition toward socialism and communism.⁴⁵ This process bears a global character although it may reveal itself in different manners in the First, the Second, or the Third World. The "crises" of the First World are seen mainly as manifestations of this process; the fact that they sometimes spread on a global scale is once

again convincing evidence that, due to the close interdependencies established on the planet, the "sick parts" of the world can contaminate the healthy parts. The geographical extension of the socialist community (new countries are joining it yearly) as well as its successes in the economic, political and social domains are interpreted as strong arguments supporting the inevitable transition paradigm. If the beneficial effects of this process are less intense on the global scale, the responsibility for internal development and its attitudes in international relations of socialism remain exemplary.

"The socialist community sets a good example of how the major problems which confront mankind today are solved" — writes L.I. Brezhnev and adds: "It is self-evident that this community (i.e., the socialist countries) simply cannot take upon itself the task of solving mankind's problems."⁴⁶

In the perspective devised by the communists, the Third World is confronted with the fundamental choice between the socialist way of development — which proves to be more rapid, more sure and more efficient — and the capitalist way — sustained by the First World in its attempt to obliterate the inexorable advance of the historical process toward the final victory of communism.

Let us therefore remember that for communists, the fundamental process taking place in the contemporary world is the transition toward communism — confirmed by the crises of the First World, the stability and the achievements of the Second and the alternative developments of the Third World. The very goal of the popular masses in any part of the planet should therefore be the installation of the egalitarian communist society. This description, performed in the spirit of scientific socialism, of the goals and processes of global development should use such indicators as the extent of the private property, the social inequity, the level of mass-consciousness in regard to class conflicts, the degree of acuteness of these conflicts, the level of mass-participation in the fulfilment of their goals, etc. For the communist model maker, information — economic, social, political, etc.

— is selected and analysed in the light of the general ideological standpoint: new information should not invert the scheme described above, even if certain details sometimes depart from this general scheme. It follows that the image produced by a model maker who embraces the standpoint of scientific socialism — and which is partly independent from the hard-core information he gets — will put a distinctive mark on any modelling process he undertakes. This a priori image is always present when a critique of existing global models is done by an observer from the Second World.

In the vision of D. Gvishiani, the early stage of the modelling process — which comes before the mathematical formalization and the computer simulation is performed — includes the selection of the model's constituents (the parameters of the system to be designed) and the conceptual substantiation of the connections between the constituent parts. An important problem arises here: namely the problem of the principles which will guide the selection of the parameters to be put into the model. The philosophical standpoint and ideological-theoretical conceptions of the model's authors determine the choice of these parameters. As a consequence — Gvishiani observes — the models elaborated by bourgeois scholars are built around a limited number of issues, which in his opinion is a fatal mistake; according to Gvishiani, only the Marxist-Leninist doctrine opens possibilities for the selection and the conceptual substantiation of these factors.⁴⁷

The coherent and explicit ideological principles of communism can be easily summarized, whereas other ideological standpoints are often difficult to discover and to describe. There is a wide range of a priori attitudes among the non-communist scholars pertaining to world dynamics. Some model makers belonging to this group fall prey to the tacit belief that the world is a mere extension of the sphere of their direct knowledge; therefore what lies "outside" should probably be very similar to what is found inside this sphere. To support this impression, the available information — which usually displays an unconcerned and apparently neutral language — is taken as evidence.

For instance, many First World technocrats display the firm conviction that all the inhabitants of the planet are motivated by the same needs and aspirations they feel and that the process of development will lead, sooner or later, to the same results as in the First World.

In summary, one could argue that frequently the ideological scheme which claims universal validity is but a projection of a particular set of experiences and beliefs. In this case, the information is fed into a pre-existing conceptual framework and coded accordingly. The choice of parameters — in the existing models — seems to confirm this conclusion. Indeed, most of the models refer almost exclusively to the "visible part" of the behaviour of the world system (i.e., environmental aspects, aspects related to mineral resources, food, economic and demographic growth, etc.). This viewpoint suggests that the intuitive images produced by the authors of the models are bound within the frontiers of this problématique, which are considered to be sufficient for the model-making. Consequently, the need for expansion by other types of structures is resented by First World technocrats.⁴⁸

Along the same line, let us mention one more argument: the extension on the global level of the principles of self-regulation — which are proper to the functioning of the non-planned economies — also bears testimony to how some rules are arbitrarily deduced from a number of particular situations and projected over the whole world. An interesting experiment should be mentioned here. A Soviet team headed by V.A. Ghelovani introduced, in Forrester's model "World 2," the planning mechanism for the capital investment. As a result, the "global catastrophe," predicted in the original model, was avoided.⁴⁹ But the planning mechanism is not consistent with the capitalist economy; it functions only within the socialist economic structure. That is the reason why the planning mechanism has been ignored by the authors of the model (i.e., Forrester and Meadows) — as D. Gvishiani reasonably puts it.⁵⁰

The simple logical artifice — to tell people that everywhere things happen in almost the same way — is a persuasive example of how the transfer of concepts, from the particular to the general, operates in

practice. Tacitly applying this ideological scheme, some scholars from the First World are talking about the crises manifest in the Second World — without understanding the complex mechanisms by which the socialist state controls and manages people's needs and aspirations. In such a context, some situations which might look as critical elsewhere, are by no means alarming in the Second World and are quietly solved. The same is true for research developed by some analysts from the Second World, who are frequently inclined to see the Third World only in terms of capitalism-socialism competition.

Still another scheme of ideological rationalization which appears frequently in research carried out by some radical western intelligentsia can be called: "extension through negation" of the sphere of one's direct experience. Contrary to those who believe that what lies beyond their reach must be almost identical with what they see within their sphere, the scholars who use the "negation" scheme seem to perceive the world outside as being totally different and sometimes even opposite to their own. This group speaks more about heterogeneity — but rather in terms of bi-polarity (communism/anti-communism, democracy/dictatorship, etc.). Available information is once again added to this pre-existing mental framework, but it is "decoded" and interpreted differently from the previous case. This time, the researchers are selectively looking for exotic aspects, which depart dramatically from what their direct experience has taught them (and that has been acquired in their double capacity of researchers and researched). In the simplistic versions of this outlook, the fundamental tenets concerning the society are reversed: if here the masses are alienated and consumption-oriented, then there they must be non-alienated and aspire toward something else which is not consumption-oriented; if here the aspirations are manipulated, then there they must be autonomous, etc.

Finally we shall mention a procedure which ought to cover the "white spots" in the sphere of one's direct knowledge by employing an abstract ideological scheme. In this case, the scheme is alien to what the given scholar is personally committed to, but is considered by him to

fit the phenomena under study.

The images created by some First World scholars about the socialist world could illustrate this way of thinking. Proceeding from the acknowledged ideological guide of the socialist world, many researchers consider that the (theoretical) knowledge of this guide is not only necessary but also sufficient for the description of the truly complex phenomenon of communism. Excerpts from the writings of Marx, Engels, or Lenin are sometimes considered equivalent to information about the social reality: in this outlook, the Second World is depicted as being closer to an (utopian) dream than to the contemporary world. The idea of heterogeneity in itself – which also bears an ideological character – becomes the source of a particular image of the world, generated through the extension of the sphere of direct knowledge in another space. But, by definition, this space is considered to be different from what the model maker experienced in his surroundings.⁵¹ Of similar nature is the thesis postulating that the heterogeneities are necessary and beneficial and consequently any process leading to uniformity – for instance, the westernization of economic and cultural life – is harmful because it infringes on the internal logic of their development.⁵²

Summarizing, our point is that there are two main modalities of expanding one's direct knowledge so as to generate an intuitive image of the world as a whole – respectively, proceeding from information toward theoretical models or proceeding from theoretical models toward information. In fact, these two modalities are not as opposed to each other as might appear at first in this rather didactical presentation. In reality, the two approaches are almost always associated with each other, regardless of how the model-maker manages his research – whether by exploring the real data first and then accommodating the theories to fit them, or first taking an ideological scheme and fitting in the available information. In both cases, two-way exchange between real-life information and the theoretical model takes place. However, there will always be some people who, by vocation and by background, will give more credit to information and, conversely, others who will place

greater emphasis on the initial ideological theoretical scheme when trying to construct a quasi-intuitive representation of the world as a whole — a necessary premise for any modelling enterprise on the global level.

The discussion of the topics developed above could be formalized as follows. Let H be an observer (model maker). We shall denote his weltanschauung by W_H ⁵³ and consider that the sphere of his direct knowledge is Δ . We shall designate by modelling a relation between a couple of systems (S, M) where S is the prototype-system and M is considered by H as being the model of S ; in fact, this modelling-type relationship functions as an equivalence relationship defined in respect to a set of properties and is built up by H using a family of observables

$$\{f_\alpha\}_{\alpha \in I}$$

taking values in a space I of phenomena which can be identified (for instance, one considers M as being the model of S if $\{f_\alpha(S) = f_\alpha(M), \alpha \in I\}$ or, more generally, if $f(S), f(M)$ display a definite relationship which is acknowledged as valid by H). In the "classical" modelling process, one more hypothesis is tacitly introduced: namely, that S is within the sphere of H 's direct knowledge (in our notations, $S \subset \Delta$).

But if S is the world system, this hypothesis can not be granted and we have by definition $S \not\subset \Delta$ (or, more precisely $\Delta \subset S$). The model maker H , who decides to explore the world system S — which lies beyond his direct sphere of knowledge — starts by framing an intuitive image of S , as an extension of the sphere of his direct knowledge. In other words, S is exchanged for the extension of S — noted $\varepsilon_H(\Delta)$ — which is considered by H as playing the role of S . The extension $\varepsilon_H(\Delta)$ depends on H , and implicitly on H 's weltanschauung W_H . Here the prototype is not a real system but a (subjective) extension of a domain of reality with which the model maker is acquainted.

The global modelling is therefore a relationship between a pair of systems $(\varepsilon_H(\Delta), M)$, where $\varepsilon_H(\Delta)$ is the (subjective) image of the proto-

type (i.e., of the world system), when M is its model considered by H as conveniently representing the world (thus, $\varepsilon_H(\Delta) \sim S$).

One question arises here. Indeed, is this procedure — resulting in the design of a prototype which is to be modelled — exclusive to the process of modelling global problems? May it not happen that such aspects are part of any modelling effort? Could it be that although the prototype belongs — or apparently belongs — to the sphere of our direct knowledge, when it is taken as an object for a modelling process it is "re-invented" by the model maker? Is it possible that when passing through all the sophisticated apparatus by means of which the model maker checks its relevance, properties, observables, relationships and so on the reality suddenly becomes less "real"?

In fact, such aspects are probably not alien to any modelling of social phenomena. However, their importance in global modelling seems to be notably higher than in other fields. One can argue that the maker of global models is applying himself not so much to modelling the world in its dynamics but rather to the exploration of his own image of the world by means of some sophisticated tools. Hence it should not be called a "world model" but a "world image model."

2. As we have seen, the maker of global models finds himself in a situation different from that of his colleague involved in the study of any smaller system, when he tries to make a choice among the instruments to be used in the modelling process.

Let us suppose that somebody decides to commit himself to the purpose of building a model of an enterprise. Of course, he will gather information in the field; he will find a number of successful experiences, which employed specific methods and whose adequacy has been effectively tested in the process. Obviously, his field is always open for innovation: new methods could be devised, in order to fulfil the exigencies of this particular research.

In comparison with this scholar, the designer of a global model has far

less tools at his disposal. More than that, usually these tools have not yet been tested in any concrete situation.

Let us take an example. In fact, the exceptional methodological interest of Forrester's Systems Dynamics is easily agreed upon. Nevertheless, it does not follow that this methodology is adequate for the purpose of modelling global problems. The same kind of observation applies to the strictly trend-oriented analyses developed by H. Kahn's team or to the Mesarović-Pestel simulator. It follows that along with the difficulties which arise when trying to adapt the theoretical scheme to the object to be modelled — which we exposed in section 1 — other difficulties also appear (namely the problems brought about by the mutual adaptability of the methodology and the theoretical hypotheses underlying the whole process). Any option in favour of one methodological scheme over another (chosen among those which seem to be or are formally suitable for the purpose) implies the abandoning of the guiding role of mere intuition. As a consequence, one is led to elaborate further on the distinctive mark put by the "globality" over any particular segment of the modelling process — in this case over the choice of the methodology to be used.

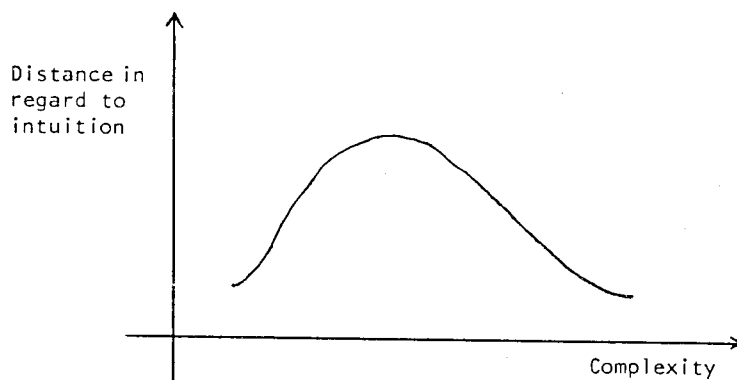
Let us not forget a fact which is often cited in the literature.⁵⁴ It is generally agreed that the methodology used in social research is a function of the theoretical assumptions underlying the respective work and, in particular, a function of the intuitive image the author has of the phenomenon at hand and its functioning. The subjective constituent of any option in the domain of the methodology is therefore added to the subjective character borne by the "object" of the modelling and by the theoretical assumptions. Thus the methodology appears as a tool of systematic (although subjective) exploration of some theoretical (equally subjective) hypotheses.

Furthermore, lastly, when choosing a certain methodology among those available, the existing data and information are taken into consideration. A methodological scheme could potentially look very exciting, but probably it could not generate a model if it had not previously

been correlated with the real data and information. The models which we have referred to pertain almost exclusively to demographic, economic, and technological data, not because the other factors have been deliberately ignored but rather because these domains offer information and data suitable to be modelled. The progress in the field of global modelling is therefore tightly linked to the progress in the field of indicators – both social and human – and in the field of social and political data gathering. Otherwise, the range of choices of methodology to be used in model-building seems to be drastically reduced.

Let us mention the influence of the exceptionally large scale of world modelling over the options related to the methodology to be used. We are less concerned here with the magnitude of the given model or with the number of the equations which have been written than with the possibility that a methodological scheme can really encompass such a huge problématique.

J.W. Forrester once argued that the behaviour of complex systems is in many respects counter-intuitive. In fact, many experiments show that images of systems behaviour (built on the basis of intuitive identification of systems structure) depart – sometimes largely – from the behaviour of the same system observed within a simulating device, which goes more deeply into the analysis of the systems structure.⁵⁵ It seems that the "distance" in regard to the intuition displays a variation directly "proportional" to the complexity. Theoretically, it can happen that this variation takes the form:



The proof can be formally developed if we consider the "distance" between the intuition and the proposed simulation to be a function both of the complexity of the system under study and of the model-maker's weltanschauung (and, implicitly, of his ideological commitment). A suitable combination between the perception of the complexity and the weltanschauung could possibly lead to variations as those described above. Thus one can argue that if the large systems display a counter-intuitive behaviour that does not necessarily imply that the very large systems (and in particular, the world system) have to have the same property. The adequacy of the "systems dynamics" device, used in the study of large urban areas or of industrial systems, to the world system cannot be based on ratiocinations of an inductive type. One needs other instruments in order to evaluate the adequacy of this truly unique situation.

We already mentioned the fact that methodology is dependent on the theoretical (or ideological) commitment of the model maker. A Marxist scholar will always display a definite reservation when faced with analysis which is based exclusively on trends. He will have the same feelings when facing a methodology stating that automatic self-regulation takes place within social systems thus ignoring the conscious intervention of social forces into the social process. This is largely due to his deep conviction that such assumptions neglect the very aspects of the qualitative and revolutionary mutations which are built into many processes in world dynamics.

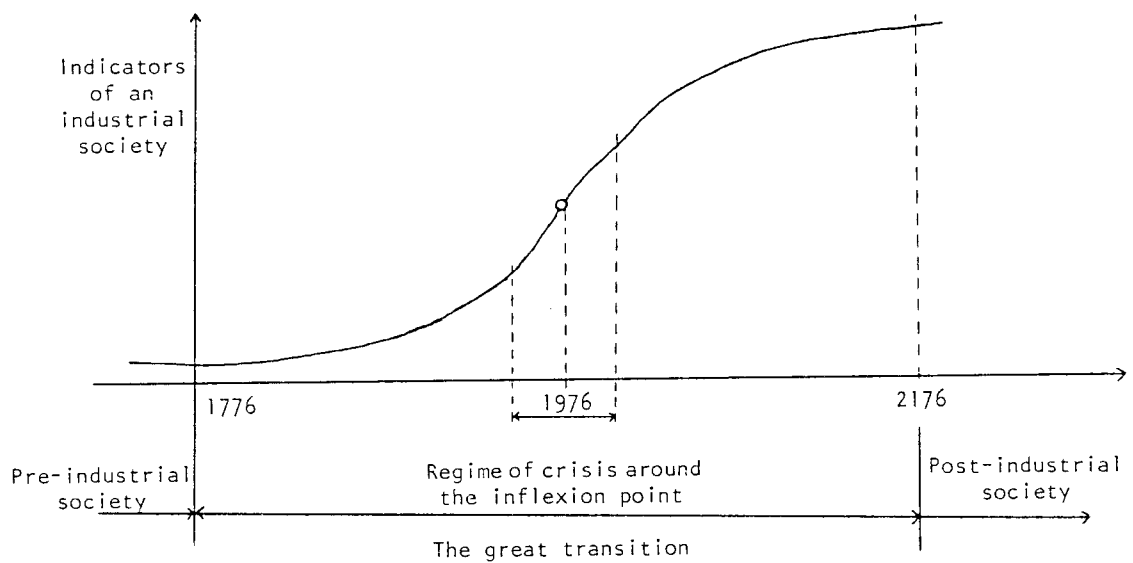
We shall illustrate our considerations by outlining a possible methodology for studying world evolution in the perspective of a generalized transition toward communism.

From the technical standpoint, a prospective scenario contains trends, events, and cross-relations between them (trends-trends, trends-events, events-events).

How will a socialist scholar manage the study of trends? From a purely methodological point of view, it seems that he will not introduce many

changes in the methodology of trend analysis. However, in all probability, he will add some other parameters to the somewhat traditional trends (economic, demographic). For instance, the analysis of the passage to socialism (or of the removal from the capitalist way of development) could be performed with data showing the rate of variation of some specific indicators — such as the increase of the total number of socialist states, of the Third World countries which adopt a single-party governmental system and introduce non-capitalist structures in the economy, the gradual diminution of the (political and demographic) weight of the First World within the world system, etc. This sort of analysis sets the general theoretical frame for the exploration of what will possibly happen in the next decades; namely what will "show up" if the existing trends (or, in other words, the trends observed over the last 30-40 years) are maintained, or accelerated. Obviously, from this point of view, the passage from capitalism to socialism is irreversible. Once installed, socialism does not allow any negotiation: the validity of the socialist power is ratified by the implacable laws of history.

As an example, let us imagine a socialist approach to global trends, in comparison with an apparently typical non-socialist approach to world dynamics, focusing only on economic growth — such as H. Kahn's model of the "great transition" towards the world-wide post-industrial society.⁵⁶ For H. Kahn, et al., the "past" relevant to our age begins with the American Revolution (1776), when the pre-industrial society enters in a 400-year great transition toward the global post-industrial society, to be reached around year 2176; the basic indicators (for instance, GNP, population, etc.) show logistic growths; our age is exactly at the "inflexion point" of this great transition, and therefore the contradictory developments and crises are only apparent, short-term non-structural dysfunctions in this global "march" toward a glorious stable society of around 20 billion people with something like \$20,000 per capita (in 2176). It should be mentioned that what was most difficult is now already done. The major problems are behind us. Thus, the evolution of mankind could be represented like this:



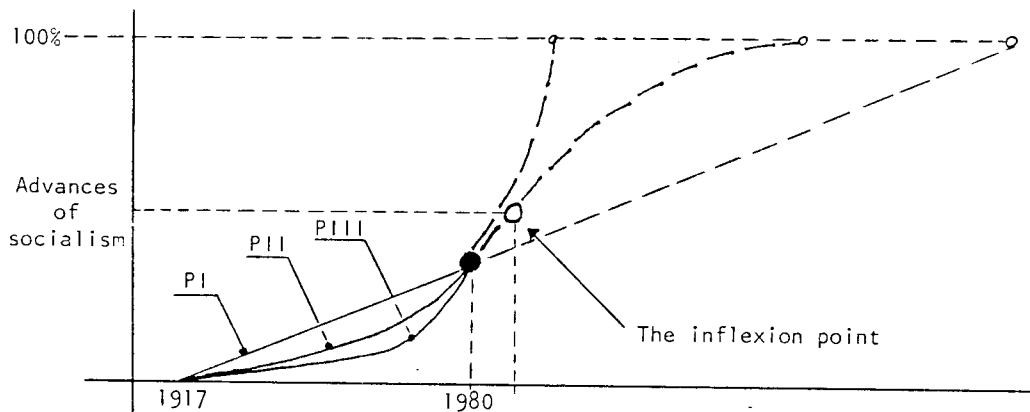
For a socialist scholar, the "past" or history relevant for our age begins with the October Russian Revolution (1917), when the first non-market planned one-party (socialist) society appeared.⁵⁷ The "great transition" is therefore from a market, non-planned society (until 1917) towards a world-wide non-market, totally planned society. The basic indicators of the global trend toward world-wide socialism are: the socialist population as a percentage of the world population, socialist net product as a percentage of the world net product, the percentage of the socialist industrial product in the world product. (Naturally the growth rates of these indicators are also taken into consideration.) Since 1971, these indicators have reached the following levels:⁵⁸

Population in the socialist world:	32% of the world population
Socialist net product:	20.1% of the world net product
Socialist industrial product:	38.1% of the world industrial product
Population growth:	1% per year
GNP per capita growth:	4% per year

Thus, in the 60-year period following 1917, over 30 per cent of the world's population has been living in socialist countries.

A linear trend hypothesis would then suggest that in 120 years (at

around 2100) the world will be entirely socialist, i.e., the non-market planned society will be generalized at a global scale (Path I). If we suppose that the growth of socialism at the world scale is not linear, but exponential, the victory of socialism will be even sooner (Path II). If we assume that the growth of socialism at the world scale is logistic, we will obtain slightly different results (Path III): but it is noticeable that, in this particular case, we are now before the inflexion point in the evolution of world socialism and that probably this inflexion point will occur during the 80s. Thus, the most difficult part has not already been passed, but it is yet to come. For summary, a trend-oriented approach to the evolution of socialism could be represented as follows:



Concomitantly, trend-analysis could explore the parallel processes of crisis and decadence within the First World. The indicators to be used could refer to the variation over time of the number and magnitude of the class conflicts within the First World, of ethnic conflicts, of the competition and disagreements between the capitalist states, of the signs of pessimism and distrust in the future of capitalism shown by some people, etc. One feature that should be stressed is that the socialist point of view is rarely concerned with changes within the socialist world. In a sense, this summarizes a peculiar experience and discloses the deep conviction that the socialist societies, which are very stable, are managed by strict long-term programmes. The inner structure of the socialist society allows for a wide range of capabili-

ties in mobilizing and adapting the available resources, and also in taking risks which confer on them a sort of immunity to perturbations on a worldwide scale. This expanded resistance of the socialist world when facing global crises is helping the promotion of its influence and strength in the international arena. Under the well-known conditions of interdependence, the socialist world shows a better adaptability to some new or difficult circumstances, even when the price to be paid is quite high. It appears that the internal structure of the socialist society — which is solidary and "monolithic" — makes it incompatible with the idea of crisis. The fact that there are some fluctuations in the internal life — for instance, the internal consumption could decrease, or the investment efficiently — shows that certain fluctuations do not lead to a conjuncture which could possibly be labelled as a "crisis." The future of the socialist world seems to be quite clear: there is a strong probability that it will continue to develop the same way as it is developing today. The socialist point of view considers that important changes on the structural level within the socialist society are hardly conceivable, despite the inevitable succession of leaders or even of entire generations of leaders. Any modification will take place within the boundaries of the species.

The analysis of trends to take place in the Second World in the future seems to confirm the basic tenets set forth by the long-term plans and programmes elaborated and put into practice with strong determination. Therefore, from the socialist point of view, the most relevant trends and events are those which take place outside the socialist world — namely in the First and the Third Worlds. Obviously, in the study of these areas, the analysis of economic and demographic trends keeps its entire relevance.

In addition, the analysis of the cross-impact between trends, and especially the mutual interrelation between economic and demographic trends and the trend towards socialism, lie at the very centre of the Marxist scholar's concern. One may suppose that these aspects play an important part in limiting the economic expansion of the First World and reducing the economic gaps on the global level.

Paralleling trend-analysis, the socialist outlook will develop an analysis of the events — and, in particular, of revolutionary mutations — to take place on the world scale. Let us clarify that, from this particular point of view, the concepts of change and revolution are used with caution, mainly because they are meant as designating a fundamental modification within the economic and social structure of the society. Thus, the displacement of the centre of power does not necessarily imply a social change, much less a revolution. In particular, the socialist revolution is linked with the total or at least partial removal of capitalist ownership of the means of production. This process must be irreversible and marks the difference between a fundamental mutation and the various form of temporary nationalizations decided on by one government and disposed of thereafter by a new government⁵⁹ installed as a result of the pluralistic political settlement.

Technically speaking, the passage to socialism (and communism) could be represented by a family of revolutionary events $\{E_i(t)\}_{i \in I}$, where $E_i(t)$ designates the revolution within the country i at the moment t . We shall try to describe how the possible (and necessary, from the Marxist point of view) revolutionary events will come to pass in the dynamics of the world.

This analysis should be performed "on the methodological basis put forth by Marxism-Leninism" which allow for "designing adequate scenarios for the modelling of global development process."⁶⁰ The scholar (or the research team) committed to the task will probably try to assess the probabilities of revolutionary take-offs in the space lying beyond the actual boundaries of the socialist world. When describing the evolution of the state i (where the event $E_i(t)$ is supposed to take place) the socialist scholar starts with the analysis of the class struggle, thus identifying "the main social forces which have to be taken into account and their probable relation in respect to the goals of the struggle"⁶¹ (respectively, to $E_i(t)$). Let us clarify that in this classical outlook, social forces are not, in principle, reducible to the political parties engaged in the parliamentary political game.

These general methodological statements may suggest to us how to proceed further. The first step is to discover the "main political forces" within the state (or zone) i . Once again following a suggestion put forth by Lenin,⁶² one shall identify them as élites (directly connected with the government system, big bourgeoisie, middle bourgeoisie, petty-bourgeois strata, the peasantry and the proletariat). Then, the mutual relationships between the above-described social categories should be explored along with the possible "crisis - conjunctures." The final step is the future-oriented analysis of the alternative previsible positions which the political forces could espouse in crisis situations. In the process, the political symptoms of the crisis problématique are to be discovered.

In summary, in state i at the moment t , $S_i(t)$, a number of social forces $\{f_j^{(i)}(t)\}_j$ ($1 \leq j \leq n_i$) are at work. Suppose that from future-oriented analysis it has been deduced that on the future time-interval $[t_0, t_0 + \theta]$, the state $S_i(t)$ could follow one of the probable evolutions described as

$$\{s_i^k(t), t \in [t_0, t_0 + \theta], k = 1, \dots, n_i\}$$

The social forces involved in the process will show, when facing the given evolution, the attitudes

$$\{\alpha_{jk}^{(i)}(t), t \in [t_0, t_0 + \theta], j = 1, \dots, n_i, k = 1, \dots, m_i\}$$

where $\alpha_{jk}^{(i)}$ is the attitude developed by the social force $f_j^{(i)}$ in front of the situation $S_i^{(k)}$. Obviously, the probability of the revolutionary event E_i to happen on the time interval $[t_0, t_0 + \theta]$ — denoted by $P(E_i)$ — is a function of all the above mentioned factors. We shall write:

$$P(E_i) = \phi_i(\alpha_{jk}^{(i)}, j = 1, \dots, n_i; k = 1, \dots, m_i)$$

This (formal) relationship does not imply that the revolutionary events taking place in space i are brought forth exclusively by the internal development of the respective space. At least in principle, the attitudes $\alpha_{jk}^{(i)}$ of the social forces $f_j^{(i)}$ as to the evolutions occurring in the space i are usually notoriously influenced by what

happens outside this very space (i.e., in the neighbouring spaces, in the spaces similar to the given space i , on global scale, etc.). The relation stated above specifies that the evolutions taking place outside the space i do influence the occurrence of the revolutionary events E_i — although not directly, but through the intermediary of the change induced in the attitude of the internal forces in the space i .⁶³

The identification of the concrete elements which appear in the right member of the equation of $P(E_i)$ is a troublesome operation. However, let us mention some simple facts. First, even if the level of the attitudes $\alpha_{jk}^{(i)}$ is not given a quantified form and the form of the function ϕ_i is not stated explicitly, the formal dependency expressed in this way could help us to go through with the analysis. Indeed, in a first approximation, the variations of the attitudes $\alpha_{jk}^{(i)}$ can be measured on an arbitrary scale. The study ought to thus concentrate on the specific combinations of attitudes which may prove "critical." For instance, such "critical" combinations are those which take "maximum" ratings but of opposite signs for particular significant $\alpha_{jk}^{(i)}$ — such as the radicalized attitudes of the proletariat and of the big bourgeoisie.

The local communist party (or parties) plays an important role in developing this type of research into specific scenarios occurring within space i . In fact, the communist parties are the legitimate bodies to carry out this type of research which includes outlining the correct diagnosis and building realistic forecasts relative to the space under consideration.

Obviously, if the level of the attitudes $\alpha_{jk}^{(i)}$ allows for quantification, the research can be pushed further in order to form the function ϕ_i . The qualitative political analyses may suggest some pertinent conditions for ϕ_i . For instance, if

$$\alpha_{j_1k}^{(i)}$$

is the dissatisfaction of the working class and

$$\alpha_{j_2k}^{(i)}$$

the repressive aggressivity of the bourgeoisie, we can postulate that, for

$$\alpha_{j_1k}^{(i)} > \bar{\alpha}_{j_1k}^{(i)}, \quad \alpha_{j_2k}^{(i)} > \bar{\alpha}_{j_2k}^{(i)}, \quad \text{with } \bar{\alpha}_{j_1k}^{(i)}, \bar{\alpha}_{j_2k}^{(i)}$$

being fixed,

$$\frac{\partial \phi_i}{\partial \alpha_{j_1k}^{(i)}} > 0, \quad \frac{\partial \phi_i}{\partial \alpha_{j_2k}^{(i)}} > 0$$

(obviously, if the function ϕ_i is derivable).

In summary, this condition states that if the dissatisfactions of the working class and the repression overcome a certain critical threshold, the probability of a disturbance (destabilization) increases in direct relation to either the variation of the dissatisfaction or the intensity of the repression.

Some other factors could be introduced in the function describing the probability of a revolution. The ethnic and religious conflicts, the conflicts between the generations, the conflicts consequent to the national liberation, the results of serious economic crises on national and international levels should be taken into the "revolution functions." The theory of catastrophes may help us find the form of the functions ϕ_i — as in Part II. Finally, let us mention the possibility of estimating the functions ϕ_i and the probabilities $P(E_i)$ on the basis of Delphi survey techniques.

Before proceeding further, we shall once again stress that, in all these rationalizations, the revolutionary event E_i is not compulsorily linked to a violent moment — as has happened up to now when the dictatorship of the proletariat has been installed. The revolutionary event implies a more general situation. Its distinguishing feature is socialist ownership of the main means of production and irreversible political power assuming long-term responsibilities. The legitimacy of this process is deduced from the firm commitment to an acknowledged ideologic guide and from the conviction that the involved actions are performed in the name of the masses. Therefore, the advent of a

revolutionary event can follow — in principle at least — also by other paths (as the parliamentary or other peaceful modalities).

We shall suppose now that the socialist scholar who applies himself to the study of world dynamics succeeded in describing the foreseeable revolutionary events $\{E_i\}_{i \in I}$ — i.e., the socialist revolutions in the First and the Third Worlds — by ascribing to them an estimated probability $P(E_i)$ of incidence over a definite span of time. Obviously $P(E_i)$ will take greater values in the space i when a critical situation shows up — or, as Lenin put it, "where the imperialist chain is weakened."

Two crucial aspects which must be considered are the ways in which the possible revolutionary events exert their influence over the trends (economic, demographic, etc.) and their impact over the socialist world. This problem could be tackled in various manners. For example, to each revolutionary event (starting with those that display higher probabilities of occurrence), a (logical) tree depicting the foreseeable outcomes of such a mutation could be constructed. The impact over the various trends produced by the given event becomes more visible and the research can concentrate on the factors that preserve the trends, those that encourage a particular trend (or trends) and those that oppose others, etc.

Finally, this type of analysis will explore the modalities in which the revolutionary events influence each other. Cross-impact techniques seem suitable for the purpose. Indeed, if the families of probabilities $\{P(E_i)\}_{i \in I}$ are given, the conditioned probabilities

$$\{P(E_i | E_j)\}_{i, j \in I}$$

can be formed. As a result, the ways in which the occurrence of an event E_j changes the probability that event E_i ($i \neq j$) will occur can be studied. The family of initial events $\{E_i\}_{i \in I}$ and the respective absolute probabilities are in the process transformed into a chain of events linked by causal dependencies. More general models — as those described by M. Turoff — show that, if we note $P_i = P(E_i)_{i \in I}$ and if

we suppose that

$$P_i = \psi_i(p_j, j \neq i), \quad i \in I$$

— that is, if the probabilities of events $\{E_i\}_{i \in I}$ are mutually dependent — then under some normal conditions, p_i is of the form

$$P_i = \frac{1}{1 + e^{-\gamma_i - \sum_{\substack{k \\ (k \neq i)}}} c_{ik} P_k}$$

with γ_i, c_{ik} as constants. In this case p_i takes the form of a logistic function in the space of the probabilities of the considered events.

The outputs of this analysis are far from being trivial and the socialist scholar can discover new insights in the problem he studies. We shall suggest here some possible implications.

First, the cross-impact techniques allow for a more systematic exploration of the diffusion of the revolutionary movement. Evidently, the victory of the revolution in a determinate country i generally changes the probability of success of revolutions in other countries j , thus $P(E_j/E_i) \neq P(E_j)$. If $P(E_j/E_i) > P(E_j)$, we shall say that the countries i and j are in a state of revolutionary resonance. When this happens, victory in country i makes the occurrence of revolution in country j more probable (due to, for instance, the mobilization of masses which is stimulated by the achievements attained in i). Conversely, if $P(E_j/E_i) < P(E_j)$, we shall say that the countries i and j are in a state of counter-revolutionary resonance. That means that the victory of the revolution in the country i lowers the probability of the revolution occurring in the country j (due, for instance, to some errors of the revolution in i , to the mobilization of the repressive apparatus in j or the promotion — in j again — of some reforms able to relax the social tensions). The case $P(E_j/E_i) = P(E_j)$ shows that the countries i and j are indifferent to each other: the victory in country i does not modify the probability of revolution occurring in j . A world map of the revolutionary resonance, counter-resonance, and indifference is obviously of great interest.⁶⁴

Turoff's model suggests that, if taken conjointly, the probability of a revolutionary victory in a particular country varies effectively with the probability of a victory in other countries. However, the growth of the probability is not linear but logistic; there is a ceiling. In other words, whatever values or augmentations p_k , $k \neq i$ (with $c_{ik} > 0$) would possibly take, they will not — by themselves — lead to $p_i = 1$. Once again, it appears that what finally drives a revolution to victory is not "the external factor" (expressed here by the stream of international revolutionary movements) but merely internal factors and internal contradictions at work within the given space. The social revolution remains an internal problem of any society.

In summary, the socialist scholar who applies himself to the study of problems involved in global modelling starts with an inquiry in the field of methodology. He will gather the tools suited to the study of the trends, the design of possible future revolutionary events and the exploration of their impact upon the trends, and their cross-impact. The outcomes of such studies are reunited in trend-based scenarios and event-based scenarios describing the alternative transitions of mankind from the "anarchic state" toward a future socialist society. Being planned, this future society will be able to entirely solve the "global problématique." Knowing its needs and the available resources, mankind will use the instruments of planning in order to manage a harmonious worldwide development.

In conclusion, it seems that, within the field of global modelling, methodology is linked more closely with the theoretical hypotheses than within other domains of the representation of social and economic processes; moreover, the results of the modelling process are dependent on the methodology used to a greater extent than in other fields.

This may be summarized in the following formal manner.

In the case of an "ordinary" system S , we shall define as

$$M = \mathcal{M}_S(S/H)$$

the model M of the system-prototype S built by the model-maker H

who chose the methodology \mathcal{M}_S for the purpose of representing S. If the model to be built refers to the world system, we have

$$M = \mathcal{M}_H(\epsilon_H(\Delta) \mid H)$$

meaning that, in this particular case, the choice of the methodology depends almost exclusively on the model maker H (and in particular on his weltanschauung).

3. In this section we shall analyse how the peculiarities of the global approach influence the communication of results to the "model user." There is sufficient agreement that every model is intended for being communicated to and used by a definite group (of decision makers, political or scientific élite, the public, etc.). The assessment of the model's accuracy cannot be separated from how it succeeds in fulfilling the acknowledged intentions set for the modelling effort and how it is received by its potential users.

The "destiny" of a "local" model (as opposed to a "global" model) is easier to trace. The model of an enterprise, for instance, is worked out by a research team (or a single model maker) and is intended for the use of a relatively confined group. The authors of the model conduct their work with the intended purpose of presenting it to the interested party — for instance, to the managers of the enterprise, or to a group of people involved in its activities. Consequently, from the very beginning, the model makers wrap the results of their work in a rhetoric which will make them understandable to the group they address. Sometimes, if the models include interesting contributions from the technical point of view, the final draft (or a variant of it) will appeal to the professional reader too. Beyond the "inner" circle of users, the results of this type of modelling are generally ignored.

The situation is basically different in the case of a global model. First, a global model extends the object of the study over every inhabitant of this planet — even if his presence is signalled only by a figure representing the total population. Furthermore, a global model could be used — directly or indirectly — in social action. The

direct link between a global model and social action is expressed when a certain group, party, or movement decides to follow and to implement a programme derived from the model. The indirect presence of the global modelling in the social life is through the dialogue it generates around the issues of global significance – and, implicitly, in the influence it can produce on the level of the leadership of public affairs. In one way or another, global models might interfere with the life of many people – if not everybody's. It seems therefore natural to consider them a matter of common concern: they are addressed to everybody and should be exposed to a general debate.

Thus, the assessment of the "usefulness" of a global model is of a particular character. A local model, depicting the functioning of an economic organization, for instance, is evaluated as a function of the degree of accuracy of the created image as perceived by its makers and by its foreseen efficiency in fulfilling the goals it was intended for. Such goals could be, for example, the (explorative) analysis of the alternative development paths of the organization or the (normative) design of some strategies to attain a certain performance.

But what are the goals to be set for global modelling? Which are the means enabling measurement of the fitness of the model to the goals of the modelling?

Suppose the addressee of the given global model (probably he would be an ordinary citizen) assesses the quality of the model after comparing it with the image he has of the world. In particular, the "validity" of a global model could be established after weighing the development of certain events as depicted by the model in the light of one's own image about such events. In this case, a canonical way of reasoning takes the following form: if the given model were "true," then predictions made on its basis about the evolution of a number of particular situations should be confirmed by the consequent real life events. The model is considered validated if the predictions come true and invalidated if they do not.

The logic of such reasoning displays a serious weakness, for the "demonstration through examples" always introduces in the analysis a great deal of arbitrariness. But this kind of approach can be found in many arguments which support assumptions of general character.

This may happen with global modelling as well, particularly if the potential addressee who "receives" the global model does not have either an image of the whole world nor feel any need to have one. The particularities of the cultural tradition may oppose (as in some eastern cultures)⁶⁵ the design of global images. So, if "provoked" to give his opinion about the quality of the model, he will again check it with his own knowledge and experience in a number of particular domains.

Who, in reality, is the "audience" of a global paper? For the purpose of our study, we will describe the audience as the set of possible addressees, who after comparing the model with their own image of the world will decide if the model represents the world "as it is in reality" (or as they think it is in reality).

If this definition is adopted, then a truly global model — which is intended to serve as a guide of common action — should comprise in its audience the quasi-totality of people living on this planet. This appears to be a very stringent condition which could hardly — if ever — be fulfilled. Let us analyse this situation.

Suppose for a moment that such a model — i.e., accepted by almost everybody as representing their "own" view of the world — does exist in reality. However, it must be proved. Logically, the sentence "all the inhabitants of the planet recognize the real world in this model" remains presumptuous regardless of how many examples have been produced in its favour. At the same time, a single example stating the contrary gives sufficient grounds for invalidating the supposed recognition of the model by the whole world.

In fact, consider two addressees: one is committed to the idea of communism; the second adheres to liberal capitalism. The former

envisions the world dynamic as a chain of structural revolutions, generated by the irreconcilable contradictions brought about by capitalism; for the latter, such events are not likely to happen and play a negligible part in global evolution.⁶⁶

The attitude of these two addressees when facing a single world model will obviously be divergent. Suppose the considered model depicts world-wide revolution: it will probably be rejected by the liberal as being propagandistic and invalid. Conversely, if the model fails to do so, the communist addressee will consider it as another utopian image about the survival of capitalism.

Thus, a generally accepted model should — at the same time — comprehend and reject the possibility of a world-wide communist revolution. Is there any possibility to devise such a model?

At first sight — and only at first sight — such a model could be devised, even if it seems logically incompatible. A model which completely ignores the socio-political aspects of structural mutation or "exiles" the accomplishment of the revolution beyond the period of time covered by the study apparently fulfils such a contradictory condition.⁶⁷ But it seems improbable that either of the two addressees will recognize the world as they know it in such an abridged version. It seems more probable that both of them will reject the image as being schematic and omissive. It seems that, in principle, the opposite views developed by the two addresses are simply inconsistent with a single model depicting the structure and the evolution of the world.

In response to this, one can argue that models are not made for the ambitious purpose of "representing" the world. They are usually intended for the study of world problématique or even more often as tools for solving a definite problem; balancing population growth and economic development is a good example of a global problem to be solved. We shall answer this objection by mentioning the fact that discrepancies between the two points of view will last even if the problem at hand is partial, or if only a solution is to be produced. The communist

addressee will always stress the fact that any aspect of global problématique is in essence generated by the capitalist order and thus has to be seen in the light of the irreconcilable conflict between socialism and capitalism. In its turn, any problem to be solved ought to be judged and managed on a planned (world-wide) scale. For the liberal addressee such solutions will always be ineffective and unrealistic.

The above argument may seem didactic and simplistic in character. But our purpose was to show what kind of difficulties could block the acceptance of the classical "One World - One Model" scheme by the "global" audience of all the (potential) addressees of the global modelling.

We are thus led to the following conclusion: if "something" is to be built - in which all the people will recognize "their" world - this "something" cannot be a singular model, however complex or elaborated.

Our discussion could be formally summarized as follows. Indeed, using previous notations, the "local" model is described as

$$M = \mathcal{M}_H(S/H)$$

where M is the model devised by H about system S . If G is an addressee and \mathcal{M}^{-1} - the inverse modelling operator (which associates a model with its original prototype S), we shall say that G also considers M as a model of S if, being given a distance ρ_G and a threshold $\varepsilon_G > 0$, for any $A \in \mathcal{M}_G^{-1}(M)$, we get

$$\rho_G(A, S) < \varepsilon_G$$

In other words, the image reconstructed by G , helped by the model M , about the prototype S is "sufficiently close" to the prototype, and G should in his turn accept M as a model of S .

If the model built is a global one, then, using the notations from sections 1 and 2 when

$$M = \mathcal{M}_H(\varepsilon_H(\Delta) / H)$$

there can always be some addressees G who will not recognize in M the

model of the world – seen as a prototype for global modelling.

The result is that a unique model is not sufficient for the description of the world – especially if the purpose of building the model is for solidary purposeful action on the planetary level.⁶⁸

IV. A PROPOSAL: PARTICIPATIVE GLOBAL MODELLING

The arguments developed in this paper could give grounds for argument to those who consider the process of building global models mainly a mental exercise, constructed for an a priori limited audience and in fact incapable of offering any substantial guidance to humanity's effort to forge a better world. However we cannot agree with their view.

But in order to widen the models' audience and their potential impact on social life, a necessary condition appears to be the re-evaluation of the global modelling process itself and of its output (the model) in the perspective of participation. This leads to a shift in the main interest for global problems: from the model itself towards the modelling process.

In Part III we analysed the process of producing a global model. It shows the rewards of inquiry into the theoretical, methodological and rhetorical assumptions guiding the modelling, helping the researcher to overcome his own theoretical, methodological, or rhetorical exclusiveness.

In fact, if the diversity in the field of images appears to be an inevitable feature, the fact that somebody does not adhere to a particular model should not be in itself disturbing. However, the study of the modelling process shows whether the given model has been generated by a coherent point of view, and namely by which point of view. Let us give an example.

In Part III, Section 3, we have shown that a communist and a liberal

capitalist could hardly achieve agreement on a model to represent the world. However, each of them would probably acknowledge that, in today's world, there are both communists and liberals, and that it is natural that each category designs global models in order to guide their actions (and establish a theoretical basis for planetary dialogue and negotiations).⁶⁹ Moreover, the failure of these models to appear and, especially, the absence of the dialogue around the matters depicted by the (eventually) opposite models could be interpreted as evident lack of scientific and political realism.

Further, let us emphasize that the development of several global models in different areas of the world could be of utmost importance. The working groups involved in the GPID Project may contribute by simulating general outlines of possible modelling processes departing from their respective points of view.⁷⁰

Global modelling could also provide a specific contribution to the design of a new world order. In this perspective the classical scheme, in which a model maker is producing an image that he exposes to the criticism of all those who are considered to be its (passive) addressees, has to be replaced by another one. If many actors in international life are invited to express themselves by global models, a participative cross-critique of the images built by various authors will appear. That will probably incite people to produce global models on the "local level": the world-wide dialogue and negotiations around matters of common interest — based on heterogeneous global models — forms a necessary input towards the installation of a new order.

Thus, from the realm of scientific interest and professional study, global modelling is transferred to the realm of social action. The exploration of the practical ways in which alternative global models can interfere with mutually concerted actions on the planetary scale is another problem which we shall not elaborate further on.⁷¹

One point, in particular, should be kept in mind. On a global level, where a set of actors is concerned, the dialogue and the negotiations

around common matters are always guided by the images the actors have produced not only about themselves but also about their partners' designs and possible patterns of behaviour. As a result of this dialogue, the zones of possible consensus (if there are any!) are identified, pointing to the domains for future actions. Therefore, discovering the problems upon which agreement could be reached and designing the resulting actions are not the output of a global model: they are a side effect of the negotiations between different models — which remain different even after the negotiations close.

This is the particular feature characteristic of what we call participative global modelling. It does not aim at producing one (or several) global models. More than that, it does not generally set itself the task of producing any model. The issues around some matters and the compromise around measures to be taken actually neither give a representation of the world (as seen by the actors involved) nor are they part of a particular model.

It appears to us that any action on the global level should not be based on a model developed by a particular actor. But what is to be the real effect, the direction content of possible world-wide actions if no explicit image, generally accepted by everybody, can be found?

In order to answer these questions, we need something more — namely some descriptions going beyond the world "as it looks like" in order to show the world "as it should be." The model will no longer be seen as a representation, but as an example to be followed — as in Platonic discourse.

We shall apply ourselves to these problems in a next paper on the desirability and the values within the heterogeneous world order.

We hope participative global modelling will develop as an acceptable theory concerning world dynamics — in the sense that J. Galtung uses the term. "A good theory" — says Galtung — "is that which leads toward the implementation of a potentially desirable reality, rather than one which depicts the image of empirical reality."⁷²

NOTES

1. The chief examples of these are reviewed in Ian Miles and Sam Cole, Goals, Processes, and Indicators . . . with Models? GPID Paper, September 1978; see also Chris Freeman and Maria Jahoda, eds., World Futures: The Great Debate, Martin Robertson, London, 1978.
2. See, for instance, I. Bestuzsev-Lada, The Future of Europe: Some Methodological Problems, paper submitted to the conference, "The Future of Europe — Research in Progress," Bucharest, 1-3 September, 1977.
3. C. West Churchman, The Design of Inquiring Systems, Basic Books Inc., New York, 1971.
4. A morphological (or "Zwicky") box is obtained through associating different possible states of the "atoms" (or morphs) forming a given issue in order to generate (or to enunciate) new (or latent but not explicit) inherent assumptions of that issue. For details see R.U. Ayres, Technological Forecasting and Long Range Planning, McGraw-Hill, New York, 1969.
5. For details, see page 16 of this paper.
6. See Johan Galtung, Methodology and Ideology. Theory and Methods in Social Research, Vol. 1, Christian Ejlers, Copenhagen, 1977.
7. J.W. Forrester, Principles of Systems, Wright-Allen Press, Cambridge, 1968.
8. See I.I. Prigogine et al., The Evolution of Complexity and the Laws of Nature. A technical contribution to the report Goals for Mankind, Club of Rome Special Session, Philadelphia, 1976.
9. See E. Jantsch, Design for Evolution, George Braziller, New York, 1974.
10. M.C. Botez, M. Celac, P. Dimitriu, Global Modelling: A Critical Approach, Working Paper, International Centre of Methodology for Future and Development Studies, Bucharest, 1975.
11. H. Kahn, A. Wiener, The Year 2,000, Macmillan, New York, 1967.
12. H. Kahn et al., The Next 200 Years, William Morrow and Company, New York, 1976.
13. D. Meadows et al., The Limits to Growth, Universe Books, New York, 1972.
14. E. Laszlo et al., Goals for Mankind, Dutton, New York, 1977.

15. W. Leontieff et al., The Future of the World Economy, Oxford University Press, New York, 1977.
16. Herrera et al., Catastrophe or New Society? Latin American World Model, 1976.
17. M. Mesarović, E. Pestel, Mankind at the Turning Point, Dutton, New York, 1974.
18. Obviously, this (quasi) equivalence bears a formal character and is not to be taken literally. Some distinctions between the ideological load carried by different models should always be accounted for. However, if the real world is opened to the ideological controversy, why should it be obliterated from the space of the images — and particularly, from the domain of global models? The mere fact that a certain model is built on a specific ideological foundation (which may happen to be remote from one's own beliefs) does not compromise it a priori — either as a product of some modelling activity or as a coherent expression of an explicitly acknowledged viewpoint. It belongs to the alphabet of dialectics which operate with plural and even opposed issues: the essential point here is to expose in debate evidence of different points of view.
19. Obviously, we are dealing here with the classical Hamming distance.
20. This problem was put forth by Johan Galtung during the GPID meeting held in Bucharest in June 1979. Galtung argued that the globalist outlook is characteristic of the western cosmogonies and rarely appears in other cultures. The idea of a global model in itself seems therefore rather unusual to everyone but the westernized élites.
21. See Johan Galtung, Global Processes and the World in the 1980s, GPID paper, 1979.
22. Apparently this approach comes very close to the intentions behind the GPID Project.
23. J.J. Kane, "A Primer for a New Cross-Impact Language — KSIM," in H. Linstone, M. Turoff, eds., The Delphi Method: Techniques and Applications, Addison-Wesley, Massachusetts, 1975.
24. R. Thom, Stabilité Structurale et Morphogénèse, Benjamin, New York, 1972.
25. T.Y. Li, J.A. Yorke, "Period Three Implies Chaos," American Mathematical Monthly, 1975; see also L. Starohin, "Our Changing Evolution: Strategies for 1980," General Systems Yearbook, 1976.
26. S. Marcus, Algebraic Models in Mathematical Linguistics, Academic Press, New York, 1974.
27. L.A. Zadeh, "Fuzzy Sets as a Basis for a Theory of Possibility," in Fuzzy Sets and Systems, Vol. 1, No. 4, 1978.
28. J. Galtung, C.A. Mallmann, and S. Marcus, Notes on "Visions of Desirable World" and "World Models," GPID paper, 1978.
29. M.C. Botez, Alternative Logics and Ethics in International Relations,

Woodrow Wilson International Center for Scholars, Smithsonian Institution, Washington D.C., 1976.

30. Some progress might come also from the use of cross-impact techniques in the study of the situations in which continuity and discontinuity are simultaneously implicated.
31. S. Brucan, The Dialectic of World Politics, The Free Press, New York, 1978.
32. Actually, the conceptual schemes developed by the theory of catastrophes offer the necessary background for speculations of a rather qualitative character. This draws attention merely upon the general form endorsed by behavioural change, thus putting less weight onto the specific aspects of the variables.
33. As a "measure of the war," one could consider for instance the frequency of the occurrence of armed incidents (or of crisis situations). The "measure of peace" is still to be defined (on the basis of the "intensity" of economic, political, cultural exchanges, for instance). We shall not elaborate further on this topic.
34. This approach is suggested by the model introduced by R.T. Holt, B.L. Job, and L. Markus, "Catastrophe Theory and the Study of War," in Journal of Conflict Resolution, Vol. 22, 2 June 1978.
35. These notations involve some ideological a priori ideas concerning the relative importance of the control parameters: α_1 is related to the Marxian classical control theory, and α_2 is the "second" (ethnic) factor. Our discussion is thus relevant only in this theoretical framework.
36. Holt et al., op. cit.
37. Recent developments on the international stage, especially after the events in Afghanistan, seem to indicate that the 80s are beginning in a state of crisis. However, according to the hypothesis described here, the amelioration of the international climate is, sooner or later, unavoidable.
38. S. Brucan, op. cit., p. 68.
39. A formal description of the modelling process can be found in M.C. Botez, "Toward a Systemic Representation of Systems: Open Multi-modelling," in J. Rose and C. Bilciu, eds., Modern Trends in Cybernetics and Systems, Springer-Verlag, New York, 1977.
40. See for instance, R. Rosen, "Modelling: An Algebraic Perspective," in The General Systems Paradigm: Science of Change and Change of Science, SGSR, Denver, Colorado, 1977.
41. Interesting considerations on the exceptional role assumed by the scholar in the field of social sciences can be found in J. Galtung, Methodology and Ideology; Theory and Methods of Social Research, Vol. 1, Christian Ejlert Publ., Copenhagen, 1977.
42. Some interesting observations on the problem have been put forth by P. Gourevith, "The Second Image Reversed: The International Sources of Domestic Politics," in International Organizations, Vol. 32, 4, 1978.

43. See, for instance, E. Laszlo et al., Goals for Mankind — A Report to the Club of Rome, E.P. Dutton, New York, 1977.
44. The space belonging to the Iranian state makes a good example of this. The aspirations of "the people of Iran" — eventually devised before the 1978 revolution for a model in which the actors were the nation-states — would probably contain those aspirations which were linked to the objectives of the Shah's régime and neglecting the aspirations of the opposition. Needless to say a model of the region's development built almost exclusively on the aspirations of the old régime would have been basically unrealistic.
45. See, for instance, The Programme of the Romanian Communist Party, Bucharest, Ed. politica, 1975.
46. L.I. Breshnev, Leninskim Kursom, Vol. 6, Politizdat, Moskva (our translation).
47. D. Gvishiani, "The Global Modelling: A Systems Analysis of the World's Development," in Problems of Peace and Socialism (240), 8 August 1978, Vol. XXI. Among the factors which should necessarily be taken into consideration is, to quote Gvishiani, "the removal of the exploitation which generates the social inequity."
48. The philosophical foundations of these approaches are explored by E. Masini, Global Modelling and the Views of Some Western Philosophers, paper submitted to the GPID Seminar on Desirable Worlds, Bucharest, June 1979.
49. See V.A. Ghelovani et al., "Ob adnoi zadatche upravlenia o globalnoy dinamicheskoi modely Forrestera" [On a management problem in the Forrester's model of global dynamics], in Doklady Akad. Nauk, USSR, 1975, t.220, v.3.
50. D. Gvishiani, op. cit.
51. Sometimes, such images display an evident élitist inclination. The hypothesis underlying them asserts, for instance, that people in the Second and Third Worlds are basically different in comparison with people from the First World. Paternalist or even disdainful conclusions could be formulated on this basis (for instance, one can hear: "their needs [in energy, or freedom, or identity] are not the same as ours, they never experienced such needs and therefore they do not aspire to individual and social security, etc.).
52. This point of view has been brought forward by J. Galtung in his paper Global Processes and the World in the 1980s, GPID Project meeting, Bucharest, June 1979.
53. These notions are used in the sense of C.W. Churchmann, The Design of Inquiring Systems, Basic Books Inc., New York, 1972.
54. Our point in these matters can be found in our contribution titles "The Participative Design of the Evolution of Heterogeneous Systems — A New Paradigm in the Science of Action," in P. Constantinescu and S. Tamas, eds., The Socialist Society Management

(in Romanian), Editura Academiei, Bucharest, 1978.

55. A measure for the distance separating the simulation from the intuitive behaviour has been introduced in the above quoted paper (and called "the Forrester-distance").
56. H. Kahn et al., The Next 200 Years, op. cit.
57. Socialist countries are: USSR, PR of China, Poland, DDR, Czechoslovakia, Romania, Yugoslavia, Bulgaria, Albania, Hungary, Viet Nam, Kampuchea, Laos, Korean PDR, Mongolia, Cuba, Mozambique, Angola, Guinea-Bissau, Ethiopia, PDR of Yemen.
58. Source: World Bank 1977 Atlas (data completed by the authors).
59. As recently happened in Great Britain, for example.
60. See D. Gvishiani, op. cit., p. 6.
61. See V.I. Lenin, Complete Works, Vol. 10 (Romanian edition).
62. Ibid.
63. This tenet belongs to the basics of the Marxist conception about authentic revolutions which cannot be either imported or exported. The revolution is always the consequence of the internal developments of a given social context.
64. Let us note that a map of this sort may stir up new findings about the dynamics of the revolutionary movement — beyond the usual clichés concerning this complex phenomenon. Indeed, one of the most widespread clichés states that spatial proximity enhances the probability of a socialist revolution to spread. If this is taken for granted in a country i contiguous to a country j in which such an event already occurred, necessarily $P(E_j/E_i) > P(E_j)$. In some cases these assumptions are verified by real facts (as in the case of i — USSR and j — some of its neighbours); in others, not. For instance, if i is DDR and j is BRD, such conclusions appear as forced, for it does not result that the victory of the revolution has enhanced its chances in BRD.
65. As J. Galtung points out in his work on cosmologies (lecture, Bucharest, 1980).
66. In J.W. Forrester's view, these two opposed attitudes converge in fact: he argues that, even if they think in different manners, people act identically — adjusting their behaviour to external constraints. That means that, for example, (internal) ideological commitment is irrelevant for the behaviour.
67. One can include in this category the models analysed in Part I.
68. Assuredly, this does not sound new for those who think in terms of dialectics. In fact, for a dialectician any evolution is set in motion by the contradictions (between standpoints too). Therefore, the evolution must imply the existence of several models and also of actions and confrontations guided by the respective models. The "perfect" model is simply unattainable and non-dialectical.
69. This by no means implies that the non-communists are converted to communism and vice versa. A model could at the same time be

considered inadequate (from the point of view of theoretical hypotheses) and legitimate (as representing a coherent point of view about the contemporary world). Some of the opinions expressed in the course of the present paper might be qualified as eclectic at first sight. Let us stress here that the general presentation of the models in Parts I and II does not mean that the authors adhere unconditionally to all of them. We simply try to take into consideration the realistic character and the legitimacy of the approaches developed within the models — even if they sometimes sharply depart from our own convictions.

70. Some interesting — but yet unexplored — proposals have been sketched by I. Miles and S. Cole, Goals, Processes, and Indicators . . . with Models?, GPID paper, 1978.
71. Our point of view on this matter has been presented in M.C. Botez and M. Celac, "The Dialectics of Social Systems Change: An Introduction to Revolutionary Awareness," a paper submitted to the SGSR Conference in London, August 1979. See also M.C. Botez and M. Celac, "Participative Planning, Interactive Communication and Societal Learning," a technical contribution to J. Botkin, M. Elmandjra, and M. Malitza, eds., The Learning Project, for the Club of Rome, 1979.
72. J. Galtung, Methodology and Ideology, p. 64.