GLOBAL MODELS AND GLOBAL MECHANISMS III: TOWARDS A FRAMEWORK OF GLOBAL MECHANISMS FOR GLOBAL MODELS

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Introduction

As stated in "Global Models and Global Mechanisms I", the situation of social science--described for the economic sector in W. Leontieff's amazing paper, "Theoretical Assumptions and Nonobserved Facts,"[1]--is reflected in the state-of-the-art of world models. An impressive, intellectual effort and highly sophisticated mathematical methods are applied to handle complex sets of some hundred or thousand equations, while the structure of the whole model is mainly based on "theoretical assumptions and unobserved facts." The corresponding, poor empirical evidence is not even improved by the use of some ten thousand or hundred thousand statistical data structured according to nonverified assumptions.

For example, at the Third IIASA Global Modeling Conference on Food and Agriculture, decisive questions remained unresolved, i.e., diminising returns of fertilizer in agricultural production; human capital as an important source of increasing productivity; the ecological capacity of rivers for agrochemical pollutions. The reason for this being a lack of empirical observations, or even a lack of knowledge of existing empirical observations (e.g. observation of the U.S.

Agricultural Department on diminishing returns of fertilizers). The deficiencies in the models caused by the lack of behavioral equations,which should be sufficiently based on empirical observations, cannot be offset even by the highest sophisticated theoretical methods if the model builder claims that the model reflects the part of reality relevant for the question which is asked and if the decision makers should apply this to their questions. This is no way to solve their problems without an intensive effort in empirical investigations for interaction with theoretical considerations. Applied systems analysis also needs the hard empirical work. The learning process in an iterative empirical--theoretical research--strategy leading to a step-by-step approximation between model and reality is described in Part I of "Global Models and Global Mechanisms: Methodological Considerations". The results of an application of this methodology to the question of long term economic development is presented in Part II. The following paper outlines how the methodology can be applied to other questions and how these questions are connected to the concept of the General Production Function as a basis for interdisciplinary research, leading to a framework of consistent global mechanisms which can be used as empirically tested behavioral equations for global models.

1. The General Production Function as a starting point for interdisciplinary research on global mechanisms.

Based on the framework of relationships centered on the General Production Function, investigations in different fields were started:

1.1 Investigations in educational structures and their impact on economic performance.

The term

$$\left[\tfrac{1}{2}\left(\frac{m^{\frac{1}{4}}}{e^{b}}\right)^{-\rho} + \tfrac{1}{2}\left(\frac{e^{b}}{m^{\frac{1}{4}}}\right)^{-\rho}\right]^{-\frac{1}{\rho}}$$

of the General Production Function is equal to 1 if the optimum relation

$$e^{b} = m^{\frac{1}{4}}$$

is fullfilled, and smaller than 1 if

$$e^{b} \neq m^{\frac{1}{4}} \quad .$$

This means that the economic efficiency of the factors education and capital depends on their relationship to each other.

The same also holds for the economic efficiency of education depending on the structure of its components, primary, secondary and tertiary education. This question was studied in cross sections of European countries for different years back to 1900. The investigations were based on a modified General Production Function.

$$Y = C_z\left[\delta_0\left(m^{\alpha}\right)^{-\rho} + \delta_1\left(e^{\beta_1 b_1}\right)^{-\rho} + \delta_2\left(e^{\beta_2 b_2}\right)^{-\rho} + \delta_3\left(e^{\beta_3 b_3}\right)^{-\rho}\right]^{-\frac{1}{\rho}} \quad \sum \delta_i = 1 \quad . \tag{1}$$

m ... material factor; energy versus capital per capita;

Y ... GNP per capita;

b_1 .. stock of primary education;

b_2 .. stock of secondary education;

b_3 .. stock of tertiary education.

The stock data of education was calculated by the use of enrolment data; the coefficients $\beta_1\beta_2\beta_3$ were primarily estimated with the help of single regression analyses and--together with $\delta_1, \delta_2, \delta_3, \delta_4$ --finally estimated in an iterative non-linear multiple regression analysis with altered ρ's starting from a multiple regression analysis for $\rho = 0$.It can be shown that the basic function

$$Y = \left[\sum \delta_i X_i^{-\rho}\right]^{-\frac{1}{\rho}} \tag{2}$$

is identical to

$$Y = X_0^{\delta_0}\ X_1^{\delta_1}\ X_2^{\delta_2}\ X_3^{\delta_3} \tag{3}$$

if

$$\rho = 0$$

The iterative process of estimation starts with this function.

Where the X_i's are according to the findings in the former studies and in single regression analysis of the relationships between Y and the X_i's are defined as

$$\left.\begin{aligned} X_0 &= m^{\alpha} \\ X_1 &= e^{\beta_1 b_1} \\ X_2 &= e^{\beta_2 b_2} \\ X_3 &= e^{\beta_3 b_3} \end{aligned}\right\} \qquad \text{(Note the exponential relationships of the educational factors)}$$

The equation ( ) then becomes

$$Y = cm^{\alpha}\, e^{b_1\beta_1}\, e^{b_2\beta_2}\, e^{b_3\beta_3} \tag{4}$$

or

$$\ln Y = \alpha \ln m + \beta_1 b_1 + \beta_2 b_2 + \beta_3 b_3 + \ln c \quad (4') \ .$$

The results of the multiple regression analysis according to equation ( ) are used for the calculation of the "complementarity term"

$$\left[\delta_0 \left(\frac{c_{\alpha} m^{\alpha}}{c_{\alpha} m^{\alpha}\, e^{\Sigma b_i \beta_i}}\right)^{-\rho} + \delta_1 \left(\frac{c_{b_1}\, e^{b_1\beta_1}}{cm^{\alpha}\, e^{\Sigma b_i \beta_i}}\right)^{-\rho} + \right.$$

$$\left. \delta_2 \left(\frac{c_{b_2}\, e^{b_2\beta_2}}{cm^{\alpha}\, e^{\Sigma b_i \beta_i}}\right)^{-\rho} + \delta_3 \left(\frac{c_{b_3}\, e^{b_3\beta_3}}{cm^{\alpha}\, e^{\Sigma b_i \beta_i}}\right)^{-\rho}\right]^{-\frac{1}{\rho}}$$

which can be derived from equations (1) and (4), if equation (4) multiplied by the complementarity term becomes equation (1).

$$Y = c_z\, m^{\alpha}\, e^{\beta_1}\, e^{\beta_2}\, e^{\beta_3} \quad . \quad \text{[Compl. term]} = \text{equ. (1)}.$$

$$\delta_0 = \frac{\alpha}{\alpha^*} \qquad \delta_2 = \frac{\beta_2}{\beta_2^*}$$

$$\delta_1 = \frac{\beta_1}{\beta_1^*} \qquad \delta_3 = \frac{\beta_3}{\beta_3^*}$$

when $\alpha \quad \beta_1 \; \beta_2 \; \beta_3$ is the result of multiple regression analysis and $\alpha \quad \beta_1^* \; \beta_2^* \; \beta_3^*$ is the result of single regression analysis Using the complementarity term the Y are modified

$$Y' = \frac{Y}{[\text{compl.term}]}$$

with the Y', a new multiple regression is started. The results are used to calculate a new complementarity term. With this new complementarity term, the Y' are modified yo Y" and the Y" are used again for a multiple regression and so on, until the difference between the n^{th} and $(n + 1)^{th}$ multiple regression is negligible.

The results show that the optimum relationship between education categories changes with the general level of education and that the optimum relationship between capital and education remained nearly constant. The latter is the reason why the educational investments in the last decade--too big compared to the capital investments--had diminishing returns. These results are quantitatively expressed.

1.2 Investigations of economic sectors based on a modified general production function.

As in the UNIDO paper ID/WG 160/10 "Considerations on Sectoral Growth in the Manufacturing Industry", stated the concept of the General Production Function can be applied to investigations in economic sectors based on a modified form of the GPF.

$$\ln y = \ln ko + k_1 q_1 + k_2 q_2 + k_3 \ln c$$

y ... value added per capita;

q_1 .. amount of skills;

q_2 .. qualifications for social information processing;

c ... capital per capita.

In a cross section of some 30 countries, high statistically significant sectoral production functions were estimated. Based on this production function further detailed studies on the firm-level are in process.

2. Application of the methodology used for the development of the GPF for investigation of the main factors of health development as a contribution for developing a dynamic model of the health system.

2.1 Basic Considerations

The achievement of the health system is not to understand without considering the amount of health disturbances. Relatively not so high level of health in an environment with high level of disturbances may indicate a higher achievement of health system than a high level of health in an environment with a low level of health disturbances.

The health system is understood as a control system with a task to protect human life correcting health disturbances.

Health disturbances are created by the environment in the largest sense of the world (climate, natural conditions for parasitic diseases, socio-economic conditions, psychological stress, pollution, and other disease creating factors).

2.2 Methodological Principles

The best methodology and the most sophisticated approach to build a set of relationships for a model is to use a large basis of empirical information about the reality that should be modelled. In the case of health models, such a basis exists in the large amount of statistical data for all countries of the world, collected by the WHO. In the following an iterative process according to Global Models and Global Mechanisms I: Methodological Considerations, describes how the investigation of this data should be started.

2.3 The development of the relationships of the health model in an iterative process.

The iterative process should be started with the investigation of the large amount of empirical information available, i.e. in the WHO statistics such as mortality rates for the various reasons of death morbidity rates, etc. Correlation-matrices should be computed in cross-section analyses and these first relationships could serve as a basis for the next step.

In the next step, first preliminary conclusions from the empirical observations can be drawn to find heuristic hypotheses for the causing factors. If, for example, two diseases are correlated and for one of them any knowledge exists about the causing factors then this knowledge can be used for meaningful heuristic hypotheses about the causing factors of the other disease. In any case, the empirically observed relationships serve as additional information for heuristic hypotheses for the introduction of environmental factors

into the investigation of health statistics in the following steps the heuristic hypotheses are tested, new interpreting hypotheses are introduced, and so on.

This leads on the one side to a step by step introduction of causing environmental factors (health disturbances) into the framework of empirically observed and theoretically interpreted relationships and on the other side to "mainfactors" of diseases according to the usual concept of this word in the factor analysis (but not necessarily restricted to the usually underlying assumption of linearity). In other words, the redundancy of the large amount of empirical observatories can be used to concentrate the content of information according to the concept of mainfactors and to find hypotheses about the causing factors behind the mainfactors that can be empirically proved.

With this concentrated information it is possible to describe quantitatively the "output" of the health system using negative indicators. This output is, according to 2.1 - 2.3, determined by the influence of health disturbances and the correcting function of the health system. In other words, the

"output" is the achievement of the health system at given environmental conditions (health disturbances).

The quantitative description of the achievement respectively the "output" of the health system is as precondition for the estimation of the influence of the various factors to this output. This makes the estimation of something like a "production function" of the health system possibly by the use

of econometric methods. To find the form of this production function a heuristic hypothesis may be drawn from the general production function* with the factors manpower, equipment, skill (education), medical progress and innovation. The latter means the application of medical progress is partly determined by organizational, motivational and behavioral structures.

The health disturbances and a goal function (a certain life expectancy, the extinction of certain diseases, etc.) determine the demand, the production function, the supply of the health system. To get equilibrium of demand and supply it could be in contradiction to economic demand and supply - the better strategy to change the demand especially by decreasing the health disturbances by a preventive medicine, e.g. improvement of life conditions respectively, sanitary conditions, improved medical knowledge of the people, improved diet, etc. For the purpose of a rational base for these strategies it would be helpful to develop an optimization model. The described investigations are steps towards the equations of this model.

Figure 2 illustrates the procedure of the iterative process for developing the relationships for a health model. On the left side are the different steps.

Step I: Correlation matrix of rank correlation.

Step II: Selected variables with high correlations; submatrices, respective clusters. Investigations of the clusters using original data (not rank orders) additional information.

Step III: Multivariable relationships between different observations of the same variable (i.e. two observations of cancer of the lung in Figures 3 and 4). These observations form a consistent network. This is a precondition of interpretation, a single observation should not be interpreted.

Step IV: Integration of the network; additional information.

Step V: Combination of the clusters.

Step VI: Introduction of socio-economic variables; introduction of factors of the health system.

Step VII: Conclusion: Interpretation, control of the relationships.

After these 7 steps the empirically founded relationships can be extended by normative assumptions and combined with relationships of long term societal development to a dynamic health model for policy questions.

The investigation was started in the summer of 1975 by the Study Group for International Analyses. After Steps I and II, now Step III is in progress; the first preliminary investigations of the empirically observed relationships lead to new investigations.

I Korrelationsmatrizen u.Literaturinformationen zwecks Auffinden v.Submatrizen u.Abgrenzen v.Teilbereichen

II Untersuchung der Teilbereiche:Einfachbeziehungen zwischen Variablen Einbringen v.Zusatzinformationen

III Verbindung v.Mehrfachbeziehungen zwischen d.Variablen u.Zusatzinformationen zu einem konsistenten Netzwerk v.Zusammenhängen, zu einem informationsmässig überbestimmten System

IV Interpretation d. Netzwerkes nach III; Einbeziehung v.Zusatzinformat.; Verwendung u.allenfalls Modifikation bestehender Theorien

V Zusammenfassung d. Teilbereiche zu Hauptfaktoren d. Gesundheitsentw.

VI Einbeziehung sozioökonomischer Variablen

VII Zusammenfassung Interpretation u. Kontrolle

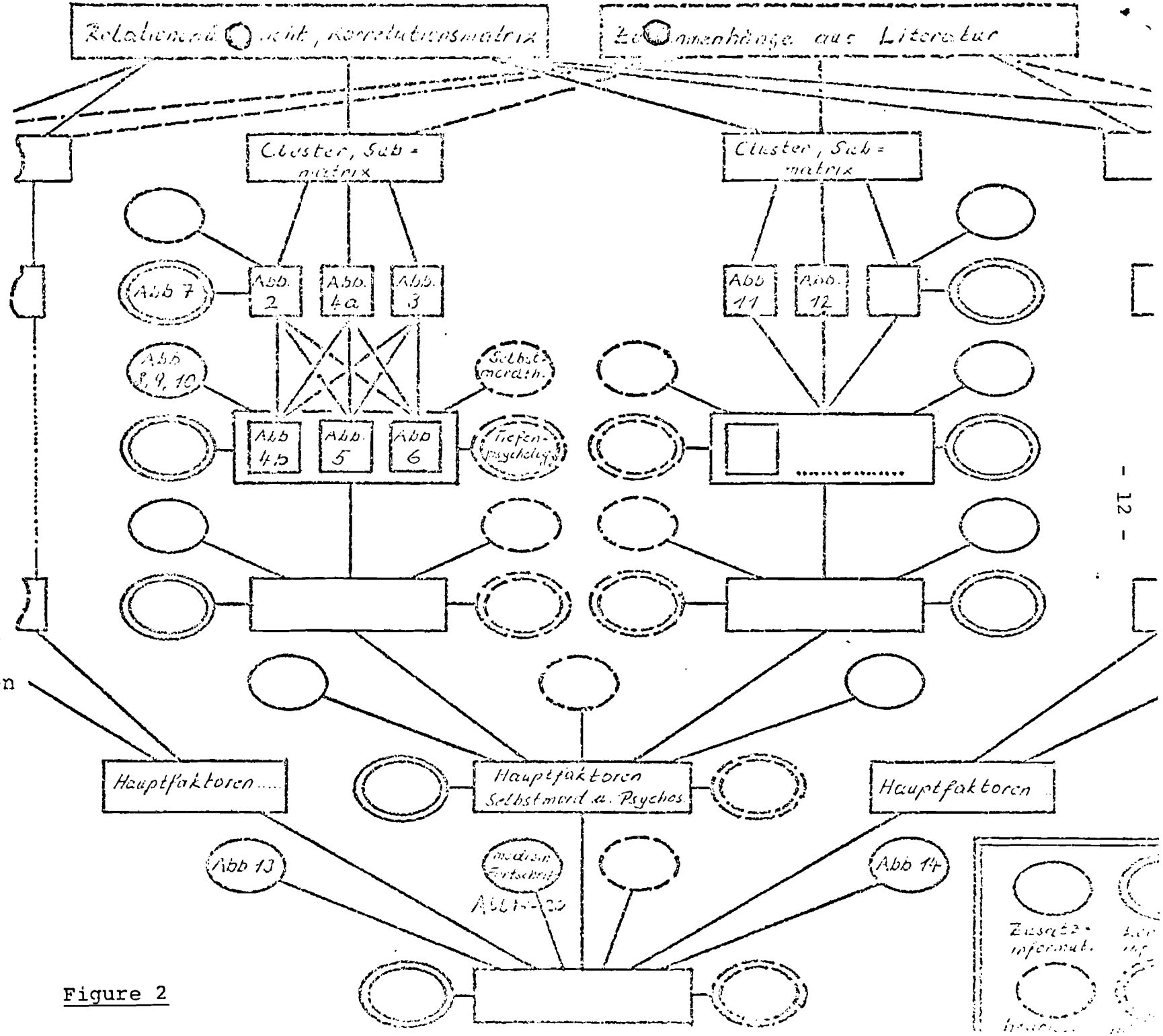

Figure 2

3. Sociopsychological mechanisms--an attempt of hard observations on soft variables.

Introduction

In discussions on the future, we hear again and again that future developments require man to change his set of values drastically, to break taboos: only a Copernican shift towards new values could save mankind; we need transmutation in present culture patterns in order to survive. Here the question arises as to how pathways into the future can be found that are realistic, i.e. feasible, based on inner motivation rather than on outer force. Answers to these questions require on the one hand better insights into the laws of material development which are so far insufficiently described in global models, and on the other hand knowledge of the regularities of immaterial development of different cultures that were not considered so far.

Both regularities form the possible alternatives of the future. The regularities of material development are greatly unknown because--as Nobel Prize winner Leontieff said--"theoretical assumptions and nonobserved facts" are the basis of highly sophisticated models which do not reflect reality due to the lack of empirical data (see also Millendorfer, "Global Models and Global Mechanisms I: Methodological Considerations"). Steps toward an improvement of the knowledge of the material development leads to questions on the immaterial development, i.e. the efficiency parameter of the

General Production Function is different in regions with different cultural backgrounds and the question arises as to how the culturally determined behavior patterns in this region differ.

Investigation cannot be restricted to the original question because of the strong interdependencies in the sociopsychological field and can be treated only in the context of a large framework of sociopsychological mechanisms for exceeding the original question and based on a very large data base. For investigations on a very large data base, it is typical that side-effects sometimes become important, namely the results far away from the original question. The following chapter describes such a side-effect, presented in Jerusalem in October, 1975 at an International Congress of Psychiatrists.

"Suicide in the Framework of Relationships between Highly Aggregated Sociopsychological Factors."

"People who work as individual psychologists may be surprized by our view of this problem. But we all know from our therapies that it is only possible to understand the individual reaction of a patient by seeing it on the background of his social relations. We realize more and more that we cannot see the individual person isolated but in tight connection with his social background which influences all ways of behavior in a population.

Therefore, we have a different approach to the phenomenon

s u i c i d e than most of the present authors. Our strategy is to find patterns in the social-cultural background of a phenomenon. Are there sociopsychological conditions in different countries that enforce suicide rates? One of the starting points in our studies was the fact that immigrants to the USA show significant variation in their suicide rates.

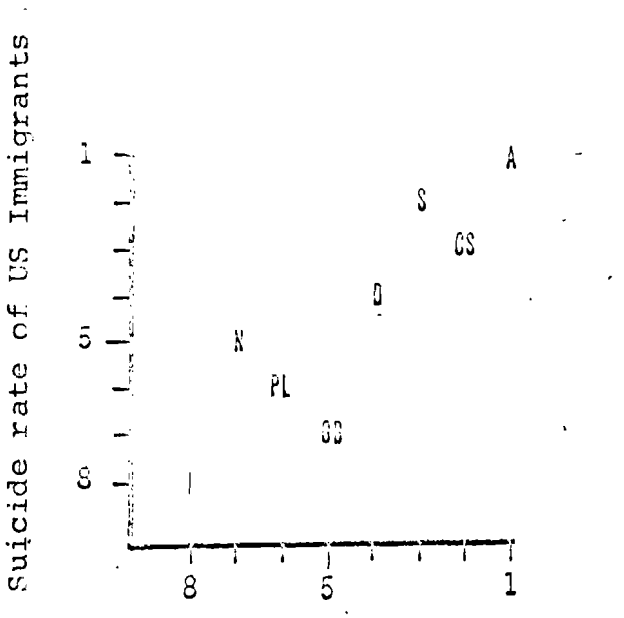

Fig. 1

These data of death rates show the same characteristics as the data of the original countries the immigrants came from with a good rank-correlation. It seems that the tendency to suicide that shows in the original country sticks with the immigrant also in his new surroundings. We can propose that the tendency to suicide is modelled by socio-cultural factors of the original country. It was now our task to find indicators that describe these conditions in the countries and give us the possibility for a highly aggregated comparison.

It is well known that the individual reacts with different symptoms when the psychological s t r e s s - l e v e l exceeds a certain standard. We cannot observe the amount of stress directly, but are able to measure it be observing certain symptoms in a population which we call indicators. We tried to find out which indicators correlate highly with suicide. Are there any sociopsychological patterns that could be verified all over Europe?

One of the connections of our highly aggregated observations concerned the high correlation between suicide and divorce.

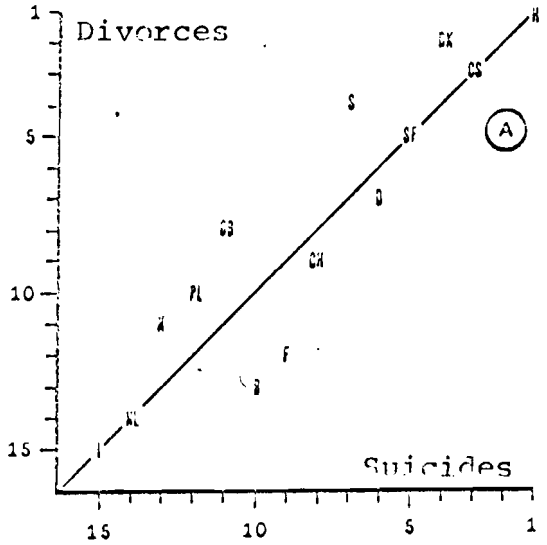

Fig.2 Divorce Rates -- Suicide Rates

You see data from fifteen European countries and can observe that the countries with high suicide rates also show high divorce rates. You see that Hungary has rank number 1 concerning the divorce-suicide rates . On the other hand,

the country with the lowest rates in this connection is Italy. There has to be a relationship of these two variables as this correlation remains constant over decades.

Another indirect connection with suicide is shown by the fact that death rates, after the international classification A 67 and A 68, psychoses and neuroses correlate highly with car accidents as a cause of death.

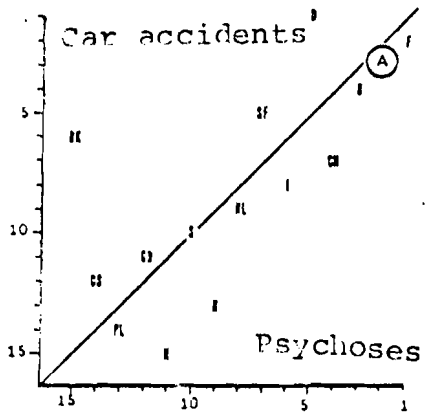

Fig. 3 Traffic Accidents--Pyschoses

The different countries are ordered after their rank. Countries with high frequences get rank number one, countries with low frequences rank number fifteen. You can observe that Austria and France show high frequences concerning psychoses a n d traffic accidents. Poland shows only a low number of psychoses and traffic accidents. The tight connection between these two variables is still another bit of information for us to understand the phenomenon of suicide in a certain population.

We tried to find a still more consistent pattern and combine the findings you saw up to now. I will show you the

result of our correlation of death rates through psychoses and neruoses with divorce rates in the same country.

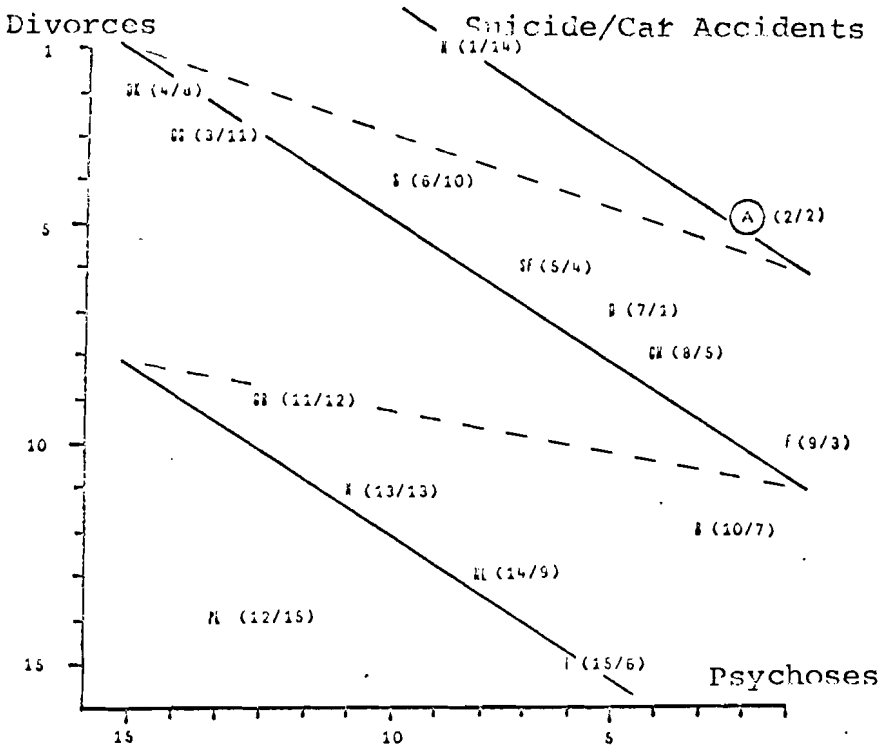

Fig.4 Aggression Levels

You cannot find any visible connection when you only observe the data of psychoses and divorce rates. The moment you intorduce another variable in form of rank-numbers behind the data of the countries, you suddenly realize a pattern. We took the suicide rates of a country and wrote them behind the data of each country. The pattern runs: 1, 2, 4, 3, 6, 5, 7, 8, 9, 10, 11, 12, 13 and 14.15. We introduced also the rates for traffic accidents in the same way. The connection is not so strict but the direction is opposite in every level.

As you can observe, we found three different levels with approximately the same sum of variables. We call them s t r e s s - l e v e l s. On the highest stress level the number of divorce rates and suicide rates on the one hand and that of psychoses and traffic accidents on the other hand are highest. No other country in our cluster shows data like Hungary and Austria on such a high level. All data on the second stress level are again similar but lower than the former. On the lowest level we find also data which do not differ much.

We tried now to interpret our findings and bring them into connection with the present psycho-theories, especially with the findings of Professor Ringel and his "Präsuicidales Syndrom". He says that the probability of suicide is dependent on the amount of self-aggression in an individual. In our diagram you also see that the probability for suicide rises with every stress level.

Our hypotheses is a probable explanation for these findings and postulates a substitution between external and internal aggression on every level. We postulate that traffic accidents could be taken as an indicator for aggression against others of external aggression and suicide could be taken as an indicator for internal or self-aggression.

We start with our explanation at the lowest stress level. A high number of traffic accidents excludes a high number of suicides. The moment the indicator of external aggression diminishes, the indicator of internal aggression becomes higher.

The number of car accidents becomes smaller but at the same time the number of suicides rises. This phenomenon looks like a process. This process develops up to a certain point. The one system of aggression indicators, as suicide and divorce, becomes unstable and changes int another system of indicators, car accidents and psychoses. We can observe this in the diagram as a jump from one level to the other.

On the next level, the same process starts anew. The loose human relations measured by traffic accidents become better, the tight relations of the partners measured by divorce rates become worse. The level as such is higher, the whole situation is worse.

When we propose that the human being needs tight human relations, and that he needs small groups in a dynamic sense of meaning, we can postulate that when the group relations, for instance in a family, become worse, the whole system becomes unstable. This system gains stability by isolation against external influences through the loss of the sense of reality, shown by the rise of psychoses. The disturbance of loose relations shows in a rise of traffic accidents.

Now the process begins in Europe by a slow breaking down of human relations in the system of marriage. This system becomes more and more unstable, and we see the jump, which leads to the higher level and brings no real change for better, but for the worse. The tight and the loose human relations become worse in every level though it seems that

the jump helps to stabilize the tight human relations by isolating the individual.

This could be seen as an iteration process of breaking down of human relations tight and loose which leads the individual to a situation that makes suicide possible and even more probable.

We have still a great number of diagrams, which fall into pattern with our observations and form the theoretical framework which is consistent in itself. We interpret our hypotheses only on the background of this network and would invite you to help us with the interpretation from your point of view and your rich experience in this field."

4. Towards a consistent framework of observation and hypotheses on long-term societal development.

The last sentences of the last chapter speaking about a theoretical framework consistent in itself is not only the task of the investigation of the sociopsychological mechanisms, but also for all studies in the different fields mentioned in this paper. These studies again should be linked together in a consistent framework. An approach to such a framework is the General Production Function.

The General Production Function can be understood as a generalization of the Cobb-Douglas Production Function explaining the residual of this Function by the use of non-economic factors like education and culturally determined behavior patterns. It contributes to a modification of the

neoclassic economic theory and its concept of a time-depending technological progress, which has "fallen down from heaven". This technological progress is split into three components. First, the world-wide advances of knowledge still time-depending and not quantitatively explained by causing factors like research; second, the culturally determined ability of countries, esp. groups of countries, to accept these world-wide advances of knowledge and to apply them as concrete measures of societal development; and third, the quality of labor measured by the use of educational indicators. From another point of view the latter can be understood as an indicator for the information processing capacity of society.

In spite of the fact that the General Production Function describes long-term development of the economy, other sectors are involved, too. The educational sector is responsible for the information processing capacity of society, esp. qualities of labor. The health system contributes not only to manpower, but has much stronger connections to the General Production Function : the medical progress is very similar to the economic residual "technological progress", as it is shown in Global Models and Global Mechanisms II.

This leads to the next subsystem, the sociopsychological field, where the causing factors of the similarity between technological and medical progress in the various regions with different culturally determined behavior patterns seem to be located. This field is the most difficult part of the task

to understand in the light of long-term development, but the first results of investigations using the described methodology on a very large data base are encouraging because they led to a new understanding of old theories similar to the General Production Function in the economic field. With extending all this investigation, the gap between the different fields and the related theories will be diminished in an iterative interdisciplinary research mentioned in Part I of this working paper. Fig. 5 is an extension of Fig.1 in Part II of this working paper, and illustrates the extension of the results of the studies described in Part II by the studies described in this Part III. An interdisciplinary research could provide a further extension in the direction of a consistent framework of global mechanisms. Some examples of possible further studies are illustrated in Fig.5 by dotted lines.

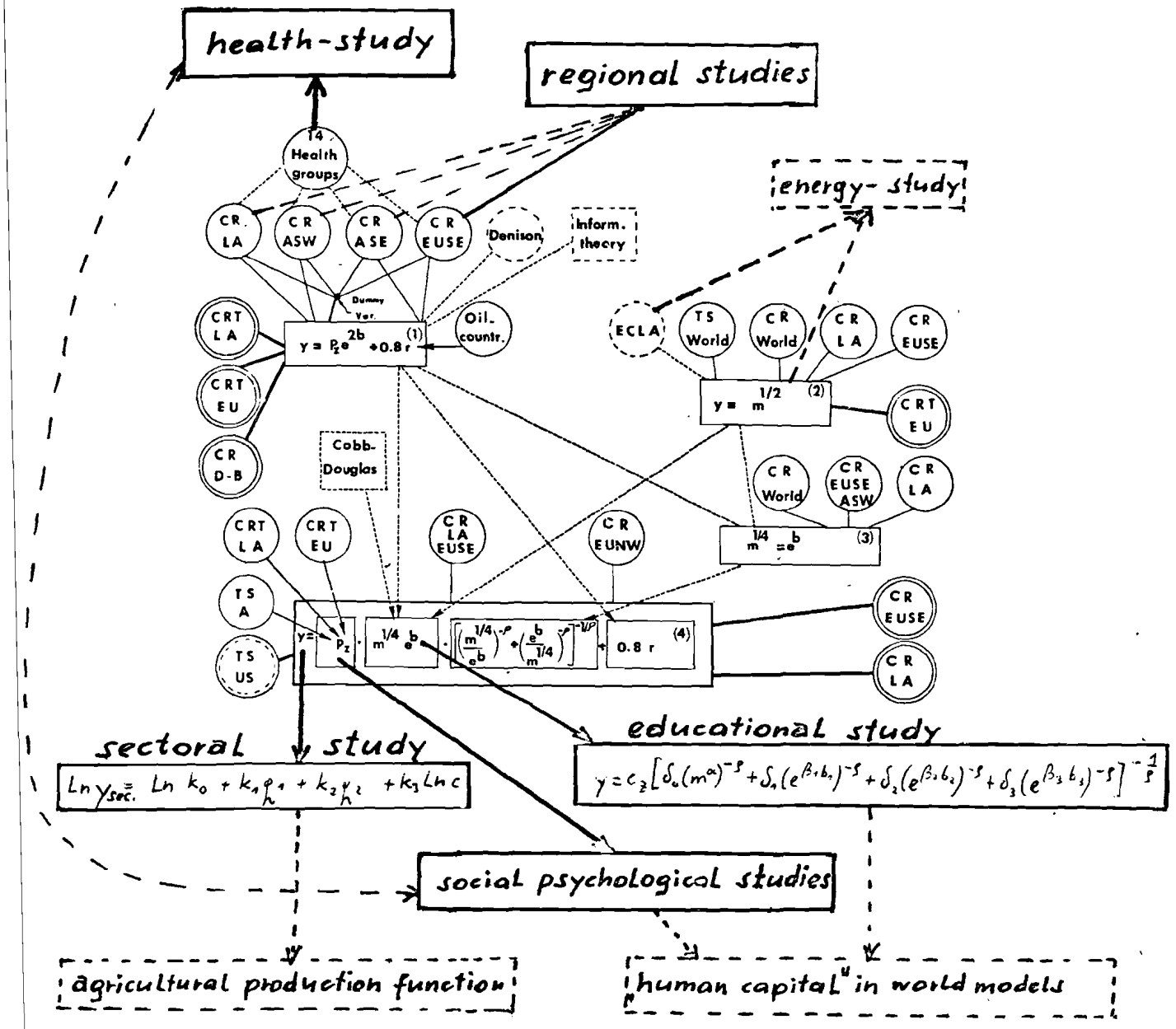
health-study
regional studies
14 Health groups
CR LA
CR ASW
CR ASE
CR EUSE
Denison
Inform. theory
energy- study
Dummy Var.
CRT LA
CRT EU
CR D-B
Oil. countr.
$y = p_z e^{2b} + 0.8\,r$ (1)
ECLA
TS World
CR World
CR LA
CR EUSE
$y = m^{1/2}$ (2)
CRT EU
Cobb-Douglas
CR World
CR EUSE ASW
CR LA
CRT LA
CRT EU
CR LA EUSE
CR EUNW
$m^{1/4} = e^{b}$ (3)
TS A
TS US
$y = p_z \cdot m^{1/4} e^{b} \cdot \left[\left(\frac{m^{1/4}}{e^{b}}\right)^{-\rho} + \left(\frac{e^{b}}{m^{1/4}}\right)^{-\rho}\right]^{-1/\rho} + 0.8\,r$ (4)
CR EUSE
CR LA
sectoral study
$Ln\,y_{sec.} = Ln\,k_0 + k_1 \varphi_1 + k_2 \varphi_2 + k_3 Ln\,c$
educational study
$y = c_2\left[\delta_0 (m^{\alpha})^{-s} + \delta_1 (e^{\beta_1 b_1})^{-s} + \delta_2 (e^{\beta_2 b_2})^{-s} + \delta_3 (e^{\beta_3 b_3})^{-s}\right]^{-\frac{1}{s}}$
social psychological studies
agricultural production function
human capital in world models

Fig. 5

5. Considerations on the question of human values in the context of global mechanisms.

Introduction

In the iterative empirical-theoretical methodology described in Part I, preliminary heuristic hypotheses on models serve as a starting point for a learning process which leads step by step to an approximation of the reality by improved models. In this sense the following considerations on human values in the context of global mechanisms should be understood as a very tentative first step. They are centered on an application of a generalized input-output matrix to illustrate the interdependencies between subsystems of society which should be investigated in order to develop a consistent framework of empirically tested hypotheses on long-term societal development. Some of these interdependencies are investigated in the described studies and marked by circles in Fig.7.(In the General Production Function the impact of natural resources, of energy and capital, of education and of culturally determined behavior patterns to economic achievement is described; first results are obtained in the health field.)

Men and System

"Antropos estin zoon politikon". Man is a social being. He needs a system of more or less institutionalized human relations, the system of societal structures to be humans.

On the other hand the system requires certain preconditions for its own functions, and it has to provide services for man

to exist as a human being. Therefore, society can be seen as a dual system with a production sector in the widest sense providing goods and services that are used by man to achieve a life of fulfillment in the human sector or the living sector.

The following graph (Fig.6) illustrates the interaction between the two sectors:

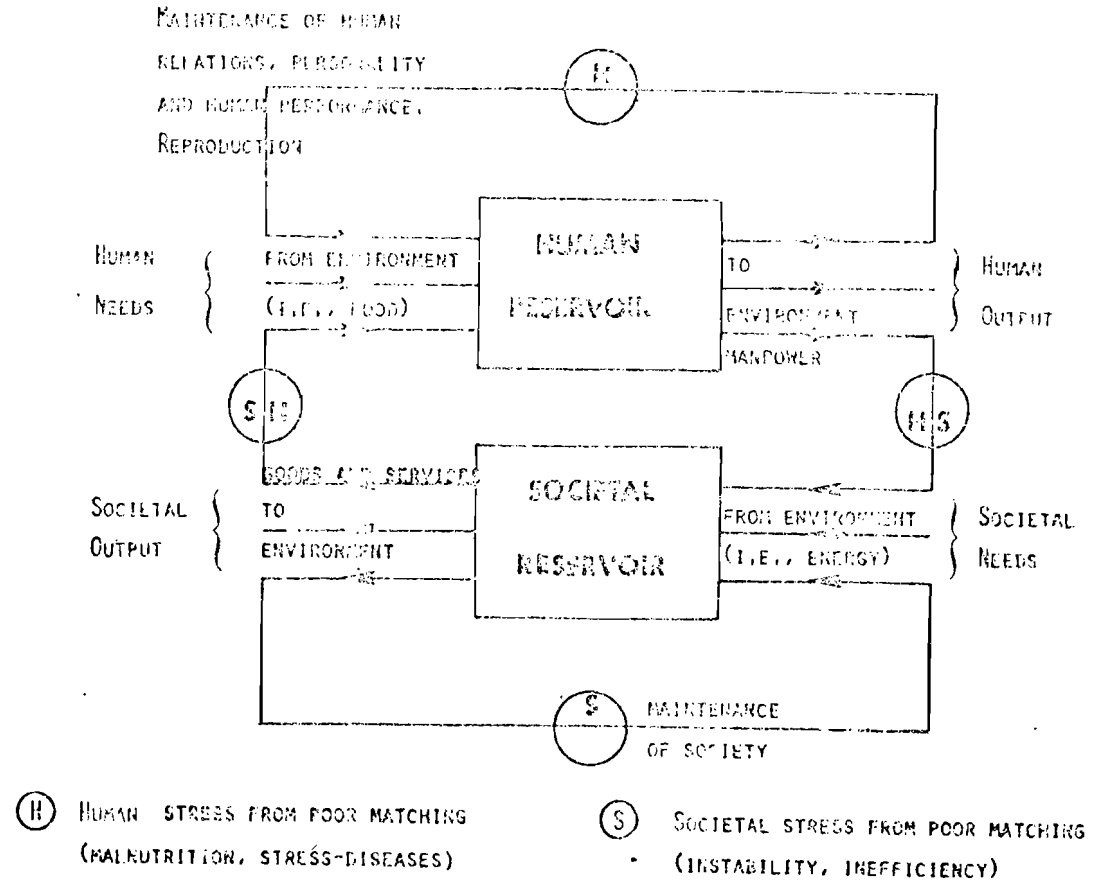

Fig.6

Fig. 6 : Dualism of production sector and living sector.

When applying these considerations to the question of values, we get on the one hand values that ensure the functioning of the production sector in the widest sense of the word and on the other hand we get values that ensure, in the living sector, a life of fulfillment. These values are interrelated as is shown in the following graph.

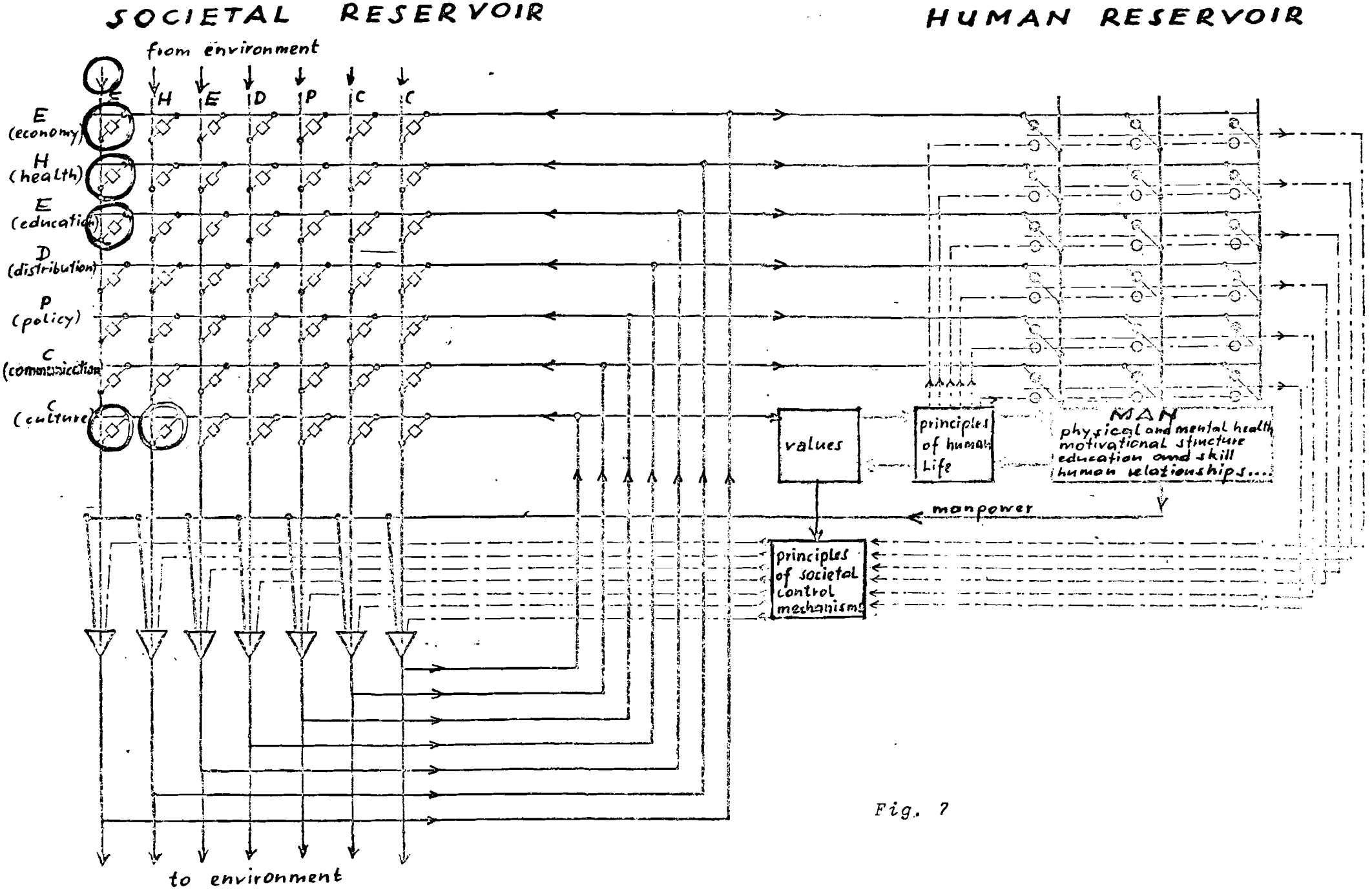
SOCIETAL RESERVOIR
HUMAN RESERVOIR
from environment
E
H
E
D
P
C
C
E (economy)
H (health)
E (education)
D (distribution)
P (policy)
C (communication)
C (culture)
values
principles of human life
MAN
physical and mental health
motivational structure
education and skill
human relationships....
manpower
principles of societal control mechanism
to environment

Fig. 7

Fig.7 : Graphic analogous representation of society's input-output relations based on the concept of the input-output matrix used in economics and a system of symbols isomorphous with mathematical equations. (For details see H. Millendorfer, "Input-Output Relations between Social Systems" in Global Systems Dynamics, E.O. Attinger (ed.), Basel, New York 1970.)

According to the usual input-output concept we get an intermediate sector where the individual economic sectors supply each other, and a final demand by man which is described as the difference between total output and the share going to the intermediate sectors. One part of the system output serves to maintain the system and one part remains as service for man. This can be applied to the entire society including the non-economic subsystems as is implied in the graph. Within the production sector different separate sectors may be introduced: economy, health, education, distribution policy, communication, and culture. Of course, these sectors can be changed in the learning process. The sector, "culture", is interesting where all values and opinion-forming institutions are comprised.

This sector influences values and opinions particularly with a view to the system, respectively the principles of the governing control mechanisms and those concerning the sector of living. Both value sectors interact in several ways; in fact, it is a system of values performing two different functions; on the one hand the maintenance and efficiency of the system and on the other hand to ensure optimum accomplishment of man's life. This sector "culture" may play a decisive role in the coming age of tremendous "Copernicanian" changes in values, preferences, attitudes,

behavior patterns, etc. Even the best knowledge of all material global mechanisms cannot be applied without taking into account these very "soft variables". Realistic conclusions need a complex framework of thinking. For these reasons this sector needs, apart from the difficulties with which it copes, increased intellectual efforts. One contribution for a better understanding may be the sociopsychological studies mentioned in other informal discussions.