

Studies in Cybernetics: 16

**SYSTEMOLOGY AND  
LINGUISTIC ASPECTS  
OF CYBERNETICS**

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**GORDON AND BREACH**

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## Editor's Foreword

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With the development of the scientific-technological revolution the physical, chemical and biological influence of mankind on nature increases sharply. The stronger this influence, the more effective must be the means of managing it, and the basic problem for us today clearly is not so much to choose the optimum (most economically profitable) method of management, but rather to predict and prevent an ever-increasing danger of natural and irreversible processes occurring which threaten the existence of man and of life on earth in general. Surely no more complicated problem has presented itself to mankind before.

One can argue about when the irreversible shifts in nature will occur and what their consequences will be but it is certain that the time available for the solution of this very complicated problem is not great.

What this in mind being done on the theory of systems or systemology acquires particular significance. This study is more often called 'systems analysis' and it arose from the demand for solutions to similarly complicated problems. Studies on systematic orientation which deal not only with the basic principals of the methodology of systems theory but also the effectiveness of a systematic approach to the solution of complicated, modern-day problems in cybernetics are particularly valuable. This book is like that: systematic by subject and by presentation.

In the first part the author deals with the nature of systems analysis in detail and in the second applies it to the more general semiotic problems of cybernetics. Both parts of the book are original and have independent meaning. One of the individual aspects of the book is its attempt to present the essence of systemology from a single point of view. In order to do this the author analyses in depth the basic ideas on the concept of systemology and shows that these ideas are linked to laws and categories of material dialectics, and that systems analysis only leads to the level of concrete, practical knowledge of basic rules of the development of nature and is not a new 'world view' as is often suggested by systems theoreticians in the West.

The author does not try to formulate a presentation of his own which would be biased if attractive, however the manner of presentation of the book may be seen as a first step in this direction.

In the exposition of systems analysis GPM is primarily concerned with that which unites a system as a whole. Many authors, when researching

complicated systems, try either to divide them into simplified sections and look at the link between them as an obstacle to further division, or conversely, pay all their attention to the links of the chain and the essence of the relationship (structure) between sections and elements of the whole, and say that the nature of the elements being linked is vital for the establishment of the whole. GPM focuses on the structure of the whole and on those properties which surface in each of its elements precisely because of the existence of a system as a whole, and on the nature of the whole stemming from the individuality of the properties of the elements which form it and which show the mechanisms of compatibility of all these parameters of the system, which is formed by the inevitable interaction with the environment.

Every system in as far as it exists must acquire the characteristics necessary for reacting against outside forces (and the effects of other systems) which try to destroy the system. The longer the system exists and the stronger the influences to which it is exposed, the greater (in the system, the whole and each of its elements) must be the properties of compatibility produced during the adaption process. These are the qualities Hegel was referring to when he said that the ocean is expressed in a single drop.

The appearance of these common qualities and the identification of their origin (concealed in the complex of external forces) which the author calls a determinant system opens a wide range of possibilities for research into those properties of complex systems which are responsible for their complexity. This allows another look at the idea of a system and to discover such links between its sections and those characteristics of its elements whose existence it is often hard to ascertain. GPM managed to identify (as a result of research into the characteristics of the overwhelming numbers of languages on earth) the agreed dependence between grammar of a language and its phonetics, and to formulate a new systematic typology of languages whereby the structure of languages is compared with the characteristics of their determinants.

The approach which the author develops allows quite an accurate definition of the difference between systematic and structural analysis. It turns out that these differences are by nature included in one hypothesis: the ideas of structuralists are based on the theory that absolute amorphous material exists from which system the properties of a given element of the system are formed instantaneously only in relation to its position in the structure.

According to the views of the systemologists completely amorphous material does not exist. Every material has the characteristics of previous systems, in which it appeared before, and moreover gained the ability to keep its acquired characteristics to a greater or lesser degree, during the process of adaption. Therefore when such material serves as a model for a

new system a long adaption of the old and formation of new characteristics occurs ie at each moment in every element of the system 2 types of characteristics exist; the original (material), which reflect the material's history, and those caught by the system (structural) which are defined by the determinant of the system.

The questions dealt with by the author on the relationship between the structural (logical, syntactic) and the substantial (material, systematic) in actual, real and artificial systems not only represent the general philosophical interest but also have great significance in the construction of manmade systems which are a basic tool for the solution of more complicated contemporary problems in cybernetics.

For the effective use of such systems it is first necessary to divide the process of solution into 2 parts: one intended for a machine, formal, corresponding to the structure of the researched or constructed object with the logical interaction of its parts; and the corporate, semantic, uncalculated peculiarities which have not been reduced to the structure of the object ie mankind. Under these conditions man's major concern being the total application of technical possibilities (in order to put the unformulated part of the problem down to technology) became a real option for specialists.

The ability of man to separate the formalised part of a problem, like other skills of man in being able to work with informal objects, is one of nature's greatest puzzles. So any attempt to penetrate this secret or even to outline approaches to it are very important. From this angle the concepts laid out in the book open a very enticing perspective. Although the author tries not to stress the link between the problems he develops and problems of artificial intelligence, nevertheless it is completely described in the book. By this means the author focuses attention on the central problem: how people think; what role language plays in the thought process, how thought is enveloped in words in social interaction between individuals, and not on the popular problem of formulating heuristics (anthropological) methods of solving artificial, frivolous problems. In this respect the problematics of the book touches on the formulation of principles of the construction of integral automatic devices (but not on heuristic programming).

The author arrives at the formulation of these principles not so much from straightforward technical experimentation as much as systematic interpretation of good quality semiotic, linguistic and psychological material, which has been gathered to date. In connection with this much attention is paid to an analysis of such primary questions of cybernetics as the sources of the ability to form mechanisms of identification and prognosis, indicative communication and modeling and the degree of importance of the application of these mechanisms for the productive interaction of people and machines, and machines with machines. The

author uses specialised symbolic apparatus in order to outline economically typical components of these processes.

The chosen exposition of its contents differentiates between fundamentalism and conclusiveness. However one must remember that the questions dealt with relate at present to a number of questions which are much harder to present and understand and therefore the reader must be prepared to put some effort into reading the book. Many parts will need to be read twice, and questions must be considered but the diligent reader will gain a lot from the reading of the book.

Informal-logical type of deduction and therefore the possibility of finding regularity where formerly only a haphazard mish-mash of facts were present is just one of the things to be enjoyed by the reader.

As is clear from all of this, the author's methodology is not a goal in itself — he has had to pay serious attention to this part of the book precisely because he is faced with problems of general cybernetics. But because of this the first half of the book which is put in context by the exposition of the author's conception of systems analysis really presents the whole idea. The reader more interested in systemology can pinpoint his attention on the first part of the book, taking the second half as an appendix which shows how the concept can serve as an effective tool for solving difficult cybernetics questions. The reader interested in questions dealt with in part two can look on the first half also as an appendix but very necessary, which a preface or list of conclusions could not comprehensibly afford to him.

2 The concept of the systems analysis has firstly not a formal-axiomatic orientation but an ontological-material one which tends towards a formulation of basic concepts and principles of systems analysis such as would achieve a most clear engineering, biological and psychological interpretation and therefore could be a means for describing and reflecting on the natures of actual existing systems and on their construction, their application to computers. In this respect the book is 'cybernetic' as well as 'systematic'.

It is important to note that the dialectic nature of basic rules of systemology presented by the author is not only stated but proved. On the basis of the calculation of principles of dialectic development the author shows the nature of the incorporate interaction of men and machines; these principles are applied in the methodological part of the work with the demonstration of the original ideas of systems analysis. These ideas are not just chosen because they are undefined, as is assumed in axiomatic theory construction, but they are developed in proportion to their application by considering what has been taught by the preceding.

This creative kitchen usually modestly hidden in publication, seems very real in the author's treatment, taking as he does the stance of a dialectic. This

enables him to identify support in the discussion as to which sections are worthy of formulating systems analysis and what must principally operate on the calculation of rules of development and rules of inconsistency, on the basis of which a machine can be constructed which can perform even the most elementary creative acts and without which plans for the productive interaction of man and machine are doomed to failure.

3 If the reader does not share the author's original dialectic convictions the conclusions reached on this basis may seem unconvincing. This fact which is vital for the solution of many contemporary cybernetic problems so that the automat can perform creative acts is beyond question. One must acknowledge the effects of formal algorithms on the behaviour of the machine and more so a way of solving the problems which arise in 'cyberneticising' the rules of dialectic procreation.

A series of negative results linked to the possibilities of incorporate axiomatic theories says that the deductive path of hypotheses of such theories cannot be conclusively more accurate than what the hypotheses actually put forward.

So the creative act is fundamentally linked to the choice of the hypotheses themselves from among those which would be capable of solving the problem. As L.V.Krushinskii showed when studying animal's intellect, the simplest act of creation of an animate creature is the application of his experience, which leads to a correlation of the type of hypothesising on the elementary rule of nature which allows a creature to interact more effectively with its environment. If the substance of the inductive creative act is found in this, but we are making the machine have an intellectual level at least equal to that of an animate being then it must be ascertained whether one can advance a theory which does not disclose important information contained in the original facts. Whether the answer is yes or no will be important for the choice of solution for a problem of artificial intelligence. The author thinks the answer is no.

4 So the need to go beyond the bounds of formal logic in order to work out principles of correlation has a second basis. However, the author does not draw conclusion from this about the basic futility of applying formal apparatus in solving complex cybernetics problems. On the contrary, in contrast to solidity, the substance of technical and natural systems of non-solidity of their structural models, he clearly describes this circle of occurrences, a description and the construction of which should be carried out at first using the strictly formal apparatus of logic and mathematics. Using this proposal on the substance of adaptability the author brings out the fact that the concept of formality can be extended without losing its rigidity. Contemporary attempts to enrich the original ideas regarding the fundamentals of maths and the attainment of richer and less usual theories

which are intended for the calculation of the ontology of substances being researched.

The methodological foundation and deep significance of these also enriches the stock of principles for the construction of formal theories and is clearly outlined in terminology of the correlation between the formalised and the unformalised which the author looks at in his treatment of systemology.

It is very important that the author shows the physical reality of what is unobtainable using strict formalisation. Because of this a material object is contrasted with its structural model.

This affords the opportunity to systematise the original concepts of semiotics and to show the inner link and basic contrast between the rule and its significance, between significance and sense, between thinking and purely linguistic processes and between natural and artificial language.

In particular the authors position that the deeper the adaption of even an inanimate, physical object, the greater the degree the inherent predisposition to interaction with the environment can principally be taken as an act of learning.

An abundance of cardinal scientific problems is discussed in a small book. This did not enable the author to use his own method of presenting his thoughts for which he is well known. One must also note the wide range of phenomena in whose analysis he applies his principles of systemology. From work on this range of phenomena he also establishes weak links between these principles and their development.

The material covered by the book also explains the fact that there is a need to expose even more important aspects of the advanced theory of systems analysis and to demonstrate its applicability but that the author was forced to decline an analyses of other systematic concepts.

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