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Evolutionary Visions of the Future. Special issue of: Systems Research. The Official Journal of the International Federation for Systems Research.
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This successful attempt to give an overview on what is going on in systems research (SR) is very useful for what is a must for SR: critical reconsideration and even more critical self-reference. The issue gives both examples and comments. Systems science is much in its formative stage. SR, judged by this special issue, proves to be the much needed instrument of a world wide dialogue. Moreover, it will help to enlarge the number of its participants. Complementing the inner circle of SR specialists, further development asks for a broader base in information, experiment and application; including related disciplines, users and even temporarily interested outsiders.

Every good Christian needs a revival from time to time. This is also true of the systems researcher, since SR has to meet - see the last contribution "The Future of General Systems Research" - a vast host of problems and challenges. There is, e.g., a multitude of approaches which often complement andexclude, contradict and corroborate each other, depending on the aspect chosen. Systems analysis, hard systems, oppose and go together with soft systems, the systemic view. As parts of visual holographic information, the single contributions present and comment this situation symptomatically; the implications ranging from seemingly concrete questions of application to epistemological and philosophical questions behind them. CHURCHMAN's "Conversations" (one remembers his "The Systems Approach and Its Enemies") remind us of the latter when dealing with the open hypothesis of unified SR and the basic uncertainty of human systems.

In doing so, he touches yet deeper antinomies. As the framework of hypotheses presupposed determines the answers derived - see, e.g., DE ZEEUW's "Problems of Increasing Competence" - what are the qualities of the 'reality' of systems approach? What are the quantities of the human systems and the human beings within it? Are they just societies' and standardized 'human entities' as, e.g., behaviorism and only too many behavioristic elements in sociology are prone to see them? Or individuals, personae, constitutionally and significantly non-determinable and non-predictable in their behavior as far as it concerns the control and the design of human systems? The way the question is put here appears to remain in the idealistic tradition of the early German social sciences. It points out, however, the common aporia of human systems management. In what degree can answers given by SR be self-corroborating? By creating their own reality by the reduction of individual, unique features? And how far does the diagnosis tend to self-immunizing qualities similar to psychological diagnosis?

These fundamental critical thoughts (recently elaborated, e.g., by F.H.Tenbruck) are far from being a mere theoretical controversy of skin-tight actuality. Systems research mirrors but the preliminary reflections on unsatisfying to undesired results of a non-discriminating control of human systems, questioning the very concepts - or better, beliefs and ideologies upon which control methods are based. Socialism and sociologism (sit venia verbo) differ only in degree in this respect. They share the underlying concept, however refined, of an at least sufficient determinability of man and man's institutions. R.ERICSON shows the inherent bias and its results in what he calls 'institutional disarticulation'.

Systems thinking, to point out the trivial as the fundamental, constitutes the most universal, most open concept with the greatest inherent potency to differentiate, to take into account even singularity, uniqueness. No doubt, social control in our complex and crowded civilization is necessary, and it must build on statistics, on generalizing concepts of society and of human nature. But there must be and can be more openness for non-determinable and unique individual influences. The systemic approach - see e.g. the successful project of F.Vester - will contribute. SR is assigned a concordant responsibility for the never-ending self-critical reflection between scientism and belief, between indetermination, uncertainty and teleological presuppositions. Probably not only by chance does the title of this issue of SR hint at the bias and the challenge. It reads as follows: "Evolutionary Visions of the Future". The evolutionary paradigm dominating undiminished: there are ever increasing doubts as to its ability to explain, e.g., the historical, cosmological, and biological evolution from the big bang to the origins of life and of consciousness. The 'isms' of evolutionsm and creationism are but foam on the tidal waves of scientific reconsideration. Was this necessarily so, as science explains? And how safe are we, envisioning what we call future on those premises concerning perceived reality and the methods used for perception? And how to count for the, in the main, scarcely systematical but, inseparably entwined, the historical, traditional (self-consciousness), and cultural uniqueness of man and his institutions?

The different contributions to the topic mentioned, induce such thoughtfulness, and give, by example, ample information to think over. The field covers virtually the whole range of SR from methodology to political application. After an Editorial by S.H.BANATHY, K.E.BOULDING opens with "Systems Research and the Hierarchy of World Systems: General Systems in Special Chaos". Behind an apt pun, the hierarchy (!) of systems is compared with military hierarchy - pointing out that systems emerge from a matrix of chaos and that all reality is not systematic. Whoever has tried to establish some general order in the systems approach, some sort of taxonomy, will know of the difficulties arising from this. For "all taxonomy, indeed, is a product of the inadequacies of human perception". Or, as Nalimov would put it, the text of the world can be read by humans only. It is the human reader who shapes the text. To establish, e.g., categorical systems, as known from Aristotle to Kant and N.Hartmann in philosophy, or as underlying the world's religious movements, turns out to be a futile attempt when not having recourse to the categories of human perception. Or otherwise: the reality perceived does not necessarily correspond to the system of the 'real' world, a theme which will turn up again.

The design of inquiring systems, therefore, is the core of DE ZEEUW's research in "Problems of Increasing Competence". Or: how can, by skilful inquiring and by reformulating questions, the reality be perceived that counts for defining and solving of the real problem behind the fuzzily felt need to do something with which one began. Social support is only too familiar with undesired side effects, mere shifting, translocating of the problem, or, worse, finding self-immunizing answers and self-corroborating solutions. Profiting from well-founded and documented case experience - one remembers similar distinguished studies from the Netherlands - DE ZEEUW develops a concept of social support systems based upon individual users, not on isolated sets of phenomena; on relations by distinction between levels rather than on separating boundaries. The concept behind: complementation of structural properties with functional aspects (user's view) and the necessary isolation of areas within their relations to each other and shared higher systems.

This concept forms also the core of the following pedagogic contribution by J.GHARAJEDAGHI and R.L.ACKOFF. "Towards Systemic Education of Systems Scientists" engages in problems of general importance. Despite the systemic contexts, the modes of teaching/learning systems are, in essence, still analytical and tied to structure, while synthesis and function, due to the inadequacy of the media used, are neglected. Naming horse and rider, the authors show that one-way teaching does not necessarily induce learning. Overinstruction in analysis and, as may be added, in only poorly - because formally - related facts is parallelled by underinstruction in synthesis, in function and context-based understanding. Learning is done by doing and, beyond understanding, by insight. Thus the authors describe the design of systems change in what is called humanization and environmentalization. One is reminded that the case method approach and project learning, as found in German universities, is but a beginning to allow students to learn what they need most: how to learn effectively and for a lifetime.

"Systems Thinking and Management Values in the Microchip Era: An Action Agenda for Institutional Transformation" focuses on the gap between social, economic and political institutions on the one hand and the rapidly shifting social needs they are to serve on the other. R.F.ERICSON sees the result as part of the cultural lag and calls it "institutional disarticulation". The essentional problem of this, in the widest sense, constitutional problem of society is seen in the non-systemic, that is isolated and unflexible design of institutions. This creates contradicting forces between institution and user as well as within the institution. It causes non-ending ad hoc negotiations, the mark of deficient bureaucracy. The author outlines a framework utilizing the principles of cybernetics and employing the informational faculties of microchips.

If seen as a cultural phenomenon itself, systems science appears as a "distinctive product" of a postindustrial, informational society. "The Emergence of Two-Dimensional Science in the Information Society" contains most intriguing ideas on metamethodological topics such as classification, taxonomy and the aforementioned categorial aspects of systems. J.G.KLIR distinguishes a) a thing-oriented classification of systems, based on experiments, b) a relation-oriented one, based on theory, and c) systems science knowledge, obtained either mathematically or experimentally. The taxonomy of systems must - since a class of all possible systems would be too large and therefore logically almost empty -take into account such classes of systems that have proved useful in the various traditional disciplines of science. This in essence being a problem-oriented approach, the author consequently describes his General Systems Problem Solver (GSPS) as a computer aided expert system to deal with systems problems. Its skeleton consists of a hierarchy of epistemological types of systems derived from the three fundamental notions: investigator, object and interaction. The epistemological systems hierarchy distinguishes levels as follows: 0 Source System, 1 Data System, 2 Generative System, 3 Structure System, 4 Metasystem, 5 Metametasystem. Finally he states:

The whole taxonomy of systems can now be summarized as follows. The largest and most fundamental classes of systems are those associated with the described epistemological types. They are further classified by the various methodological distinctions. The more of these distinctions are introduced, the smaller classes of systems are obtained. The smallest classes of systems are reached when systems become totally equivalent in terms of their relations, i.e. *isomorphic* with each other. Since systems in each particular isomorphic equivalence class may be based on quite different kinds of things, but these differences are irrelevant to systems science, it is desirable to define convenient representative systems for these classes. Such systems should be interpretation-free (i.e. insensitive to the kind of things involved) and expressed in some convenient standard form; they are usually called *general systems*.

The quotation seems to be justified insofar as classification, to repeat the obvious, will increasingly have to deal with AI in its various attempts, e.g. with expert systems and with the proposed, but to the reviewer's knowledge, still to a very limited degree, operationable General Problem Solver systems. (There are critics who postulate that these limitations will remain due to principal impossibility.) However, one of the main, if not the main tasks will be that of dialogue between man and computer, or, more precisely, the compatibility between man's network of terms and that of the computer data bank. Moreover, the fifth generation of computers furnished with associative memory and 'learning'units being in sight, classification will have to reflect the generative order of the existing network of terms (see Begriffsanalyse, Begriffsbildung), i.e., the structuring elements of the texts we perceive and control our world, and, moreover, the processes by which terms are coined. Science, as the author concludes, will have two dimensions: the experimentally based (conventional) science and the theoretically based systems science. This is not the place to deal with this 'radically new paradigm of science' in detail. It may be said, however, that after a very optimistic beginning AI seems to have met fundamental restrictions derived both from the not only rational nature of human thinking and from inherent systemic limits.

The concluding - and by far the largest - chapter (by L.R.TRONCALE) - examines "The Future of General Systems Research: Obstacles, Potentials, Case Studies". It is a most rewarding lecture for the systems researcher, giving a brilliant survey and a wealth of stimuli. It is directed specifically at systems methodology and application.

As for classification, a wealth of new attitudes can be derived from this SR issue, as shown above: in single contributions and in toto. Not going so far as to postulate a two-dimensional science, it is made plain again, that the information sciences will become increasingly important, in both everyday life and in science. Computerization, as the mathematization of the world, is but a symptom of the increasing limitation by deliberately structuring, or of the dwindling free space for not societally restricted action. There is no need to stress the central role of classification generally. The order in which we document, process, transfer, communicate, teach or learn knowledge shapes concomitantly our world, our life. It influences not only what we perceive, but also how we do it, how we value it, how we receive it emotionally. Man is to a high degree, as linguistics teaches, the order of his knowledge. Fortunately, that order will not be dominated totally by computer characteristics, since nature will prevent it, but it will be shaped increasingly by EDP characteristics. Systems sciences, the systems approach will necessarily be the very heart of both computerized Problem Solvers and man-centered orders of knowledge. The first, because life seems no longer possible - social and ecological problems pressing - without the employment of computers. The latter, because it presents the only order capable of embracing all aspects of human existence, including non-rational ones and indeterminable change. It was always part of good classification work to be familiar with the innate peculiarities of the system to be classified as well as with the problem and the environmental context. It will also be increasingly necessary to be familiar with its properties as seen from the systems science approach and the qualities of general systems relations as well. Therefore, it seems indispensable to go still deeper into the concrete systems at concrete, i.e. operational, levels before abstracting structures of knowledge which are obtained about the system, thus shaping the perceived reality in view of problem, user, and environmental context.

The last argument leads back to the aforementioned more general frame of possible implications of systems science. If we see systems science as part of our culture: of what kind are the influences on our self-understanding, on our attitudes to our environment and, most important, on the value systems behind them? Simply stated: do they influence, and if they do, in what manner do they influence our answers to the question how man ought to live and how he can do right?

The volume under review puts, if but concludent and restricted, these questions in several of its contributions and gives answers likewise. The concluding "Correspondence" of the issue, "Systems Closure and Inquiry" (by B.G.D'ARCY and N.JAYARATNA) puts it, in the way of a short but very advisable note, in a nutshell. The paradigm of systems inquiry selects -in general arbitrarily - the boundaries of the system to observe and thus determines the reality perceived. Weltanschauungen, due to the personal qualities of the inquirer and the selected boundaries of the system, are distinctly and powerfully embedded. The role of ideology in a proposed hierarchy of world systems, the design of social support systems, the institutional disarticulation and, not least of the examples given, the two-dimensional nature of postindustrial society give vivid testimony.

There is a necessity for setting systems boundaries, and there are positive aspects of the systems science way to do so. Systems inquiry may give orientation on the limitations of a concept, of a problem solution. It may show the free space left within which systems design/systems control can be effected, with the results and side results to be expected, the traps, the undesired consequences to be avoided. That is, and here lies the imminent danger, true if and insofar the application is conscious of the values implied, of inherent ideologies and their consequences, and if and insofar these are taken critically into account. The danger quickly becomes real with the application of some systemic approach if, at the same time, it is uncritically claimed that this is the right way to do so. That would make systemic control an ideology in itself and a subject to balance and control, this all the more since, to repeat it, the human world is indeterminable; there is no certainty, neither in diagnosis nor in prognosis. There are, on the other hand, the laws of the natural sciences and the postulated regularities of social and societal behaviour; the probabilities, the distributing functions of even such fuzzy systems as living systems are: biological, societal, assumed teleological and psychological, etc. To act on those assumptions, - partly, not totally depending on them - is necessary in our both complex and overcrowded territory called earth.

But we must not forget that neither postulated laws nor assumed ultimate destination can be proved or disproved, not for the unique person, not for the unique cultural environment, not for the unique historical moment. The evolution and the creation paradigma, e.g., both remain open for questioning their explanatory power. The same must apply for all kinds of systems approach, all the more as it gains, increasingly, the power and the opportunity to set restrictions, to choose the concept and the tools control and, concomitantly, the Weltanschauung within.

The problem of credibility is, therefore, matched by the imposed responsibility. What otherwise might happen is shown exemplarily in the education system. Both the socialistic and the sociologistic concept of society and the human being seem to neglect the unique individual qualities, the persona, of man, tending to reduce him to an element of society and the bearer of a role. The educational system exhibits similar features: the student is scarcely taught how to behave properly in society and not at all what are the fundaments of critical judgement: traditional values and culture. It is therefore the orientation function with all the cultural images and examples handed down from history which is lost. Instead, the student is taught to think in prevalent paradigms of the prevailing political system and its often hidden Weltanschauung. There is a marked ideological difference if children are presented with pictures of a world in balance or with those of a permanent, e.g. class, conflict. History, historical uniqueness and tradition cease to be living, constitutive parts of learning and correspondingly of the students personal potential to perceive and, most important, to decide critically. Culture as the totality of history, environment, and tradition is reduced - similar to the fate of the person - to a mere point-like state of social being. Orientation, judgement shrink to the same niveau. It is only consequent if the emerging human beings tend to utilitarism, scientism and their political equivalents. Systems movement in education, the svstemic approach to learning/teaching tends to bring the existence of the environment, the question of how our life circumstances have grown in history, and the cultural context into focus. And in this respect the multidimensional facetting of knowledge will help the student to find a richer identity and with it the potential to learn and to adapt to rapid cultural change.

Again, the special issue of SR, which envisions the future not only of systems science itself, but also of the culture it arises from, is worth careful study. If there is anything left to be desired for the next issue, then it is this: that it may enlarge the field covered from the individual's level. Maybe it will prove a good idea, too, to include more non-American contributors, e.g. from the English, the French or the Russian scence, to name only a few complementing and rather different backgrounds. It will be advantageous to compare the differing empirical, rational and idealistic surmises from the European campus. It will, as this issue did, establish the periodical even more as a forum for a systems dialogue.

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BRODIE, M.L., MYLOPOULOS, J., SCHMIDT, J.W. (Eds.): **On Conceptual Modelling. Perspectives from Artificial Intelligence, Databases, and Programming Languages.** New York, etc.: Springer-Verlag 1984. 510p., ISBN 0-387-90842-0 and 3-540-90842-0

Knowledge representation/conceptual modelling is a key problem in expert systems, problem solving, language understanding, and other areas of artificial intelligence, in data base and information storage and retrieval systems, in programming languages, and last, but not least, in classification theory. Until recently, the problem has been dealt with largely independently in these areas. A volume that brings together contributions from three of these areas is, therefore, most welcome, even if contributions from classification theory are lacking. The papers were presented at a symposium so that the authors had an opportunity to consider other viewpoints in the final version, and the discussions are also included. All this strenghthens the effect of crossfertilization.

The volume is nicely unified through introductions to the problem in Part I: *Artificial Intelligence, Database, and Programming Language Overviews,* which consists of the following three papers: *An overview of knowledge representation* by John Mylopoulos and Hector J.Levesque; *On the development of data models* by Michael L.Brodie; *The Impact of modelling and abstraction concerns on modern programming languages* by Mary Shaw; and through Part V: *Concluding Remarks from Three Perspectives. - An artificial intelligence perspective* by Carl Hewitt; *A database perspective* by Michael Stonebraker; and *A programming language perspective* by Stephen N.Zilles.

In between are the individual contributions. They are arranged into three parts according to perspective, but there is, fortunately, much overlap between these parts, as it should be if one searches for common principles. These contributions are:

Part II: *Perspectives from Artificial Intelligence. Generalization/specialization as a basis for software specification* by Alexander Birgida, John Mylopoulos, and Harry K.T.Wong; *Some remarks on the semantics of representation languages* by David J. Israel and Ronald J.Brachman; *Open systems* by Carl Hewitt and Peter de Jong; *The logic of incomplete knowledge bases* by Hector J. Levesque; *Towards a logical reconstruction of relational database theory* by Raymond Reiter; *A formal representation for plans in the programmer's apprentice* by Charles Rich.

Part III: *Perspectives from Databases.*
On the design and specification of database transactions by Michael L.Brodie and Dzenan Ridjanovic; *A unified model and methodology for conceptual database design* by Roger King and Dennis McLeod; *Adding semantic knowledge to a relational database system* by Michael Stonebraker.

Part IV: *Perspectives from Programming Languages. The functional data model and its uses for interaction with databases* by Peter Buneman and Rishiyur Nikhil; *Types in the programming language ADA* by Bernd Krieg-Brueckner; *Data selection, sharing and access control in a relational scenario* by Manuel Mall, Manuel Reimer, and Joachim W.Schmidt; *Types, algebras and modelling* by Stephen N.Zilles.

The papers are not for the faint of the heart. They are all rigorous and often couched in quite formal language as required by the topic. The integrated bibliography and the index further indicate that this volume is more than just the sum of the individual papers presented.

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