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"Social Complexities from the Individual to Cyberspace"

PRINCIPLES OF SOCIOCYBERNETICS

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ABSTRACT

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The paper aims at providing a short introductory outline of what is sociocybernetics, how it relates to (general) system theory and cybernetics, and to illustrate how some of its basic principles can be applied to sociology.

Sociocybernetics is defined as the application of systems science and first and second order cybernetics to sociology and other social sciences. The paper will then briefly sketch in which way systems science and cybernetics, at a meta-disciplinary level, constitute a paradigm in the sense of Thomas S. Kuhn. A third part of the paper will be devoted to identifying some of the basic principles of system theory and cybernetics like circular causality, positive and negative feedback, steering and control, goal-orientation, information processing and communication, boundaries and boundary maintenance, interrelated components, holon-property and emergence, and finally self-organization/self-reference and the observer-dependence of all knowledge in the context of second order cybernetics. Limitations of time may lead to not dealing with all of these concepts in the presentation.

The final part of the paper will illustrate how (some of) these concepts can be applied to the objects of sociological investigation. It is proposed that social systems are composed basically of individuals (e.g. according to the view of Maturana and Varela) and that there are interrelationships which are both (physical) action and communication. Action and communication are most often inseparable from each other. Individuals are conceived as actor-systems which can form higher level non-individual actor-systems, e.g. groups or organizations. As information-processing systems such collective actor-systems permit to integrate concepts like culture, social structure, goal-directedness, and values.

1. INTRODUCTION

This paper provides an introductory outline of what is sociocybernetics, how it relates to (general) system theory and cybernetics, and it will illustrate how some of its basic principles can be applied to sociology. The intention is not to present the state-of-the-art, as it is reflected in sociocybernetic literature and the conferences and congresses on sociocybernetcis [i]. Instead, some of its basic principles, about which a consensus can be assumed, will be presented in a systematic context. This reflects to some extent what is going on, e.g., in the Research Committee 51 (RC51) on Sociocybernetics of the International Sociological Association (ISA), but without mentioning all the different currents existing, e.g., in this research committee. So also Luhmann´s theory of social systems as autopoietic systems, a topic which is dealt with in detail elsewhere [ii], will not be a major concern here.

The principal sources of theoretical inspiration for sociocybernetics as presented here are many authors from the rich universe of system theoretical discourse, not all of which can be duly quoted in appropriate detail for lack of space: Ashby, Beer, Buckley, Forrester, Laszlo, Maturana and Varela, Meadows, Miller, Pask, von Bertalanffy, von Foerster, von Glasersfeld, Wiener, and more current authors - many of them members of RC51 - like Bailey, Bossel, Burns, Geyer, and Kjellman.

Although this paper deals with theory, a main concern both of cybernetics and system theory - as well as sociocybernetics - has always been applicability, problem-solving relevant for practical life, and interdisciplinarity, without which issues of complex contemporary societies can neither be grasped nor effectively be dealt with.

2. THE CONCEPT OF SOCIOCYBERNETICS

Any theory remains sterile if it is not used in some area of application and it remains pure speculation unless it is used to formulate concrete hypotheses which can be operationalized and after all be compared to data and the empirical world. In this way in particular highly abstract general system theory and cybernetic theory may be very distant from empirical data, but after all they are connected to data and the empirical world, even if indirectly and across a more or less extensive sequence of steps of concretization and operationalization. In this, however, system and cybernetic theory is not different from any other theory which claims to be scientific. Science in general is considered to be rational, logically consistent and coherent, intersubjective, reproducible, to use accepted methods, and to be based on empirical findings.

However, system theory and cybernetics ***are*** different from other scientific approaches in terms of what are acceptable methods and in particular in scope and in abstractness. (General) system theory and systems research and cybernetics are not aiming at investigating and explaining certain parts of the world as it is subdivided by disciplines. Instead, they are looking at what is common to a wide range of phenomena, i.e. what is common to systems in general. Systems can be human beings, animals, plants, machines, cities, countries, the weather, etc., etc., etc. "System" is a most general and abstract concept, although systems science and cybernetics often concentrate on certain kinds of systems, e.g. dynamic systems. Consequently system theory and cybernetics, in principle, encompass everything that can be meaningfully considered as a system (see below). They are dealing with highly abstract "things", i.e. not teachers and students and not cats and dogs nor cars and airplanes, but with "systems", of which the examples given are highly specific instantiations.

This changes when a systems scientist moves towards application or as soon as we deal with sociocybernetics as a particular field of application. Here the traditional "substantive" science has to come in, but not necessarily along the traditional disciplinary divisions. One might be interested in biological or technical systems, but taking the systems approach this very likely leads, e.g., to interdisciplinary issues of ecological systems or socio-technical systems.

To the extent that system theory and cybernetics are used and applied in a particular discipline we can speak, e.g., of "biological systems theory", "mathematical systems theory", or also "sociological systems theory" or preferably "sociocybernetics". The term "Sociocybernetics" is preferable in order to avoid misconceptions and a too narrow identification of this very wide field with Parsonian theory or with Luhmann´s theory. Both of them evidently fall into sociocybernetics, but the latter encompasses a far wider range of theoretical approaches.

Sociocybernetics can be defined as "The application of systems science, including first and second order cybernetics, to sociology and other social sciences."

We speak of systems **science** because it is not limited to theory, but also includes application, empirical research, methodology, axiology (i.e. ethics and value research), and epistemology [iii]. In general use, "systems" and "cybernetics" are frequently interchangeable or appear in combination [iv]. Hence they can be considered as synonyms, as is the case in the present paper, where in the following the term "system theory" will be used to cover both of them to avoid the clumsy double terminology. Looking closely, however, the two concepts have different traditions and are not used uniformly in different languages and national contexts. Sociocybernetics includes both what is called 1st order cybernetics and 2nd order cybernetics. Cybernetics, according to Wiener´s definition, is the science of "control and communication in the animal and the machine," including human beings and natural "machines" [v]. Heinz von Foerster went on to distinguish a 1st order cybernetics, "the study of observed systems", and a 2nd order cybernetics, “the study of observing systems”. 2nd order cybernetics is different from 1st order cybernetics in two fundamental aspects. One is that it is explicitly based on constructivist epistemology. The other one is that one of its main concerns are issues of self-reference and the observer-dependence of knowledge, including scientific theories [vi]. In the interdisciplinary spirit of systems science sociology is clearly at the center of interest of sociocybernetics. However, the other social sciences, like psychology, anthropology, political science, etc., need to be included too, depending on the research question to be dealt with [vii].

3. THE PARADIGM OF SYSTEMS SCIENCE

It has been argued that sociocybernetics as an approach focussing on a particular discipline, sociology, cannot be understood without systems science and cybernetics. The latter, however, are not disciplines themselves, they are located at a meta-disciplinary level. Nevertheless, systems science can be considered a paradigm in the sense of Thomas S. Kuhn [viii], whose theory and history of science can be read itself as a systemic account.

A paradigm, or in Kuhn´s later theory a disciplinary matrix, consists of eight components:

1. A scientific community using, elaborating, and professing the paradigm.
2. Metaphysical assumptions, which are, implicitly or explicitly, underlying the body of scientific theory, methodology, and scientific work.

3. Central components of the theory.
4. Specific methods generally accepted by the scientific community.
5. Standards for solutions of problems.
6. The paradigm in a more narrow sense, also called "exemplar".
7. The kind of data considered as acceptable by the scientific community.
8. Specific problems and issues of the discipline or scientific community using the paradigm.

3.1 SCIENTIFIC COMMUNITY

Although systems science is not yet really institutionalized with curricula, institutes, and faculties, there is clearly a scientific community. It is dispersed across traditional academic institutions but also exists in dedicated academic and especially non-academic institutions dealing with systems research under a variety of names both at the national and international level. To name only a few, national institutes are, e.g., the Santa Fé Institute, Santa Fé, USA, the FHG/ISI - Institute for Systems Technology and Innovation Research of the Fraunhofer Society, Karlsruhe, in Germany, the Instituto Andino de Sistemas in Lima, Peru. At the international level we find, e.g., the Institute for Applied Systems Analysis - IIASA, in Laxenburg near Vienna, Austria, which is financed jointly by several governments.

An essential part of a scientific community are, apart from institutes and research groups, scientific associations. These exist in considerable number both at the national and the international level. To give some examples, the International Federation for Systems Research - IFSR - tries to bring together the different systems and cybernetics associations under one roof. The IFSR is an association of associations, while there are two worldwide scientific associations with traditional individual membership, the World Organization of General Systems and Cybernetics - WOSC, and the International Society for Systems Sciences - ISSS. At the European level there is the European Systems Science Union (ESSU). While these associations are concerned with systems science and cybernetics in general and across all disciplines, the Research Committee 51 (RC51) on Sociocybernetics focusses on sociology and the social sciences. It is part of the International Sociological Association - ISA and cooperates with the International Social Science Council - ISSC.

To ensure communication inside and beyond the systems scientific community there is quite a number of journals like, e.g., the International Journal for General Systems, the International Journal of Systems Science, Kybernetes, and the Revista Internacional de Sistemas. Also there are journals covering specialized sub-fields, like Cybernetics and Human Knowing and the electronically published Journal of Sociocybernetics, both connected to ISA-RC51 on Sociocybernetics. This shows that there is indeed a substantial worldwide scientific infrastructure and community, even without mentioning the large field of informatics and information science, which is firmly and fully established as an own independent discipline, but which is to be subsumed under "systems and cybernetics" where it took its origin.

3.2 METAPHYSICAL ASSUMPTIONS

Looking at systems philosophy and basic claims of systems science, five key issues can be identified as central metaphysical assumptions in the sense of Thomas S. Kuhn.

A first one is the ***unity of nature*** which implies the unity of sciences. "Science" in this context includes both the natural sciences (or the paradigm of physics) and the social sciences as well as the so-called humanities and phenomenology. Systems science, aspiring to be an abstract science covering, in principle, everything and all disciplines, has to assume that there is unity of nature and that nature can be inquired by a uniform science using the same basic principles for everything. At more concrete levels there need to be, of course, distinctions between different types of systems and different fields of research, each one having its own specific characteristics. The traditional split between natural sciences and the humanities/ social sciences, however, is not seen as a fundamental ontological or epistemological divide, but as a difference between certain areas of investigation which can be overcome within a common meta-framework, if this meta-framework is only abstract and complex enough.

Related to this issue is at the epistemological level in some literature a basic philosophical nominalism and in other literature, going much farther, a ***constructivist*** basis. Both have in common that "things" are not ontologically given as such, but that it is the perceiver or observer who names certain phenomena according to his convenience, thus constituting the "givens" of this world (nominalism) or even constructing the very phenomena (constructivism). Epistemological constructivism was developed in particular by Heinz von Foerster, one of the early cyberneticians, in the context of 2nd order cybernetics. A further development can also be found in in the autopoietic theory of Maturana and Varela or, with certain reservations, in the sociological theories of Niklas Luhmann who was strongly influenced both by von Foerster and by Maturana and Varela. Luhmann considers social systems as autopoietic systems. A recent important impulse to constructivism was given by Arne Kjellman in the context of RC51 on Sociocybernetics with his epistemological theory on subjectivism and the ´priverse´ as he calls it in analogy to the ´universe´ [ix].

A third assumption, based on the unity of nature and the unity of science is ***interdisciplinarity***, which was mentioned above already. The inherent interdisciplinarity of systems science can furthermore be traced back to its highly abstract and meta-disciplinary character, its insistence on a holistic approach, and its tendency to be problem-oriented. All of these are likely to cut across traditional disciplinary boundaries.

Already in ancient Greek philosophy talking about "systems" meant to talk about "wholes which are more than the sum of their parts." Hence ***holism*** is another metaphysical assumption central to the concept of system and therefore central to systems science. Holism is complemented by two related concepts, emergence, referring to the appearance of new (structural) properties if (structural) components are put together, i.e. organized, in a way that new properties appear in the new overall structure, and synergy, which is the appearance of new properties if processes are put together and organized in a way that the overall effect is different from the effects which are obtained if the processes are taken separately.

These phenomena point to the last assumption, that of ***complexity***. The old scientific view of monocausal uni-factorial relationships between the phenomena to be investigated scientifically is replaced by concepts like circular causality, feedback, interdependencies, networks, multi-level hierarchical systems, multi-causality, multiple effects, unintended effects etc. - in a word, by complexity. The basic assumption is, that the world to be investigated is complex, but also that by using the previously mentioned theoretical concepts (and of course still others) it is possible to formulate system theory itself as a complex theory of complexity. After all, only a complex theory can grasp a complex world, or, as Luhmann expressed this very nicely, only complexity can reduce complexity.

3.3 CENTRAL COMPONENTS OF THEORY

Central components of systems theory are closely related to the concept of system itself. Speaking about a system implies to distinguish it from its environment. Hence the ***relation system-environment*** is a first central theoretical concept. The evironment in its turn can often be conceived as an over-arching system and the internal structure of a system may be constituted in its turn by sub-systems, so that the ***systems hierarchy***, which is not the same as the control hierarchy, is a second basic structural concept. A key concept referring to process is ***feedback.*** This can be further differentiated into positive, i.e. deviation amplifying, and negative, i.e. deviation reducing, feedback. The latter is the classical control-loop. Closely related is steering or feed-forward. This is not a reaction to events, e.g. deviations, which took place already, but a reaction to events which are anticipated to occur in the future. The Greek "Kybernetes", the helmsman of an ancient Greek ship, tried to take preventive action ***before*** wind and waves hit his ship, and so does his modern counterpart steering a tanker.

Both steering - feedforward - and control - feedback - require at least a comparison in order to identify a real or anticipated deviation from a desired state and consequently to be able to react. Hence they require at least some rudimentary form of ***information processing***. In this way cybernetics - the science of control and communication in the animal and the machine - is at the same time information science or informatics. Dealing with humans we have not only information processing in the technical sense but also ***cognition*** which includes the processing of knowledge and meaning. For lack of space we cannot discuss here the differences and relationships between information, cognition, knowledge, and meaning. Suffice to say that cognition is closely related to meaning, an often ill-defined concept, and that, in this author´s view, cognition is related to the inside perspective, e.g. of the observer. In order to deal with these issues properly the constructivist approach is indispensable.

Both information processing and cognition are essential to ***problem-solving***, the central concern of both applied and theoretical systems science. From a functionalist perspective [x] systems are mechanisms to resolve problems. Furthermore, the concept of "problem" includes both the factual and the normative, while much of traditional science insists on keeping the normative - or values - outside science (unless they are treated as strictly empirical objects of study). A problem can be defined as follows:

"A problem is a state of affairs which is unsatisfactory for some reason and which is to be changed therefore." [xi]

Problem-solving is most often confronted with ***complexity***, which was discussed already as a metaphysical assumption, but which is also an important theoretical concept. Theories, or even entire sciences, of complexity are required to deal with it. For dynamic systems a particular strategy for dealing with problems of complexity is self-organization or also autopoiesis, a special kind of self-organization found in living systems.

3.4 Specific Methods

A specific method related to information processing and cognition but also related to the underlying epistemology of constructivism is ***modelling***. According to model theory a model is a simplified representation of something, but not necessarily an iconic representation or image. This means that the term model is used in a rather broad sense in systems science [xii]. Human beings, or in general systems which have cognitions, develop internal cognitive models which in some way or another represent their environment and their problems. This is true both in open systems theory, which assumes inputs and outputs of information, and in autopoietic theory, according to which such models and the information they contain are constructed strictly internally. At the epistemological level constructivism can be conceived as the construction of an internal model representing an external reality which cannot be known, but in relation to which the model can undergo practical tests whether it works for practical purposes or not. A specific and concrete method of the systems paradigm, based on the achievements of informatics and computer science, is computer simulation.

3.5 Standards for Solutions of Problems

Within the paradigm of systems science those solutions, both of theoretical and applied problems, meet the standards of the scientific community which are compatible with the theories and methods of systems science as they have been outlined above. Moreover, of course, they have to meet the general criteria of science .

3.6 The Paradigm

The paradigm or exemplar of systems science is the "system". Of course, there are many definitions of what is a system. This author found the following definition useful:

"A system is a whole consisting of interdependent components." [xiii]

This definition is valid for all types of systems, static, dynamic, living, information processing, cognitive, psychological, open, closed, autopoietic, etc. Furthermore it proved very useful and practical to work with the characterization of dynamic systems developed by Laszlo [xiv]. According to him a system has four basic properties:

1) The holon property, i.e. being a whole with a boundary.
2) The systems hierarchy with subsystems downwards and supersystems upwards.
3) Positive feedback loops, i.e. deviation amplification.
4) Negative feedback loops, i.e. deviation reduction.

3.7 Kinds of Acceptable Data

There does not seem to be any data specific to systems science with the exception of the results of simulation models which cannot be obtained in any other way. These, however, are not empirical data in the strict sense. They are inferred data or computed data and constitute only a very small part of the universe to be covered by systems science. As to empirical data in a strict sense, all data which is acceptable for the sciences and the social sciences should also be acceptable for the systems sciences. This, however, does not mean that such data is interpreted in the same way or that it is considered equally useful or convincing in both contexts. Statistical data and statistical significance, e.g., have quite different meanings in the context of a one-factor theory and in the context of a systemic multi-factor theory taking into account feedbacks and different system levels [xv].

3.8 Specific Problems and Issues

In general, all empirical and theoretical issues compatible with the paradigm as presented so far can be considered as legitimate. Problems and issues specific for systems science are those which are related to the central theoretical concepts, specific methods, and paradigm as presented above. These are not be encountered in other disciplines or meta-disciplines.

4. BASIC PRINCIPLES OF SYSTEM THEORY AND CYBERNETICS

A number of principles of system theory was identified above discussing the paradigm and central components of system theory and need not be repeated here. There are, however, two basic principles underlying these, which could be considered as the axiomatic foundations of systems theory. These are (1) in terms of structures a relational view of the world and the "objects" to be studied, and (2) in terms of processes circular causality, i.e. causal chains feeding back to themselves in a self-referential way, whereby the concept of self-reference might be considered an informational concept at the level of theory or knowledge rather than at the material level like circular causality itself. Such circlar sequences of cause and effect [xvi] may have different consequences, (1) reinforcement of the initial cause (which is a deviation from a stable state in which nothing happens), in which case we have positive feedback, i.e. deviation amplification, (2) weakening of the initial cause, in which case we have negative feedback, i.e. deviation reduction, or (3) the unlikely case of having no effect which can be considered an exceptional case in between positive and negative feedback for which system theory does not provide a particular name but which could be called zero-feedback. The terms positive and negative are used in a strictly mathematical way and have no normative connotations whatsoever.

Feedback is not the same as steering and control which can be considered as special cases of negative feedback in which information comes into play, i.e. a comparison between a somehow measured actual state and an ideal state somehow stored in the control or steering loop. The result of this comparison determines how the causal chain goes on and influences itself. It is clear that such comparison based negative feedback is suitable to stabilize a loop, while without this comparison a reduction of the initial deviation will take place but with a high risk of over-shooting into the other direction thus resulting in instability. The difference between control and steering [xvii] is simply that the former uses an actual value measured after the event, while the latter uses an anticipated value estimated before the event in order to avoid the event by preventive action. In both cases the comparison with an ideal target constitutes a very simple goal-orientation. In more sophisticated systems this takes more complex forms reaching the level of consciousness and psychological rational and irrational decision-making e.g. in human beings [xviii].

The measurement of the state of a process (input), storage of a target value (memory), the comparison (processing), and the eventual determination of how the causal chain will continue to operate (output) imply all of the basic functional components of an information-processing system. Connecting at least two information-processing systems results in communication, not only in (physical) action as in the case of the basic steering and control systems described above. Cognition can be conceived as a particular kind of information-processing taking place, e.g., in psychological systems or in general in systems which have consciousness and an inside perspective [xix].

Relations, loops, processes, and structures constitute components of larger systems. They are in their turn composed of components which are interrelated and thus forming systems. Such relations, which may take the form of one-way or two-way interdependencies, may exist between structures, processes, or also structures and processes thus opening up a large combinatorial universe if only the relatively few types of possible components discussed so far are taken into account. Crucial for a system, however, is according to its definition, its properties as a whole. This means that we can speak of a system only if we can indicate what is the whole, i.e. if we can, among others, indicate a boundary. Depending on the type of system the boundary is more or less permeable or open. In principle it is controlled by the system itself which often devotes a large number of the mechanisms mentioned above as well as resources and efforts to firmly establish, maintain, and control its boundary.

A system boundary, however, is not an ontological property of a thing existing in its own right out there in reality. In the context of constructivist system theory and observer-dependent 2nd order cybernetics it is relative to effective problem-solving, i.e. whether a certain delimitation of the system is useful and works for the purpose at hand, and it is relative to the observer´s perspective and cognitive interest. The resulting uncertitude about the boundaries of a system to be investigated can be handled (a) by means of a consequent problem-oriented approach [xx] and (b) by consequent use of the concept of reference system as proposed by Luhmann [xxi]. The latter means that before entering any discussion or analysis of a systems it has to be clearly stated about ***which*** system one is going to talk. This determines both what is the environment of the system, what is its boundary, and what are its subsystems. All of this remains meaningless or confusing unless it is clear which is the system of central interest, i.e. the reference system. Only then a systems hierarchy can be established treating components of the system as subsystems and identifying its embeddedness in a larger super-system. The systems hierarchy in this sense, which is a structural hierarchy, must not be confused with the control hierarchy which is a hierarchy of steering and control mechanisms. While in the former systems get the bigger the higher they are in the hierarchy, a central steering and control unit even of a very large systems need not necessarily be very big itself, it could be one person in an absolute monarchy or an empire.

The holistic properties of a system can be determined only once the reference system with its boundaries and its location in the systems hierarchy has been determined. The holon property, or the whole which is more than the sum of its parts, is by no means anything mystical. Taking the relational approach mentioned, it is clearly a consequence of organization and of the relations resulting from a specific organization of components. The sum of components become a car with which one can drive only once they are properly organized or assembled. Emergence refers both to single properties which appear at the level of a whole, in certain cases, however, they can also constitute at the level of emergence a coherent layer of properties interdependent and interacting at that level. This is the case, e.g. when emergent properties of atoms join to form the coherent field we call chemistry or when chemical processes produce emergent biological processes, i.e. life.

Artefacts and technical systems are obviously assembled by human beings. Other systems are assembled by organizing principles and mechanisms of nature, e.g. a river, and still others incoporate mechanisms and principles which contribute to the organization of the system itself. The theory of self-organizing systems was a central research topic, e.g., of Heinz von Foerster and his 2nd order cybernetics. Self-organizing systems are not necessarily living systems although of course the reverse is true. The concept of living systems implies in addition to self-organization self-reproduction. A special theory of living systems, autopoietic theory, was developed by Maturana and Vareala [xxii]. Later on it was used by Luhmann in his attempt to conceptualize social systems as autopoietic systems [xxiii]. Although this attempt has remained controversial and problematic, a clear line can be drawn from simple (mechanic) circular feedback loops via steering and control loops implying information processing to self-referential systems which operate in a circular way at the level of information and meaning and to self-organization which implies, in addition to circularity and self-referentiality, the circular (self-)organization of structural change and adaptation, i.e. the build-up of negentropy and internal complexity of a system by means of its own internal processes. A last step beyond self-organization are living, i.e. autopoietic and self-reproductive systems. Both the theory of self-reproductive systems, which includes scientists and other human beings, and the epistemological foundation of constructivism, which in its turn asserts that information and knowledge about the world and oneself is after all constructed internally, provide the philosophical and theoretical grounds for the observer-dependence of all knowledge. This is a fundamental proposition of 2nd order cybernetics.

5. APPLICATION TO SOCIOLOGY

Sociology starts when two individuals are together [xxiv] or, in sociocybernetic terminology, if two actor systems, which are information processing systems, start to interact and to communicate. Thus the basic components of social systems are considered to be individuals or actor systems which corresponds to the views of Maturana and Varela [xxv] and many sociocybernetic and non-sociocybernetic sociologists, while other options [xxvi] cannot be discussed here for lack of space. Traditional social units like groups, organizations, communities, collectivities, nations etc. can easily be conceived as conglomerates of actor systems which are in certain cases themselves higher level non-individual actor-systems and in others not. In terms of sociocybernetics, however, what is added in comparison to traditional sociology are the detailed concepts of information processing and the sophisticated loops of different kinds of circular causality, inculding mechanisms of self-organization, which were discussed above. Hence what is going on in a group is not simply interaction, but both (physical) action and communication which are most often inseparable from each other and in terms of information processing "group knowledge and values" can be clearly conceptualized either as a shared knowledge stored in the memories of the individual actor systems or externalized knowledge stored in an external memory like symbols, written reports and statutes etc. If formalized procedures, steering and control mechanims are added, we arrive at the concept of formal organizations, which in their turn can form higher-level systems up the systems hierarchy.

Social structure can be conceived as the particular and (relatively) stable pattern of relations between such higher level units. As such they are indeed the "social facts" already Durkheim was talking about, and although created after all by individual actor-systems (mostly in a collective effort) their effects feed back to those individuals. This means that feedback exists not only at a given level of the systems hierarchy, but also between its different levels and different levels of emergence. Crucial for sociocybernetics is that there are both effects, upwards ***and*** downwards, and not only a "determination" from below as in reductionist approaches.

Communities, regions, countries etc. are typically hybrid systems composed of different types of sociological units like individuals, small groups, collectivities, organizations etc. In particular in this case the sociocybernetics and the systems concepts presented above permit to go far beyond a crude analysis of what organizations and collectivities "do" and "say" providing a framework for a detailed analysis of how and where the effects of communications and actions proliferate across the system, how they feed back and in which way they may activate steering and control mechanisms which may result in their amplification or also their disappearance without any effect.

In a sociocybernetic approach the holistic properties and phenomena of emergence which may appear e.g. at the organizational level are theoretically well-founded. As higher level information-processing systems they also dispose of the respective components and mechanisms which can be identified and justified theoretically. Therefore we can speak of collective stocks of information or knowledge, stored in externalized repositories like newspapers, books, libraries, electronic databases, the Internet etc., etc. The often used and mostly undefined highly fuzzy concept of culture can get more shape in this way. In such a theoretical context culture can be conceptualized as a stock of knowledge, including values, which is shared by a collectivity (ethnic group, class, nation, community but also organization or a small group) and which is passed on to the next generation of individuals in the respective collectivity [xxvii]. The usual confusion between culture and society and the clumsy attempt of circumventing it by talking about the "sociocultural" can thus be replaced by clear concepts and distinctions between social systems, in which interaction and communication go on, and cultural systems which are the stocks of shared knowledge which are closely related and without which at least large social systems are hardly conceivable, but which are conceptually clearly distinct and only therefore accessible to precise analysis. In such a framework social and cultural values and their origin and validity are not something mysterious, but part of the stock of social and cultural knowledge just as a target value is already present as a rudimentary value in the basic steering or control feedback circle. The resulting goal-directedness of the different types of social systems, their long-term processes of adaptation to their respective social and natural environments and after all the evolutionary processes in which they are embedded explain the origin and change of cultural knowledge and cultural values by means of the sophisticted theoretical tools of system theory, cybernetics, and sociocybernetics the basic principles of which the present paper has tried to present.

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vi) Cf. HORNUNG, Bernd R., HORNUNG, Rosario (2001), *Implications of Autopoiesis and Cognitive Mapping for a Methodology of Comparative Cross-cultural Research,* in GEYER, Felix, VAN DER ZOUWEN, Johannes (eds.), *Sociocybernetics: Complexity, Autopoiesis, and Observation of Social System*, Greenwood Press, Westport, Conn., London.

vii) For more information, see the material and papers presented on the website of ISA - RC51 on Sociocybernetics at http://www.unizar.es/sociocybernetics; cf. also HORNUNG, Bernd R., ADILOVA Fatima T. (1997), *Conceptual Modelling for Technology Assessment of IT Systems, Smart Cards, and Health Information Systems,* pp. 787-800, Kybernetes, vol. 26, no. 6/7.

viii) KUHN, Thomas S. (1973), Die Struktur wissenschaftlicher Revolutionen, (Orig. The Structure of Scientific Revolutions), Suhrkamp Verlag, Frankfurt/Main.

ix) KJELLMAN, Arne (2002), *The Subject-Oriented Approach to Knowledge and the Role of Human Consciousness,* pp. 223-247, International Review of Sociology, vol. 12, no. 2; KJELLMAN, Arne (2003), *Constructive Systems Science - The Only Remaining Alternative?,* Report Series, no. 03-014, Stockholm University / Royal Institute of Technology, Stockholm.

x) For a discussion of the functionalist approach and the unit approach see BAILEY, Kenneth D. (1994), *Sociology and the New Systems Theory,* State University of New York Press, Albany N.Y., see pp. 56, 54-57, 60-62, 66-69, 223-227.

xi) More on the problem-functionalist approach which takes the concept of "problem" as starting point for developing an approach to social systems including both factual and normative theory see HORNUNG, Bernd R. (2004), *Sociocybernetic Problem-Functionalist Analysis of Community and Regional Development*, pp. 17-23, *NG* - Nase Gospodarstvo/Our Economy, vol. 50, no. 3-4.

xii) Also in some kinds of model theory e.g. STACHOWIAK, Herbert (1973), *Allgemeine Modelltheorie (General Theory of Models)*, Springer-Verlag, Wien, New York.

xiii) HORNUNG, Bernd R. (1988), Grundlagen einer problemfunktionalistischen Systemtheorie gesellschaftlicher Entwicklung, Verlag Peter Lang, Frankfurt, Bern, New York, Paris, see p. 38.

xiv) LASZLO, Ervin (1973), Introduction to Systems Philosophy, Harper & Row, New York, London.

xv) For a discussion of some of the methodological problems cf. e.g. HORNUNG, Bernd R., HORNUNG, Rosario (2001), *Implications of Autopoiesis and Cognitive Mapping for a Methodology of Comparative Cross-cultural Research*, op. cit.

xvi) A discussion of the principle of causality in terms of 2nd order cybernetics is given in FOERSTER, Heinz von, POERKSEN, Bernhard (2002), *Understanding Systems,*, Kluwer Academic Publishers - Plenum Publishers, New York, Boston, Dordrecht / Carl-Auer-Systeme Verlag, Heidelberg.

xvii) For a more detailed analysis cf. HORNUNG, Bernd R. (2004), *Sociocybernetic Problem-Functionalist Analysis of Community and Regional Development*, op. cit.

xviii) Cf. e.g. STONIER, Tom (1992), *Beyond Information, The Natural History of Intelligence*, Springer-Verlag, Berlin, Heidelberg, New York, Tokyo; STONIER, Tom (1997), *Information and Meaning, An Evolutionary Perspective*, Springer-Verlag, Berlin, Heidelberg, New York, Tokyo.

xix) Cf. ATMANSPACHER, Harald, DALENOORT, Gerhard J. (eds.) (1994), Inside Versus Outside, Springer-Verlag, Berlin, Heidelberg, New York, Tokyo.

xx) Cf. HORNUNG, Bernd R. (2004), *Sociocybernetic Problem-Functionalist Analysis of Community and Regional Development*, op. cit.; LUHMANN Niklas (1974), *Soziologie als Theorie sozialer Systeme,* pp. 113-136, LUHMANN Niklas (1974), Soziologische Aufklärung 1, 4th edition, Westdeutscher Verlag, Opladen, see pp. 113-114, 116.

xxi) LUHMANN, Niklas (1987), *Soziale Systeme,* pp. 189, 243, 629f, Suhrkamp Verlag, Frankfurt/Main, English edition LUHMANN, Niklas (1995), *Social Systems*, Stanford University Press, Stanford.

xxii) MATURANA, Humberto R., VARELA, Francisco J. (1980), *Autopoiesis and Cognition, The Realization of the Living*, D. Reidel Publishing Company, Dordrecht, Boston.

xxiii) LUHMANN, Niklas (1987/1995), *Soziale Systeme/Social Systems*

xxiv) Cf. KORTE, Hermann; SCHÄFERS, Bernhard (eds.) (2000), *Einführung in Hauptbegriffe der Soziologie,* Leske + Budrich, Leverkusen, Opladen 2000, pp. 12, 15. Also authors like Max Weber, Buckley, Durkheim, and Giddens state that ultimately society is composed of human beings.

xxv) Cf. MATURANA, Humberto R., VARELA, Francisco J. (1980), *Autopoiesis and Cognition*,op, cit.; also BURNS, Tom R., BAUMGARTNER, Thomas, DEVILLE, Philippe (1985), *Man, Decisions, Society,* Gordon & Breach Science Publishers, New York, London, Tokyo.

xxvi) E.g. LUHMANN, Niklas (1995), *Social Systems*, op. cit.

xxvii) For more details cf. HORNUNG, Bernd R. (1995), *Sociocultural Evolution, Towards the Merging of Material and Informational Evolution*, pp. 867-872, ASSOCIATION INTERNATIONALE DE

CYBERNÉTIQUE (AIC) (ed.) (1995), 14th International Congress on Cybernetics, Namur (Belgium), August 21st-25th 1995, Proceedings, AIC, Namur.