

PHILOSOPHICAL FOUNDATIONS OF SYNERGETIC MODELLING

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The concepts of organization and self-organization are explained philosophically (i. e. they are considered as philosophical categories). The philosophical foundations of synergetic modelling are characterized from the position of philosophical interpretation of these concepts. They are compared with philosophical foundations of cybernetic modelling. The categories of organization and self-organization can be distinguished from each other on the basis of their relations to consciousness or some external ordering factors. The category of organization denotes the process which is created by consciousness or some external ordering factors. The category of self-organization denotes the process which is created beyond consciousness or some external ordering factors. The categories of organization and self-organization are semantically connected with each other by the category of goal. In the case of organization the goal originates from consciousness. In the case of self-organization, the goal is not produced by consciousness. Cybernetic modelling starts from the category of organization. Synergetic modelling proceeds from the category of self-organization. The cybernetic models reflect the states which retain their previous quality. The synergetic models reflect the irreversible transitions from one quality into another. Self-organization, as it has been proved in synergetics, is possible only under the conditions of strong non-equilibrium. The mechanism of coordination of elementary actions in self-organization does not depend upon the nature of the system's elements. Cybernetics and synergetics are exact sciences and therefore they do not examine consciousness. In society, however, conscious actions are added to self-organization. Here the nature of the system's elements, that is of the individuals (personalities), starts to play an essential role. The understanding of connection between organization and self-organization enables to build up more perfect models in order to control natural and social processes.

The article discusses the categoric (philosophical) foundations of the cybernetic and synergetic modelling of natural and social phenomena. The cybernetic and synergetic approaches are compared with each other with the help of the concepts of organization and self-organization defined as categories (philosophically).¹

I confront the concept of self-organization with the concept of organization. It is natural that the terms *organization* and *self-organization* can express concepts of different types. However, there does not exist any integral, generally acknowledged typology of concepts in contemporary philosophical literature. My task is not to analyse different types of con-

¹ Няпинен Л. Я. О значении терминов «организация» и «самоорганизация» в современной научной и философской литературе. — Acta et commentationes Universitatis Tartuensis, 1983, 630, 84—104.

cepts. Therefore it is necessary to explain what I consider as a categorically defined concept and what as a scientifically defined concept.

As a categorically defined concept I understand the concept which has got a definition and is used in the context of philosophical categories. As a scientifically defined concept I consider the concept which has got a definition and is used in the context of exact (in ideal mathematized) scientific theory.

In the paper referred to above I analysed the use of the terms *organization* and *self-organization* in the present-day scientific and philosophical literature. The analysis of concrete philosophical and scientific texts showed that in traditional literature the term *organization* was used, for instance, in the following meanings: (1) as a synonym of the term *structure*, (2) for denoting the unstable (changing, moving, passing) order, (3) for expressing the functionality of machines and machine-like systems, (4) as indicator of the effect of integration of systems (difference of characteristics and appearances of the system from characteristics and appearances of its parts), and (5) for considering the teleonomy of development. The term *self-organization* was used seldom and its meaning was not explicitly confronted to that of the term *organization*. Among these ways of using the terms *organization* and *self-organization* I did not find the definitions (or the descriptions replacing them) of these concepts either in the categoric context or in the context of an exact scientific theory.

As it is known, in creating scientific concepts the existing semantics of the corresponding words is not always taken into account. However, into philosophical language new terms should not be introduced without taking into account the existing semantics as we could put into circulation a word (in our case the words *organization* and *self-organization*) for denoting some phenomenon which already has a name (here e.g., *structure*, *function*, *integration*, *goal*, and others). If the meaning of the term *organization* may be reduced to the structural-functional order, there does not seem any necessity of introducing the term *organization*. The use of this term would be justified semantically if it was connected with something new that is something more than structural-functional order. This 'something more' I connect with the role of the organizer and in the referred paper (reference 1) I have tried to substantiate it by the categoric, semantical, and etymological analysis. In doing so I was supported by the results of other authors.

There is no possibility to repeat this argumentation in this paper. I shall give the core of my considerations only.

The process of organizing (and self-organizing) and the resulting organization are traditionally defined separately from each other. That makes the understanding of the unity of the process and its result somewhat vague. It is not right to consider these definitions as categoric ones. In the categoric understanding organization and self-organization are components of human socio-historical actions. In the categoric definition proposed by me organization and self-organization are regarded in such a way that the inseparable connection between these processes and their results is explicit. The result is in both cases designated by the term *organization*. However, the processes that lead to the result are different. The process carried out by conscious, mind-directed action of man (or society) or by some external ordering influence is named *organization*. The process that is going on *beyond* the conscious action of man or beyond some external ordering influence is called *self-organization*. Thus, the term *organization* expresses the connection of concepts inseparable from one another: *organizer* (man, society, or some external agent)—*organization*, *organizing* (the conscious, mind-directed process or the process regulated by external factors)—*organization* (the result). The term *self-organization*

indicates the interconnection of the concepts *self-organization*, *self-organizing* (i.e. the process going on beyond the conscious action or some external ordering influence)—*organization* (the result).

Two points are taken into consideration in this treatment: (1) the role of the organizer, and (2) the interconnection of the process and its result.² In the previous definitions the meaning of the term *organization* was reduced to the structural-functional order. No attention was paid to the question of the origin of order—*who* or *what* regulates a system.³

Taking into account the above-said, the concept of organization would denote the process that leads to the rise of goal-oriented structures due to conscious human goal-directed action or some external ordering influence, and the concept of self-organization would denote the process that leads to the rise of goal-oriented structures beyond conscious human goal-directed action or some external ordering influence.

Usually the nature of organization is understood as a certain order of the elements of a system that makes it possible to achieve some integral result. However, in such understanding there is often tacit agreement that the organization is carried into effect thanks to conscious human efforts. That is why, as I have tried to show in the referred paper, the concept of organization is used to express the rise of harmonious functioning in a system when harmony is determined by an external ordering influence. In synergetics organization is understood analogically.

Self-organization, however, is understood in synergetics otherwise than in cybernetics and systems engineering. In the two last disciplines self-organization is understood as an effect of an external *ordering* factor. In synergetics self-organization is understood as the rise of harmonious behaviour distinguished from man's intervention and from external (with regard to the system) ordering factors. External factors (e.g. strong non-equilibrium mentioned below) are indispensable for self-organization, but only as conditions, not as ordering forces.

In my Candidate's (PhD) thesis, completed under Rein Vihalemm's scientific direction, I used the categories of organization and self-organization for the detection of essential changes (revolution by I. Prigogine) in exact sciences.⁴

It became evident that there exist two conceptual systems in contemporary mathematized science: *the theories of organization* (cybernetics, the kinetic theories in chemistry, including the theory of self-development of elementary open catalytic systems developed by A. P. Rudenko,⁵ and

² Here I based myself upon M. Rozov's work (Розов М. А. Научная абстракция и ее виды. Наука, Сибирское отделение, Новосибирск, 1965), where the author in solving an analogical task—the task of categoric definition of the concept *scientific abstraction*—draws attention to the fact that the term *abstraction* marks both the process of abstraction and its result.

³ The fact that in the existing definitions of a system attention has not been drawn to the problem *what* regulates a system has been stressed by P. Anokhin (Анохин П. К. Принципиальные вопросы общей теории функциональных систем. — In: Принципы системной организации функций. Наука, Москва, 1973, 5—51). He notes that the mechanism of ordering organized systems is not reduced to *powerful* interaction of their components. His opinion is that it is necessary "... to disclose these determining factors which make the components of a system free from superfluous degrees of freedom." (Анохин П. К. Философские аспекты теории функциональной системы. Избранные труды. Наука, Москва, 1978, 68).

⁴ See the abstract of my Candidate's thesis and the references therein: Няпинен Л. Я. Философский анализ понятий «организация» и «самоорганизация» в современном научном познании. Автореферат диссертации на соискание ученой степени кандидата философских наук. Тарту, 1984.

⁵ Руденко А. П. Теория саморазвития открытых каталитических систем. Издательство Московского университета, Москва, 1969. I have considered some philosophical aspects of this theory (comparing it with M. Eigen's evolutionary model) in the paper: Няпинен Л. Я. Философский анализ двух концепций предбиологической эволюции. — Acta et commentationes Universitatis Tartuensis, 1984, 694, 84—96.

others) and *the theories of self-organization* (the generalized thermodynamics developed by I. Prigogine and his collaborators, the theory of self-organization of biological macromolecules developed by M. Eigen, the synergetic method of H. Haken, and others). The former are expressed by the category of organization, the latter by the category of self-organization. All the theories of self-organization represent a certain integral *orientation* in contemporary mathematized science, i.e. synergetics. The main difference between the theories of organization and those of self-organization is the fact that the former are based on the methods of *constructing*, but the latter start from the already existing, from what is given in the historical reality. The theories of self-organization form a new conceptual system (i.e. a conceptual system in the sense of W. Heisenberg) which originates from the works of I. Prigogine (and his collaborators) in non-linear non-equilibrium thermodynamics. The rise of a new conceptual system is connected with the circumstance that synergetics was the first among exact sciences to use the evolutionary models from biology. On the basis of these models the new concepts are brought in. In I. Prigogine's scientific programme (see below) they are the *microscopic entropy operator* and *inner time* (as *operator*) that make it possible to examine the second law of thermodynamics as a fundamental postulate of dynamics. Also M. Eigen (in his evolutionary model) takes into consideration a fact from biology—the self-reproduction of biological macromolecules (by the positive feedback)—although he starts from theoretical physico-mathematical considerations. It is the use of the biological evolutionary models and the creation of new concepts on their basis in physico-mathematical theories that gives the rising conceptual system its novelty, namely natural-historical character. Therefore all these theories may be characterized by the same categorically defined concept—*self-organization*.

It was interesting for me to learn that H. Haken interprets the concepts of organization and self-organization analogically to the categoric definitions that I have suggested.⁶ This analogy lies in the fact that H. Haken takes into account the inseparable unity of the process and its result, and also the origin of the determinants of the functioning or behaviour of the system. The concept of organization expresses the situation in which the determinants of the process come from outside and the process itself leads to the formation of goal-oriented structures. The concept of self-organization expresses an analogous situation with the difference that the determinants of the process are not forces but integral regularities (long-range correlations) and they emanate from inside the system. From the philosophical point of view it must be stressed that in experimental situations the determinants of the organization are contingent on the subject (the experimenter).

The philosophico-methodological assertions made by some scholars (W. R. Ashby and others) on the basis of cybernetic imaginations are somewhat misleading because the traditional approach of exact sciences (in its epistemological status cybernetics is based on classical thermodynamics) does not pay attention to the starting situation (initial conditions) of experimental and technical processes. Emphasis is laid on opening the laws of the system's development, but the world is seen as a "closed system".

⁶ Haken, H. Synergetics. An Introduction. Second Enlarged Edition, 1978, Springer, Berlin, Heidelberg, New York, Ch. 7. It must be stressed here that the use of the term *self-organization* in the context of synergetic theory differs from the use of this term in the context of cybernetic theory. The term *self-organization* is used in cybernetics and contemporary science in general often as a synonym of the term *self-regulation*. In synergetics, however, the term *self-organization* has another meaning. By the way, one of the authors who introduced this term — W. R. Ashby — specially warned against the vague use of this term (see: Эшби У. Р. Принципы самоорганизации. — In: Принципы самоорганизации. Мир, Москва, 1966, 331).

The fundamental real system whence cybernetics starts is a machine-automaton, a technical installation constructed by man. Man creates the machine using the laws of nature that express the relations of idealized objects. These laws not existing in nature "in clean shape" are realized in machines. If man wants to reveal the law "in clean form" he must create special initial conditions for this. However, in cybernetics, like in classical exact sciences in general, the initial conditions (which enable to create different constructions on the basis of the laws of nature) are not considered in the theoretical sense. Only the laws are analysed on the theoretical level. As the origin of initial conditions is not taken into theoretical consideration, the content of the scientific picture of the world remains non-historical.

Synergetics gives us a different image. I. Prigogine has said that "the most surprising conclusion" drawn from the new system of concepts presented by him is the following: from the existence of the laws orientated in time, such as the growth of entropy towards the future, follows the existence of the states orientated in time.⁷ This conclusion differs radically from the idealized picture of traditional physics (physics can be taken as the etalon for traditional exact sciences) in which the initial conditions (corresponding to some state of the object) are arbitrary. They are not examined by theory and are created by the research worker. A theoretical meaning is given only to the equation expressing the laws that link the arbitrary initial conditions with the final result. But I. Prigogine shows in the language of mathematized science that the real situations are orientated in time, that the states and the laws are closely connected with one another, that the initial conditions of the system emerge as the result of its previous evolution. Although under certain conditions there exist also stable, reversible systems, they must not be regarded as more fundamental than the systems that are unstable to a remarkable extent. According to I. Prigogine, instability is closely linked with irreversibility: the irreversible, orientated time can emerge only because the future does not exist in the present.⁸

I. Prigogine, in fact, shows the limits of traditional cognition of exact sciences—hypothetical-constructive-deductive method of knowledge—and strives for the union for cooperation of this method of knowledge with the historical cognition. The hypothetical-constructive-deductive method of knowledge is the a priori experimental and mathematical constructing of the idealized, remaining-repeating phenomena. The specificity of the historical cognition is linked first of all with the reconstructing of the irreversible process in historical time. The characterization of the historical phenomena is not possible without any knowledge of their past, of their emergence in the process of irreversible evolution. Their future is not inherent in the present (as understood already by H. Reichenbach⁹). It seems that the hypothetical-deductive knowledge in principle cannot explain historical phenomena. But it is possible to use the hypothetical-deductive theories of exact sciences in the modelling of some aspects of historical phenomena. It must be regarded as the cooperation of

⁷ See: Пригожин И. От существующего к возникающему. Время и сложность в физических науках. Наука. Главная редакция физико-математической литературы, Москва, 1985, Ch. 10.

⁸ A more detailed philosophical interpretation of I. Prigogine's scientific programme see: Вихалемм Р. А., Няпинен Л. Я. О диалектической природе синергетических теорий (философское значение исследований школы И. Пригожина). — Acta et commentationes Universitatis Tartuensis, 1986, 731, 108—124; Вихалемм Р. А., Няпинен Л. Я. Принцип историзма в научной программе И. Пригожина (о противоречии между классической научной картиной мира и исторической действительностью). — Acta et commentationes Universitatis Tartuensis, 1987, 786, 24—38.

⁹ Reichenbach, H. The Direction of Time. University of California Press, Berkeley, 1956.

reconstructive (historical, descriptive-theoretical) and constructive (hypothetical-deductive) approaches but not as an attempt to replace one by the other.

Cybernetics can be considered, in a certain sense, a typical representative of classical exact sciences.

As it was shown by I. B. Novik,¹⁰ *function* is the uniting and specific category for cybernetic modelling. The scientific nature of this concept consists in the dependence of the output (the reaction of the system) of the so-called model of "black box" on its input (the information from the environment). This dependence can be identified statistically by the method of trials and errors. The objective basis of cybernetic modelling is the relative independence of function from the material substratum and its structure. In the cybernetic models the development of a system is usually considered mainly as a functional balancing with the environment by the mechanism of feedback. The decisive role in cybernetics is played by negative, not positive feedback. The cybernetic models reflect only the processes of simplification of structures (forms), i.e. only the regressive part of development.¹¹ Cybernetic schemes do not include complication of system's forms. Only the stable states which retain their previous quality are considered in the cybernetic models. Transformations between different qualitative states are considered only logically.

The synergetic models, on the contrary, reflect the *transitions* between different qualitative states by positive feedback. These transitions are possible only if the influence of external environment on the system is so changeable that amplification of the fluctuations may cause the system to move away from equilibrium so far that it cannot return to the former state and there may appear new possibilities of development. The qualitative transitions are simultaneously both determined and undetermined. The fundamental objective indetermination lies in their basis. It is not determined into which qualitative state from some (or many) possibilities the system really goes after the selection. But the field of possibilities is determined. Determination means here not the stability of state, but "looking for stability", not homeostasis, but homeoresis¹²—the striving for changes.

The category of *goal*, worked out already by Aristotle (in his causality doctrine), may be considered a uniting and specific concept for the synergetic models.

¹⁰ See for instance: Новик И. Б. Кибернетика. Философские и социологические проблемы. Госполитиздат, Москва, 1963; Новик И. Б. О философских вопросах кибернетического моделирования. Знание, Москва, 1964. The starting point for building mathematical models in cybernetics is the model of final automatic machine (introduced in 1936) and in synergetics—the model of morphogenesis (published in 1952). Both were created by the English mathematician A. M. Turing.

¹¹ This happens when one is modelling some kind of evolutionary process by the medium of an electronic computer (see for instance: Эшби У. Р. Принципы самоорганизации. — In: Принципы самоорганизации, 332—334 ff.). When W. R. Ashby, for example, models (using the numbers from 0 to 9) the movement of some closed system through some medium states into the equilibrium, he supplies the model with final information "in noise" and gives to the model world some unchangeable laws. Doing this he starts from the machine-like schemes (as it is natural for a representative of cybernetics). However, these schemes are not good enough (contrary to Ashby's pursuits) for the *explanation* of natural-historical processes (the genesis of life and others). Yet the machine-like schemes can be used as models of some aspects of natural-historical processes. A machine is always created by man. But the natural-historical processes have not any creator: they rise up by self-organization.

¹² *Homeostasis* is the possibility of the technical and homeological systems to preserve the dynamic relative durability of their characteristics. *Homeoresis* is the endurance of not only the single parameters, but of the whole stream of changes, processes, evolutionary trajectories, which C. Waddington named *chreods*. See. Waddington, C. H. Towards a Theoretical Biology. I. Prolegomena. Aldine Publishing Company, Birmingham, 1968.

Four causes-beginnings by Aristotle are: (1) the substratum, (2) the nature of the being of the thing, (3) the acting beginnings of change or rest, and (4) the causes in the meaning of *goal*. (In Latin these causes are called respectively *causa materialis*, *causa formalis*, *causa efficiens*, and *causa finalis*.) These four causes as a whole enabled Aristotle to consider the world as an integral organism, to which also man himself belongs. Aristotle's method of the analysis of reality explains the natural phenomena with the help of all the four causes. (True enough, Aristotle himself explained the nature teleologically.)

Man has conscious goals. In the self-organizing processes there exist non-conscious goals (in the teleonomic sense). The uniting feature of the conscious goal and non-conscious goal is the trend toward achieving the determined result.¹³ The conscious goals (at least in the quality of final result) are brought into the machines by man. Man's conscious goals are reflected in the scientific models as external goals. It makes sense to talk about the external goals only in relation to the *result* of the conscious organizing action of man (society). When the scientist fixes the machine-like aspect in a natural phenomenon, the goal in it only seems to be external. In fact it makes sense to talk only about the inner goals in relation with natural processes. Goals exist in all self-organizing systems, including the non-organic ones,¹⁴ but not every system has an inner goal.

The goal in objective processes has been disclosed also in cybernetics. However, cybernetics made it possible only to describe (with the help of the category of organization), but not to explain the goal. The explanation of goal became possible by the medium of the category of self-organization in synergetics.

The states reflected in the cybernetic models are the result of the regressive tendency chosen by the system itself. Synergetic models reflect in addition the states resulting from the progressive tendencies selected by the system. Cybernetics models the tendency of maintaining the already existing state. Synergetic models (the Brusselator scheme¹⁵ and others) help understand both the nature of the existing qualitative state and the qualitative states that preceded it. They fix the external functions, the inner and external structure of the process and also, in a certain sense, an element of "history". For the first time in exact sciences these models take the triple connexion of structure, function, and history into consideration so explicitly. The category of history denotes in my understanding the reconstruction of the past as an *irreversible* process. In synergetic models the past (the irreversible process in historical time) is reconstructed at least in the most minimal way. The interpretation of certain qualitative state by these models always assumes the knowledge of the former qualitative states of the system (which were realized due to the bifurcations). The subject of synergetics is, so to say, the projecting of potentialities of the past upon the presupposed future development. But in so doing, as I. Prigogine has stressed, one must keep in mind that the

¹³ This has been shown on the basis of cybernetic material by M. Makarov (Макаров М. Г. К вопросу категории «цель» в философии диалектического материализма. — Acta et commentationes Universitatis Tartuensis, 1960, 83, 15) and B. Ukrainsev (Украинцев Б. С. Особенности самоуправляемых систем. Знание, Москва, 1970, 28—30).

¹⁴ I am pleased to note that also some other philosophers have started to acknowledge the existence of goals (in the teleonomic sense) in the non-organic nature, see e.g. Казаринов М. Ю. Детерминизм в сложных системах управления и самоорганизации. Издательство Ленинградского университета, Ленинград, 1990. R. Vihalemm used the category of goal in relation to the chemical systems even earlier: Vihalemm, R. Uhe teaduse kujunemislugu. Keemia arenguteest. Valgus, Tallinn, 1981, 130—141.

¹⁵ See for instance: Nicolis, G., Prigogine, I. Self-Organization in Non-Equilibrium Systems. From Dissipative Structures to Order Through Fluctuations. Wiley, New York, 1977.

moment when a sufficiently complex process will arrive in the state of bifurcation cannot be prognosticated.

The general and crucial aspect of all synergetic models is that the harmony (coherence) between the elements of the system may come into being without any external *ordering* factors. The coherence is not the result of a powerful influence upon each element from some kind of external centre. For that reason, use of power in management cannot in principle lead to harmonic development of society. The analysis of the historical development of socio-economic systems from the position of synergetic modelling makes it possible to say the following: "... any limiting of the social and personal consumption is violence, that means it is possible only on the sufficiently low level of economic freedom. On the other hand, the existence of such regimes demands a low level of consumption."¹⁶

We have to consider society not only as a system with conscious action (organization as a process with its result), but as a self-organizing (developing beyond consciousness) system with organization (with conscious action). In society man must organize self-organization. But self-organization assumes the independence of the active elements of a system, which in society are individuals. Differently from the elements of non-social self-organizing systems, people have consciousness. People can self-develop as personalities through freedom of choice. Because of this fact one must be cautious in modelling social phenomena. The so-called logistic equations that are widely used for the ecological problems may in case of social tasks be used only if we can speak about the "average" man. In the free society people are so different that the "rough" consideration proves fully unfit. But the mechanism of coordination of actions in self-organization in society is the same as in the other cases of self-organization.

Self-organization in society is connected with the expansion of the economic freedom and with the principles of liberalism and individualism. F. Hayek proved (although he was not accepted for many years and was awarded the Nobel prize only when he was already 75) that *an activity following the collectivistic thinking leads unavoidably into the totalitarian society*.¹⁷ (According to Hayek, collectivism means whatever theoretical systems which—contrary to liberalism—try to organize the whole society in order to achieve some common general goal. The creators of these systems refuse to accept the sphere of autonomy of an individual protected by the law.) Reading the works of F. Hayek we can see that he clearly and repeatedly distinguishes two types of orders. "Conscious orders" are created by human intellect. These orders are based on the orders and prohibitions according to some plans worked out earlier and are directed to the achievement of clearly distinguished goals. "Spontaneous orders" are formed in the process of historical development. They do not embody anyone's intentions (conscious goals) and cannot be controlled from a single centre. Harmony between individuals is achieved not by their subordination to somebody's will, but because they follow universal rules of conduct. Consciously ordered structures include armies, government offices, industrial corporations, etc. Spontaneously (beyond the consciousness) ordering structures are languages, justice, morality, market, etc. The spontaneous structures appear as results of human activity, but not as products of consciousness. They cannot be created according to previous planning. The sovereignty and autonomy of an individual, property of an

¹⁶ Розинко А. Н., Черненко И. В. Свобода и принуждение в социально-экономических системах. — Философская и социологическая мысль, 1990, 3, 96.

¹⁷ See for instance: Hayek, F. A. *The Road to Serfdom*. University of Chicago Press, Chicago, 1944.

individual and private entrepreneurship, outer and inner freedom, democracy, and juridical order also do not appear as a direct result of organization—the conscious activity of man—but they emerge as a result of self-organization—natural and long-term development. Conscious activity can accelerate this process of development (and also slow it down), but must not replace it. In the totalitarian societies self-organization has been totally replaced or modified by organization. Therefore the structures typical of the civil society cannot emerge there.

Self-organization is possible in the *open* society and is not possible in the closed society. According to K. Popper, we must look upon the closed society as the contradiction of the open society: “. . . the magical or tribal or collectivist society will also be called the *closed society*, and the society in which individuals are confronted with personal decisions, the *open* society.”¹⁸ The condition of the openness of society is referred to also by F. Hayek: “The great change which produced an order of society . . . was the transition from the face-to-face society, or at least of groups consisting of known and recognizable members, to the open abstract society that was no longer held together by common concrete ends but only by the obedience to the same abstract rules . . .”¹⁹

Synergetics accentuates also one condition of self-organization: the order arises from chaos only under the condition of strong non-equilibrium. It is necessary to distinguish strictly chaos under the conditions close to equilibrium (in which, generally speaking, self-organized structures can only decompose) from chaos under the strongly non-equilibrium conditions (in which composing of structures through self-organization can take place). The former type of chaos is non-creative, the latter is creative. The meaning of the word *creative* is the unpredictability and unavailability of the unknown. The creative chaos is the field of unknown and unpredictable chances. One has to “pay” for the realization of these chances: the “food” (matter, energy, information) for the active elements (in society these are honest individuals of initiative) should be continuously oversufficient. (The further excitement of the structures formed under strongly non-equilibrium conditions does not demand much energy any more, but assumes the knowledge of the *topology* of influence. An unremarkable perturbation in the right place can cause a great qualitative change.) The non-creative economic chaos includes chances only for unethical people. The most harmful are the speculators. Some wise man has once said that a speculator is more dangerous than a murderer, because the latter kills only one or some people, while the former destroys the whole nation. It is well known that during early capitalism the preliminary accumulation of capital was provided in an extremely rude and dishonest way. However, the strategic task of the former socialist countries (which were the closed societies) is not to transform from socialism into capitalism, but from closed society into open society. Starting from the early capitalism would not enable them to become highly developed countries, some of which have lived in the information society for about a decade.

According to A. I. Rakitov, even in the situation of the present-day crisis in the Russian society one must speak not about the transition from non-civilized society into civilized society, but about the replacement of civilizations. “The latter demands different working skills, different mentality, justice, behaviour, demands the replacement of despotism by democracy, of the slave by the free producer and entrepreneur, of the

¹⁸ Popper, K. R. *The Open Society and Its Enemies*. 5th edn., 1966, Princeton University Press, Princeton, New Jersey, Vol. I, 173.

¹⁹ Hayek, F. A. *Law, Legislation, and Liberty*. University of Chicago Press, Chicago, 1979, Vol. 3, 164.

biological individual by the social and juridical individual, that is a personality. Such radical changes are not possible without *the revolution in self-consciousness, without deep transformations in the kernel of culture...*"²⁰ (My italics—L. N.)

For the people who got their education in the totalitarian society it is useful to return again and again to the words of F. Hayek: "The supreme superstition that the social order is created by government is of course just a flagrant manifestation of the constructivistic error."²¹ And elsewhere: "...Most of ... steps in the evolution of culture were made possible by some individuals breaking some traditional rules and practising new forms of conduct—not because they understood them to be better, but because the groups which acted on them prospered more than others and grew..."²² "Man did not adopt new rules of conduct because he was intelligent. He became intelligent by submitting to new rules of conduct..."²³ And, at last, fully in the spirit of synergetics: "...progress cannot be dosed (nor, for that matter economic growth!) All we can do is to create conditions favourable to it and then hope for the best. It may be stimulated or damped by policy, but nobody can predict the precise effects of such measures..."²⁴ The priority of self-organization before organization is stressed by the words: "Man is not and never will be the master of his fate: his very reason always progresses by leading him into the unknown and unforeseen where he learns new things."²⁵

In cybernetics as well as in synergetics the objective processes are modelled in order to control them. The cybernetic models make it possible for man to strive for the desirable results using the *programme* created by him. The synergetic models take into account that the programmes form in the course of self-organization. However, both cybernetics and synergetics are exact sciences. It must be underlined that in exact sciences the approach to the interaction between organization (management) and self-organization does not go (and due to the specificity of exact sciences must not go) farther from certain boundaries. The limits mean that exact sciences in their models of influence upon self-organization give only such recommendations according to which the future state of an object of management is given from the *outside*. Exact sciences do not make any contribution to the opening of the creative potential of the elements of the system. In the social systems it is the creative possibilities of the elements, that is of the individuals, that appear to be determining. Exact sciences do not teach every man, but the governments. The latter do not necessarily think about the welfare of "every" man. Moreover, not every man wants to follow blindly the directions of the power. In this connection it is interesting to mention that in one of the last reports to the Club of Rome²⁶ the task of management is understood in a different way from the approach in exact sciences: the indetermination must not be overcome, but must be made the ally of management. People should trust in free individuals rather than in "wise" governments.

Now all the former socialist societies are striving to change. Often the changes remain only external.²⁷ The values of essential parameters (low

²⁰ Ракитов А. И. Цивилизация, культура, технология и рынок. — Вопросы философии, 1992, 5, 12.

²¹ Hayek, F. A. Law, Legislation, and Liberty, Vol. 3, 204.

²² Ibid., 161.

²³ Ibid., 163.

²⁴ Ibid., 169.

²⁵ Ibid., 176.

²⁶ Кинг А., Шнайдер Б. Первая глобальная революция. Доклад Римского клуба. Москва, 1991.

²⁷ In the case of Russia this conclusion is made by I. Chernenko: Черненко И. В. Теория катастроф и судьба России. — Философская и социологическая мысль, 1991, 11, 11—31.

level of economic freedom, ignoring the principles of liberalism and individualism, total mediocrity and incompetence, and others) have remained unaltered at least in all the former Soviet republics. They have not left irreversibly the ways leading to slavery, about which F. Hayek warned.

If people really want to get on the road to freedom, it is necessary to stop offering recipes for the improvement of the world and to rise up to the level of socio-historical and philosophical understanding of the existing state of things and the ways to move from it to the civilized society. This is not possible without understanding the connection between organization and self-organization.

SÜNERGEETILISE MODELLEERIMISE FILOSOOFILISED ALUSED

Leo NÄPINEN

On refereeritud mõistete *organiseerimine* ja *iseorganiseerumine* kategooriaalset (filosoofilist) määratlemist autori varasemates töödes. Neis määratlustes arvestatakse kaht momenti: 1) organisaatori rolli ning 2) protsessi ja tema resultaadi teineteisest lahutamatumust. Eelnevates määratlustes ja neid asendavates kirjeldustes taandus termini *organiseerimine* (ja *organisatsioon*) tähendus struktuur-funktsionaalsele korrastatusele. Neis ei pööratud tähelepanu küsimusele: *kes* või *mis* korrastab süsteemi.

Kategooriaalselt määratletud mõistete *organiseerimine* ja *iseorganiseerumine* abil on autor juba varem iseloomustanud kaht kontseptuaalset süsteemi tänapäeva matematiseeritud loodusteaduses. Need on *organiseerimise (organisatsiooni) teooriad* (küberneetika, kineetilised teooriad keemias, sealhulgas A. Rudenko elementaarsete avatud katalüütiliste süsteemide isearenemise teooria, jt.) ja *iseorganiseerumise teooriad* (I. Prigogine'i ja tema kaastöötajate üldistatud termodünaamika, M. Eigeni bioloogiliste makromolekulide iseorganiseerumise teooria, H. Hakeni sünergeetiline meetod jt.).

Oluline on märkida, et H. Hakeni matemaatiliselt formuleeritud organiseerimise ja iseorganiseerumise mõisted on kooskõlas autori kategooriaalsete määratlustega. See on üks argument selle kasuks, et kategooriaalselt määratletud organiseerimise ja iseorganiseerumise mõisted on sünergeetilise modelleerimise filosoofiline alus.

Edasi võrreldakse juba konkreetsemalt sünergeetilise ja küberneetilise modelleerimise filosoofilisi aluseid.

Nagu näitas I. Novik, küberneetilist modelleerimist ühendav ja talle eriomane kategooria on *funktsioon*. Sünergeetilist modelleerimist aga ühendab autori arvates kategooria *eesmärk*, mis on teada juba Aristoteelse filosoofiast ja mida käsitatakse käesolevas kirjutises teleonoomilises mõttes. Ühtedel juhtudel on eesmärk teadvuse, teistel aga looduse ja ühiskonna eneste produkt. Mõlemaid ühendab suunatus määratletud resultaadi saavutamisele (küberneetika materjali alusel näitasid seda M. Makarov ja B. Ukrainsev).

Objekti uurimisel puutus eesmärgiga kokku ka küberneetika. Kuid küberneetika keeles õnnestus ainult kirjeldada (organiseerimise kategooria abil), kuid mitte seletada eesmärki. Seletamine sai võimalikuks iseorganiseerumise kategooria vahendusel sünergeetikas.

Kõikides sünergeetilistes mudelites arvestatakse fakti, et kooskõla (koherentsus) mis tahes iseorganiseeruva süsteemi elementide vahel tekib inimese teadvuslikust sekkumisest ja süsteemi suhtes välistest korrastavatest mõjutustest mööda minnes. Ka ühiskond on ajaloo käigus iseorgani-

seerunud (teadvusväliselt arenenud) süsteem. Organiseerimine (teadvuslik tegevus) ainult lisandub sellele. Ühiskonna iseorganiseerumine on seotud indiviidide (isiksuste) vabadusega. Kui inimeste elu määravad valitsused, muutub ühiskond suletuks, kui vabad indiviidid, siis avatuks (K. Popperi mõttes). Valitsused, nagu rõhutas F. Hayek, ei loo mitte sotsiaalset (koherentsusel baseeruvat), vaid ainult mehaanilist (jõulisel mõjutusel põhinevat) korda. Tsiiviilühiskonda ei kujunda mitte valitsused, vaid vabad indiviidid. Valitsused ainult takistavad või soodustavad seda. Seetõttu on õige loota mitte niivõrd «headele» valitsustele, kuivõrd vabadele indiviididele, isiksustele.

Præguste ja tulevaste põlvkondade ees seisab raske ülesanne: loobuda ühiskonna «parandamise» retseptidest ja õppida mõtlema teadvustades iseorganiseerumise (teadvusvälise käitumise) prioriteeti organiseerimise (teadvusliku tegevuse) ees. Seda soodustaks ka sünergeetilise mõtlemise põhimõtete omandamine. Suletud ühiskondades kasvanud inimeste peapuudus on ebaadekvaatne mõtteviis. Kui see ei muutu, ei muutu ka ühiskond.

ФИЛОСОФСКИЕ ОСНОВЫ СИНЕРГЕТИЧЕСКОГО МОДЕЛИРОВАНИЯ

Лео НЯПИНЕН

В статье реферировано категориальное (философское) определение понятий *организация* и *самоорганизация* в ранних работах автора. В этих определениях учитываются два момента: 1) роль организатора и 2) непрерывная взаимосвязь процесса и его результата. В предыдущих определениях и в заменяющих их описаниях значение термина *организация* редуцировалось к структурно-функциональной упорядоченности. В них не обращалось внимания на вопрос: *кто* или *что* упорядочивает систему.

С помощью категориально определенных понятий *организация* и *самоорганизация* автор уже в кандидатской диссертации охарактеризовал две концептуальные системы в современном математизированном естествознании. Этими системами являются: *теории организации* (кибернетика, кинетические теории в химии, включая теорию саморазвития элементарных открытых каталитических систем Руденко, и др.) и *теории самоорганизации* (обобщенная термодинамика Пригожина (и его сотрудников), теория самоорганизации биологических макромолекул Эйгена, синергетический метод Хакена и др.).

Существенно отметить, что математически сформулированные Г. Хакеном понятия организации и самоорганизации соответствуют категориальным определениям автора. Это один из аргументов в пользу того, что категориально определенные понятия организации и самоорганизации являются философской основой синергетического моделирования.

Далее уже более конкретно сравниваются философские основания синергетического и кибернетического моделирования.

Как показал И. Б. Новик, общей и специфической для кибернетического моделирования категорией является *функция*. Синергетическое же моделирование объединено, по мнению автора, категорией *цель* (известной уже из философии Аристотеля и трактуемой в данной работе в телеономическом смысле). В одних случаях цель есть продукт сознания, в других — продукт самой природы и самого общества. Цели обоих видов объединяет направленность на достижение определенного результата (на материале кибернетики это показали М. Г. Макаров и Б. С. Украинцев).

