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THE RIDDLE OF A HUMAN BEING: A HUMAN SINGULARITY OF CO-EVOLUTIONARY PROCESSES

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Abstract: The theory of self-organization of complex systems studies laws of sustainable co-evolutionary development of structures having different speeds of development as well as laws of assembling of a complex evolutionary whole from parts when some elements of "memory" (the biological memory, i.e. DNA, the memory of culture, i.e. the cultural and historical traditions, etc.) must be included. The theory reveals general rules of nonlinear synthesis of complex evolutionary structures. The most important and paradoxical consequences of the holistic view, including an approach to solving the riddle of human personality, are as follows: 1) the explanation why and under what conditions a part (a human) can be more complex than a whole (society); 2) in order to reconstruct society it is necessary to change an individual but not by cutting off the supposed undesirable past, since a human being as a microcosm is the synthesis of all previous stages of evolution, and as a result of repression of, it would seem, the wild past one can extinguish a "divine spark" in his soul; 3) in the physical sense, singularity denotes a moment of instability, phase transition; one can talk about the human singularity of co-evolutionary processes, since in such a moment of instability individual actions of a human can play a key role in determining a channel of further development as well as in appearance of a new pattern of collective behavior in society; 4) as the models of nonlinear dynamics, elaborated at the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences in Moscow, show, there is a possibility of a direct influence of the future and even a touch of an infinitely remote future in certain evolutionary regimes and under rigorously definite conditions, more over, it turns out that such a possibility exists only for a human (admittedly, through a specific state of being inherent to him—the sleep without dreams) but not for the human society.

Keywords: co-evolution, human being, nonlinearity, self-organization, tempo-worlds

'Each man has a hole in his soul whose measure is God'.
Jean-Paul Sartre

A COMPLEX WHOLE AS A SYNTHESIS OF PRECEEDING STAGES OF DEVELOPMENT

One of main inherent attitudes of social development at present is to radically change a human being in order to change for the better the social life. A human being is an el-

ementary cell of society, and by transforming the social medium on the level of elements and by changing own properties of this medium, we can change a field of possible paths of development of this medium as well as facilitate reaching preferable future states of society as a complex system. This most important attitude has been often formulated to the letter vice versa: one need to change society and the social conditions of life in it in order a man himself would change.

Everywhere in the modern life, in the scientific literature as well in the popular scientific literature, at numerous scientific conferences and seminars, in the settings of tasks of perspective research formulated by a great number of grant finders and grant holders in their research projects, in discussions conducted in the Internet, a key inner aspiration and the setting of a decisive task could be traced: how to liberate a man, how to make him truly creative, active and interactive, how to facilitate his embedding in a social medium and to make him creative in communication and activity.

A task is set in such a way: to liberate a man socially, to raise his quality of life by providing him with a well-deserved place in the scale of ranks in a corresponding society. Another task is set as well: to liberate a man by rendering more free time to him. For instance, members of the World Futures Studies Federation actively discussed in February 2002 through the World Wide Web a report of Reuters agency that by 2009 robots-humanoids will perform work in factories, by 2015 they will be able to take upon themselves almost any work in hospitals and at home, and, by 2025 in the developed countries, there will be more such kind of robots than people. In other words, the task set is to liberate a man in a spiritual way by dint of ousting a bodily man.

From the point of view of synergetics, it is obvious that such a statement of the question and such formulations of objectives of social transformations are doubtful and, may be, even dangerous. The nature of complex formations and structures in the world is so that their complexity is connected not only with a great number of composing elements and subsystems and not only with the complexity of interactions between them, but also with a complex way of their unification and with a synthesis in them of previous historical states (stages) of development.

According to synergetics, a man as a microcosm is a synthesis of preceding stages of development, at that, perhaps, and both ontogenetic and phylogenetic development. The coming into being of a complex whole is accompanied by the accumulation of all preceding stages of development and by their right, resonant insertion into a united structure of "burning" of a human creature and not by their ousting and cutting off. Obviously, it doesn't signify that all without exception historical stages of development enter a whole developed structure and that they are inserted into it in an invariable and historically fixed form. By assembling the complex, some preceding stages of development can fall out in a natural way and other, essential ones can enter in a converted, transformed state. The building of a complex whole leads to transformation of parts, elements, subsystems which form it.

From the theoretical viewpoint, it becomes clear that, for the purpose of transformation of a human being, one cannot simply force the old, the wild and the unreason-

able, the bodily basis out of him, out of his psyche. One cannot simply cut off his history. The old, a burden of his historical path should be included, resonantly integrated, transformed in him. The falling out of essential elements of a complex evolutionary structure can make the further development of this structure unstable. And management, educational or pedagogical effort directed at the elimination of allegedly undesirable elements of wideness, unreasonableness and bodily basis in a man turns simply to be ineffective.

Thus, the main principle of holism that "the whole is more that the sum of its parts" may be traced back to ancient philosophical studies. One of the earliest formulations of it may be found in Taoism, in philosophy of Lao Tzu. However, a complete and profound sense of the principle has been revealed only by such theories, as gestalt-psychology, general systems theory, and synergetics.

The principle of consideration from the whole to the parts is quite unusual and nontraditional for classical science. The latter moves in the course of analysis mostly from separate parts to a whole, at that this reductionistic way of analysis is not supplemented with a reverse movement from the parts to whole, is not concluded by the building of an integral picture. From the synergetic point of view, it is order parameters that determine the behavior of parts (subsystems) of complex systems. They allow to enormously reducing the complexity of description of a system under consideration.[1]

The classical principle of superposition is not valid in the complex and nonlinear world we live in: the sum of partial solutions is not here a solution of equation. The whole is not equal to the sum of its parts. Generally speaking, it is neither more nor less than the sum of parts. It is qualitatively different in comparison to parts which are integrated in it. Besides, an emerging whole alters parts. The co-evolution of different systems means a transformation of all subsystems by mechanisms of system coordination-ordination and correlation between them.

New principles of organization of an evolutionary whole from parts, or the formation of complex structures from simple ones, are discovered by synergetics.[2] Holism has an evolutionary character in synergetics. A nonlinear synthesis is the integration of structures of "different ages", that is: structures at the different stages of evolutionary development. This is a junction of elements of "memory", and what is more, "memory of different depth". The principles which govern the integration of such structures of "different ages" are gradually being revealed by the Moscow school of synergetics. The integration of simple structures into a complex one occurs by the establishment of a common tempo of development in all unified parts (fragments, simple structures). Structures of "different ages" start to co-exist in one and the same tempo-world.

1. H. Haken, *Synergetics,* Berlin, Springer, 1978; H. Haken, *Synergetics. Introduction and Advanced Topics,* Berlin, Springer, 2004.

2. Knyazeva Helena and Kurdyumov Sergey P., 'Nonlinear Synthesis and Co-evolution of Complex Systems', in *World Futures,* vol. 57, 2001, pp. 239-261; H.N. Knyazeva and S.P. Kurdyumov, *The Foundations of Synergetics. Blow-up Regimes, Self-organization, Tempo-worlds,* Sankt-Petersburg, Aletheia, 2002 (in Russian).

THE WAVE OF CONSTRUCTIVISM IN PHILOSOPHY, SCIENCE AND ART

The holistic concepts developed by synergetics are closely connected with the notions of activity of a subject and with the principles of his creative and constructive work in the world. A mounting wave of constructivism envelops philosophy, science and art.

As regards the Russian psychology, a leader here is the so-called activity approach since the 1920-ies. Its development was connected, first of all, with the names of such Russian scholars, as Lev S. Vygotsky, Alexei N. Leontiev, and Piotr Ya. Galperin, Vasily V. Davydov, and their disciples. The activity approach doesn't lose its significance in the modern psychology; on the contrary, it is still highly perspective. In the frames of this approach, a man as a subject is defined through his activity: in the process of his activities, he creates an object, when realizing his intentions and reifying his ideas, and the object not only stands against him, it has an influence backwards upon him. The very object is a way of construction of the subject of cognition and creative activities. If one doesn't consider the activities as an unlimited alteration and conquest of nature or as a designing of future forms of organization of complex socionatural and geopolitical systems without taking the diversity of own trends of development of these systems into account, such activities entirely swims with the current of co-evolutionary strategy of development. Exactly from this standpoint, the psychological theory of activity has been elaborated by the Russian psychological school. "Such an approach presumes the availability of unreduced multiplicity and of pluralism of different positions, of points of view, value and cultural systems which enter into relations of a dialogue and change as a result of it. The activity understood in such a way presupposes not an ideal of anthropocentrism in relations between a man and nature but an ideal of co-evolution, joint and interdependent evolution of nature and of mankind, what can be interpreted as a relation of partners possessing equal rights, if you wish, of interlocutors in an unplanned dialogue".[3]

In philosophy, and, first of all, in epistemology, this is the *radical constructivism* as an intellectual approach which proceeds from the assumption that a man in his processes of perception and thought not so much reflects the surrounding world as creates it. The approach has been under development by different authors and on the basis of various disciplinary fields: on the basis of the systems theory and of cybernetics—by Heinz von Foerster[4], on the basis of neurobiology and of cognitive science—by Humberto Maturana and Francisco Varela[5], on the basis of genetic (developmental) epistemology—by Jean Piaget[6], and on that of psychology of perception—by Ulrich Neisser.[7]

3. Lektorsky Vladislav A., 'The Activity Approach: Death or Destruction?' in *Questions of Philosophy*, no. 2, 2001, pp. 62 (in Russian).

4. Foerster, Heinz von, Das Konstruieren einer Wirklichkeit', in Die erfundene Wirklichkeit. Wie wissen wir, was wir zu wissen glauben? München, Piper, 1998; H. von Foerster & B. Pörksen, Wahrheit ist die Erfindung eines Lügners: Gespräche für Skeptiker, 2. Auf., Heidelberg, Carl-Auer-Systeme Verlag, 1998.

5. H.R. Maturana and F.J. Varela, *The Tree of Knowledge: The Biological Roots of Human Understanding*, Boston (MA), Shambhala Publications, 1998.

6. J. Piaget, *Biology and Knowledge*, Chicago, University of Chicago Press, 1971.

7. U. Neisser, Cognition and Reality. Principles and Implications of Cognitive Psychology, San Francisco, W.H. Freeman & Co., 1976.

H. von Foerster said that the surrounding world in such a form, as we perceive it, is our invention, i.e. we do not discover the world by reflecting it by means of our organs of sense but we invent and construct it in conformity with our own cognitive apparatus developed in the course of biological evolution. H. Maturana and F. Varela, originators of the theory of autopoiesis, asserted that "any activity is cognition, and any cognition is activity"[8], what was developed later on by Varela in the form of conception of enactive, embodied or situated, cognition. The conception plays nowadays a key role in the development of different directions in cognitive science. J. Piaget elaborated genetic epistemology (called developmental psychology as well) which came out of his thorough investigation of a child. He supposed that a man constructs himself and the world surrounding him by means of some intellectual activity that is called "orientating". For all that a man isn't a creature that passively perceives and processes information incoming from the surrounding world, but he behaves actively. Jean Piaget's thesis "L'intelligence organise le monde en s'organisant elle-même" ("The intelligence organizes the world by organizing itself")[9] often serves as a slogan of the constructivist orientation in epistemology.

B. Vaassen made a careful and special analysis of radical constructivism and summarizes the essence of these different positions as follows: "A man is a creature who purposefully constructs the reality", therefore:

- to construct means to distinguish in a purposeful way;
- the process of construction engenders a coherent, relative world;
- construction is an infinite and recursive process;
- a man constructing the world and the world constructed by him constitute a processual unity;
- construction is a process generating continuity and circular causality;
- construction is an individual activity legitimating itself[10].

A great turning-point in painting was connected with a transition from realism, from the striving for exact reproducing the perceptible reality, as it was, for example, at the school of ambulates in Russia in the second half of the 19th century, to the French impressionism on the boundary of the 19th and 20th centuries, in whose paintings reality was refracted through feelings, moods, impressions of painters. In canvas of impressionists, plausibility is created through unlikelihood, through muted water-colors, as by Claude Monet, or, on the contrary, through exaggeratedly bright, gaudy colors, as by Vincent van Gogh, through a conglomeration of dabs, which resonate with a spectator's perception of reality and can reflect reality even better than photos. Different variations in symbolism, in particular the style of Bauhaus in 1919-1933 in Germany and Austria (Wassily Kandinsky, Paul Klee, etc.), might be considered as a manifestation of radical construc-

8. Maturana and Varela, The Tree of Knowledge: The Biological Roots of Human Understanding.

9. P. Watzlawick (ed.), Die erfundene Wirklichkeit. Wie wissen wir, was wir zu wissen glauben? München, Piper, 10. Auflage, 1998, S. 23.

10. B. Vaassen, Die narrative Gestalt(ung) der Wirklichkeit. Grundlinien einer postmodern orientierten Epistemologie der Sozialwissenschaften, Braunschweig/Wiesbaden, Vieweg, 1996, S. 63-69.

tivism in painting. "The art should convert a true story to a fairy tale, should melt physics into metaphysics, it, according to Paul Klee, doesn't reflect the visible but creates it".[11]

A HUMAN BEING IN THE CHAINS OF CIRCULAR CAUSALITY

From the synergetic point of view, order parameters (characteristics of a system as a whole) determine behavior of parts (subsystems) of a complex system. They allow us to essentially reduce the complexity of description of the system under consideration, and to describe the complex in a relatively simple way.

The synergetic models elaborated by Hermann Haken include in themselves the notion of order parameters, the slaving principle and the principle of circular causality. The latter describes a relation between order parameters and parts (elements) of a system. The behavior of parts (elements) is subordinated by these parameters, is enslaved by them: the individual parts of a system generate the order parameters that in turn determine the behavior of the individual parts. In other words, to draw an anthropomorphic picture: namely the order parameters represent a consensus finding among the individual parts of a system. Thus, the few order parameters and the few possibilities they have in accepting their individual states reflect the fact that in complex systems only few definite structures that so-to-speak are self-consistent with respect to the elements are possible. Or to put it differently, even if some configurations are generated artificially from the outside only few of them are really viable. This holds for any systems, even for societies.[12]

It follows that order parameters and the chains of circular causality are:

- a way of cognition of complex systems;
- a way of building of a complex organization;
- a way of embedding of an individual part (for example, a man in society) in the whole, in an interactive net of communication and activities.

It is of great significance here that not only order parameters determine behavior of individual parts (the slaving principle) but also every individual part makes a contribution in determination of order parameters as dynamical characteristics of a system. And, moreover, in states of instability (near a point of bifurcation or a moment of blow-up), behavior of an individual part may become essential for the whole system and may determine the formation of a new collective pattern of behavior.

It is important to understand that the formation of a whole is connected with modification and deformation of parts (because they enter another medium where other rules of behavior are valid). And, when changing parts, the whole can *awaken* new unusual, unexampled properties of any part or some parts: it can call them into being.

It is important to understand that we are not external observers of the co-evolution-

11. A.A. Genis, *The Tower of Babel: the Art of the Modern Time*, Moscow: Nezavisimaya Gazeta Piblishers, 1997 (in Russian), pp. 190.

12. Haken Hermann and Knyazeva Helena, 'Arbitrariness in Nature: Synergetics and Evolutionary Laws of Prohibition', in *Journal for General Philosophy of Science*, vol. 31, no. 1, 2000, pp. 57-73.

ary process, but we are participants of this very game. We are inside the very trends of co-evolutionary development. We have no right to passively expect what will happen. We can and should become creator of desirable and favorable futures. The physicist Dennis Gabor (1900-1979) once said that the best way to predict the future is to create it. In synergetics, this attitude towards the future finds a special sense. If we shall manage to determine spectra of purposes of development of complex systems, spectra of structure-attractors of their evolution (it is already done for the simplest natural systems, and at present, from these methodological positions, the modeling of the economical development of some regions of Russia under the conditions of instability and of economic crisis is carried out[13]), the role of humans and their responsibility in choosing the most favorable scenarios of development will extremely increase.

Exactly in this respect we may speak about a human *singularity* of co-evolutionary processes. The singularity in the mathematical sense signifies a point in which a derivative of function becomes zero or—what is more important for us regarding thermodynamics of blow-up regimes—an infinite value of the very function is reached, i.e. the course of curve changes in a qualitative way (this is, for instance, a return point, a knot point, a breakpoint, an asymptotic point, etc.); in the physical sense—it is a moment of instability, of a phase transition, of rebuilding of the course of the evolutionary process. In these very moments of instability, a man as an active subject of construction of the world can play a decisive role in defining the channel along which the evolutionary process will run in accordance with a spectrum of structure-attractors of a medium and with own value preferences of the subject.

A HUMAN BEING AS A MICROCOSM. HIS HIGH NONLINEARITY

Emergent properties of structural forms are connected with the nonlinearity of development of complex systems in the world. The nonlinearity has a profound sense, being an indicator of the non-uniqueness of an evolutionary path as well as of possibility of a qualitative breaking, a phase transition, a situation "at the edge of chaos" when fluctuations can throw down a system into another state, towards the formation of new structures.

Complex systems are organized in a hierarchical way. A part itself can be a whole if it consists in turn of smaller parts on the underlying level of world organization of. *A part can be more complex than a whole* (by its behavior, by a spectrum of possible forms) if it has a higher exponent of nonlinearity that that of the whole. According to our synergetic worldview, this seems to hold for a man in society. A man is more complex than a social group or society, since its nonlinearity is higher. A strong nonlinearity signifies that a corresponding structural form on its own level of organization possesses a more complex spectrum of forms-structures and of possible regimes of development. It is a man who can go out on such automodel regimes where he feels an influence of quite

13. S.P. Kapitza, S.P. Kurdyumov, and G.G. Malinetskii, G.G., *Synergetics and Prognoses of the Future,* Moscow, Nauka Publishers (in Russian), 1997.

remote, even maybe "absolute", future what we are going to discuss in details in the next to last section of this article.

The high nonlinearity and integrity of a human individuality is embodied in the free human activity. This statement might be taken as a pivotal point of comparative analysis of the Eastern worldview and synergetics. By getting the integrity, each entity finds freedom. By finding freedom, it doesn't infringe on the freedom of another entity but co-exists with others in an immiscible and indivisible way. This is the highest type of unity when everybody retains his individuality what allows him to communicate with other individuals. The Buddhist monks say: "When one man represents all men, every individual is, accordingly, a center of Universe. One man is identical to many others, many others are identical to one man, and the world is being created by each creature. An individual and the world create each other".

THE PRINCIPLES OF NONLINEAR SYNTHESIS OF THE SIMPLE INTO THE COMPLEX

Let us now formulate main principles of co-evolution, of nonlinear synthesis of relatively simple structures into complex ones.

Thus, the complexity of a structure is connected with its coherence. By coherence, we understand the concordance of tempos of life of structures by means of diffusive, dissipate processes that are a macroscopic manifestation of chaos. In order to build a complex organization, it is necessary to coherently joint subsystems within it, to synchronize tempos of their evolution. As a result of the unification, structures fall into one tempo-world, so they acquire one and the same moment of peaking; they start to co-exist in the same tempo-world.[14]

To create a complex structure, it is necessary to know how to unify structures "of different ages", i.e. structures of different stages of evolution and having different rates (tempos) of evolution. It is necessary to know how to include the elements of "memory", the biological memory, DNA, or the memory of culture, cultural traditions. Inasmuch as the structure-attractors which characterize the developed, steady evolutionary stages of structures in the nonlinear world are described by the invariant-group solutions, the spatial and temporal properties of structure-processes turn to be tightly bound. The dynamics of development of a complex structure needs a coordinated (with one and the same moment of peaking) development of substructures of "different ages" within it, this leads generally to the breakdown of spatial symmetry. The insertion of "memory" (of elements of the past) signifies the symmetry breakdown in space.

Different but not arbitrary structures can be unified. The degree of connection of structures which are to be integrated and the stages of their development are not arbitrary as well. There are various but not arbitrary ways of unification of structures into integral ones. There is a restricted set of integration ways, ways of construction of a

14. Kurdyumov Sergey Pavlovich, 'Evolution and Self-organization Laws in Complex Systems', in *International Journal of Modern Physics C*, vol. 1, 1990, pp. 299-327.

complex evolutionary whole.

The selectivity (the quantum character) of ways of integration of parts into a whole is connected with the imposed requirement of existence in one and the same tempo-world, i.e. of development of all parts with one and the same moment of peaking. This is the physical basis of quantification by integration of complex evolutionary structures. If joinable structures have even slightly different from each other moments of peaking, then, near the moment of peaking (the singularity), they will become incomparable in intensity.

Thus, the synthesis of relatively simple evolutionary structures in an entire complex structure occurs by the establishment of a common tempo of evolution in all unified parts (fragments, simple structures). The intensity of processes in various fragments of the complex structure (for example, for the social medium—a level of economic development, quality of life, provision with information, etc. in different countries) can be diverse. The fact of integration signifies that structures becoming parts of a whole acquire a common rate development.

An integrated complex structure arises only if there is a certain degree of overlapping of simple structures. There must be a certain topology, "architecture" of overlapping. A constructive "sense of proportion " must be observed. If the area of overlapping is not sufficient, then the structures will develop independently, they won't feel each other, they will live in different tempo-worlds. But if the overlapping is too wide, then the structures will flow together very fast, they will straight away "degenerate" in one rapidly developing structure.

One may attempt to formulate rules of symmetry breakdown, when uniting structures of "different ages" into a whole and to indicate an optimum degree of connection (of overlapping of areas of localization) of substructures within a complex structure, a proper topology of their location, laws of switching of regimes and other factors, ensuring sustainable concordant development in one and the same tempo-world.

When integrating structures, a magnitude of maxima of intensity of processes occurring in them must be in an appropriate way matched with their distance from a center. Three structures having equal maxima of intensity (levels of development), when integrating, settle themselves in apexes of an equilateral triangle. If one of these structures is more developed, the equilateral triangle turns into an isosceles one: bigger intensity of burning is "compensated" by its bigger distance from a center of symmetry. But there is no continuity in such a mechanism of "compensation", i.e. a majority of intermediate states are unstable and only selected, definite configurations of structures are metastable. The compensation of a magnitude of a maximum by its bigger distance from the center of symmetry of a complex structure "works" in a discrete, quantized field of possibilities of integration.

When maxima of intensity increase, a distance between them decreases ((the model of "converging waves of burning" is developed and studied by our scientific school), and, on the contrary, when they decrease, the distance increases. One can integrate structures with different powers of intensity by arranging them at different distances from the center and by observing certain forms of organization.

The factor of unification of parts into a whole structure is chaos, dissipation, fluctuations or—for social structures—their analogue (exchange processes of various kinds). Chaos plays a constructive role not only in the moments of choosing a further evolutionary path, but also in the processes of assembling a complex evolutionary whole. Chaos leads to the establishment of coherence of development in all parts (substructures). To put it figuratively, chaos serves as a "glue" that binds parts into a united whole.

If a complex structure is organized from more simple ones in a right topological way (that is, if there are a certain degree of interaction and overlapping of substructures and a certain symmetry of "architecture" of an emerging united structure), the united structure finds itself on a higher level of hierarchical organization, i.e. a step towards a superorganization is taken. Thereby, the rate of development of structures, which are integrated into a complex one, is being picked up. The rapidly developing structures "pull to themselves" by their tempo of life the slowly developing structures. In case of right unification, a ratio of maxima of more developed structures to maxima of less developed ones remain constant, i.e. small, underdeveloped structures don't fall out into another tempo-world, they don't become a simple background for development of structures with bigger maxima, there is no decay of tempo-worlds.

Besides, if an evolutionary whole is organized in a right topological way, the whole begins to develop at a rapid pace, which is higher than there was a pace of the most rapid developing structure before the unification.

The path of unity and of integration of different parts into entire structures is not steady, permanent and monodirectoral. The evolutionary ascent towards more are more complex forms and structures passes through a number of cycles of decay and integration, of tearing off from the whole and inclusion in it, the slowdown of the processes and their acceleration.

From the theory of self-organization it follows that any open systems with strong nonlinearity are most likely to pulse. They have natural cycles of development: the stages of differentiation of parts alternate with the stages of their integration, scattering alternates with rapprochement, the weakening of bonds changes into their strengthening. The world seems to go towards a universal unity, a super organism. But it moves forward not monotonously but through certain fluctuations and pulsation. The stages of decay, even if partial, are followed by stages of more and more powerful unifications of structures. This modern scientific notion of complexity reminds us of the eastern images of "rhythms of life" that are peculiar to our world, first of all, of the Chinese symbol Yin-Yang.

The cycles of increase and decrease of the intensity of processes, of decay and unifications of parts indicate regularity of nonlinear processes; the cycles are determined by the very nature of nonlinear processes. Any complex structures at the moment of maximum of accretion, or at the culmination of development (at the moment of peaking of processes), are subjected to the inner instability with respect to small perturbations, they are under the threat of decay.

The history of mankind testifies that the world empires increased in size and became stronger to the maximum extent and in the end they came asunder, sometimes disap-

peared completely without leaving a trace. But if the beginning of decay of some geopolitical system is observed, it is reasonable, from the synergetic point of view, to put a question: is the nonlinearity of the system sufficient to turn the evolutionary processes back, to switch them to another regime of the renewal of bonds, the attenuation of processes in the central domain and their stirring at the periphery of the structure? If the nonlinearity isn't sufficient, then the former intensive processes may simply be extinguished and come to naught.

Thus, the fundamental principle of behavior of complex nonlinear systems is the periodical alternation of stages of evolution and involution, the unrolling and the rolling, the explosion of activity, the increase of intensity of processes and their fading, weakening, the converging to the center, the integration and the disintegration, at least the partial decay. There are profound analogies here to the historical testimonies of the downfall of civilizations and the break-up of great world empires, to the cycles of N.D. Kondratieff, the oscillatory regimes of J.K. Galbraith, the ethnogenetic rhythms of L.N. Gumilioff.

At the initial stage of formation of a complex structure, its right topological organization is of great importance. When the process of integration occurs, the structures aren't simply put together, they don't simply become parts of the whole in an unaltered, undistorted form. They become somehow transformed; they form strata on each other and intersect, and at the same time some of their parts fall out. As the physicists say in such a case, there exists an overlapping with the energy loss. This signifies that the unification leads to the economy of energy, to the diminution of material expenses and human efforts.

The topologically proper organization of structures in an entire evolutionary structure results in an approach to the moment of peaking, the moment of maximum development. The whole develops faster than its integral parts. It is more profitable to develop together, since the joint, co-evolutionary development is connected with a saving of material (in particular, energetic), spiritual and other resources. Every new way of the topologically proper integration of structures, the appearance of successive layers (with bigger exponent of nonlinearity) of hierarchical organization picks up speed of development of the whole as well as its integral parts. Therefore, the evolutionary path to the building of more and more complex organizations of structures in the world is to a certain extent pre-determined. We should lend our ears to Eliot's advice: "We must be still and still moving / Into another intensity / For a further union, a deeper communication".[15]

The principles of nonlinear synthesis of the simple into the complex may be summarized in the form of the following key notions:

- it is a *common tempo* of development that is a key indicator of connection of structures into a united whole. It is the indicator of what we are dealing with an entire, integrated structure not with a conglomeration of isolated and uncoordinated fragments;
- *non-uniqueness* of ways of assembling of a whole from parts;

15. T.S. Eliot, *Selected Verse*, Moscow, Raduga Publishers, 2000, pp. 260.

- a whole is assembled *not by crumbs but by chunks, by large blocks*, it is assembled not from single elements, for example from atoms, but from intermediate media which are drawn up—in case of progressive evolution—in the form of a hierarchy of media, each of these media having its own, specific exponent of nonlinearity;
- structures-parts enter a whole not in an invariable form, they *are transformed and deformed* in a certain way in accordance with peculiar features of the emerging evolutionary whole;
- in order to build a stable integrated structure, a proper *topology* of connection of structures is important (for instance in case of a structure of burning of a nonlinear dissipative medium, one should observe a right configurational distribution of maxima and minima of intensity of the process of burning of the structure);
- for assemblage of a new complex structure, for re-crystallization of a medium, one need to create situation *"at the edge of chaos"* when small fluctuations are able to initiate a phase transition, to throw down the system in another state, and to set another course to the process of morphogenesis, another way of assembling of the complex whole. "The very nature of co-evolution is to attain this edge of chaos".[16]

A PART OF CHAOS AND A PART OF EXTERNAL MANAGEMENT: A PLACE OF A HUMAN BEING IN THE UNIVERSAL PROCESS OF COEVOLUTION

To ensure a sustainable co-evolutionary process of complex structures and to build a complex evolutionary whole, one must make a selection, to adjust parts to each other, to co-ordinate their tempos of development, to carry out iterations. Such expedients has been used for a long time in technics where variational problems and optimization problems are solved, tolerances are taken into account. And fact of the matter is here not only to tough up the course of assembling of a whole, to control the course of co-evolution, but also to reveal possible variants of building the whole. The experience accumulated by solving technical problems one may try to transfer to super complex systems: to co-evolution of man and nature, co-evolution of different countries and geopolitical regions into a world community.

The most important idea here follows from synergetics: for sustainable development, for dynamically developing process of co-evolution, there must be a certain *part of chaos*, of spontaneity of development and self-management as well as a certain *part of external control* which must be *coordinated* with each other. Both extremes—both pure chaos, merely elemental, market mechanisms of selection and of "survival of the strongest" and total external management, stark control and policy of protectionism with re-

16. S. Kauffman S., At Home in the Universe. The Search for Laws of Self-organization and Complexity, London, Viking, 2005, pp. 29.

spect to elite organizations or structures, state monopoly, etc.—are not unacceptable.

Chaos as a complex interdependence of elements of order and disorder in complex systems of nature, human psyche and society performs a number of functions of no small importance in the processes of self-organization and self-management:

- chaos, small fluctuations are a mechanism of coming out on a tendency of self-structuralization of an open nonlinear medium, on one of a spectrum of potentially possible ones;
- chaos is a way of synchronization of tempos of evolution of subsystems (individual parts) within a complex system and thereby a way of preservation of its integrity;
- poising at the edge of chaos is a way of maintenance of a complex organization (self-organized criticality), a way of building of complex evolutionary landscapes in biology, ecology, economy, culture;[17]
- chaos is a factor of adaptation to changeable conditions of environment, of preparation to different variants of future development;
- the state of chaos, sparseness, diversity of elements is foundation of reaching their unity, organization (unity through diversity as a principle of the theory of systems, order out of chaos /Ilya Prigogine/[18], order from noise /Heinz von Foerster /, organizing chance /Henri Atlan/[19]);
- chaos is a stimulus, a push of evolution, a going out from an evolutionary dead-end, and spontaneity is a kind of their vital gust;
- and, finally, chaos is a factor of renovation of a complex organization.

AN INFLUENCE OF THE FUTURE. TEMPORAL PROPERTIES OF STRUCTURE-ATTRACTORS

It is well known that those who cannot learn lessons from history must go through it again. Of course, the lessons from history underlie our current activities. But it turns out that today's activities are not only determined by the past, but also are built from the future. The present activities should be oriented—consciously or unconsciously—to one of the possible and feasible (in a given social medium) structure-attractors of development.

It is commonly considered that only the present is more or less accessible for us. The future is attainable only through a complicated and hard work on the forecasting and modeling, whereas the past can be understood through a labor-intensive work on the reconstruction and description as well. An estimation of the past or the future are both inevitably connected with a number of inaccuracies and aberrations in our conceptions and interpretations. The approach based on the modern theories of complexity and on synergetics is completely different.

17. Ibidem.

18. I. Prigogine and I. Stengers, *Order out of Chaos. Man's New Dialogue with Nature,* New York, Bantam Books, 1984.

19. H. Atlan, Entre le cristal et la fumée. Essai sur l'organisation du vivant, Paris, Editions du Seuil, 1979.

The very configuration of available complex evolutionary structures is informative. The analysis of well developed, steady stages of evolution, i.e. of evolutionary structure-attractors, allows us to find out some local areas where the processes go on today as they will go on in the whole structure in the future as well as some other local areas where the processes go on today as they were in the past. This surprising peculiarity follows from the fact that the structure-attractors are described by invariant group solutions in which time and space are not independent; on the contrary, they are closely interrelated. So, if we will learn to "read" spatial configurations of evolutionary structures, we will be able to see in them elements of the ready-made (not obtained by the forecasting, but what will be in reality) future and of the real (free from interpretations) past. It seems as if synergetics would give us a key to the time machine, and with the help of it we could get into the true past and the real, not hypothetical future. However, this key is efficient only in skilful hands. Only those who purchase "synergetic glasses" can become prophets.

According to the synergetic models of the Moscow scientific school, there exist two different and complementary regimes in open nonlinear media: HS-mode and LS-mode with peaking. HS-mode is a mode of "infinitely running out wave" when there is no localization, all structures, heterogeneities are being washed away (further investigations showed that in HS-regime which is close to S-regime one can observe non-monotone structures with increasing half-width; localization of processes in the form of structures takes place and the growth of sizes of a complex structure occurs). LS-mode with peaking is a mode of "converging wave of burning", a mode of localization and intensive growth of processes in a more and more narrow area near the maximum. The changing of these regimes takes place in open media (systems) with strong nonlinearity.

In case of increasing of nonlinearity in LS-regime, new solutions appear when a complex structure begins to develop in the regime not simply of oscillation LS $\rightarrow$ HS $\rightarrow$ LS but rather of automodel regime of activity decay and "infinitely propagating wave", i.e. as if in the regime of "rest" and "sleep" of complex organization. Only in case of self-similarity of the mathematical description (automodel functions), a connection between space and time appears. Then the today's processes in the center of this structure become an indicator of how they will proceed in the whole structure in the future. This regime is however unstable. Some cases are possible, when this regime lasts over a quite long period of time, and at that the structure in its center touches an infinitely remote from us (absolute) future of mankind (not $t = t_f$ but $t = \infty$).[20] Such kind of a state seems to be close to the state of a dreamless sleep. This statement is a consequence of analysis of invariant group properties of the "falling" automodel solution.

Secular observations upon the change of states of human being in the universe led the Eastern wise men to the following conclusion: when a man is awake he falls out of the universe, and when he sleeps he is dissolved in it. The greatest mystery of yoga is a dreamless sleep. When a man is asleep and doesn't see any dreams all, activity disappears. It comes back by awakening. What is this interval filled up? The answer to this

20. Knyazeva and Kurdyumov, The Foundations of Synergetics. Blow-up Regimes, Self-organization, Tempo-worlds, pp. 103.

question is treated in Upanishads as a revelation of the greatest mystery.

The dreamless sleep is a peculiar state corresponding to a maximal non-revealing, undercoverness, or a minimum revealing, of properties of the human nature. If the movement in the world usually occurs from the unrevealed to the revealed, an opposite process is possible. As applied to the activity of an individual, it signifies that the maximal manifestation of vital forces in the state of wake should correspond—at another end—to a stage when all forces are collected together, into one and indivisible whole being at rest. The empirical expression of this state is dreamless sleep. It is supposed that, being in this state, a man touches an absolute and perfect future. His connection with the whole, with the One, with the yawning abyss of Non-existence, with the body of God is established. As if a man would be linked up to separate universal connections and events and would be directly regulated by them.

This state is depicted in Kaushitaki Upanishad as follows: "When a man, being thus asleep, sees no dream whatever, he becomes one with that prana alone. Then speech goes to him (when he is absorbed in prana) with all names, the eye with all forms, the ear with all sounds, the mind with all thoughts. And when he awakes, then, as from a burning fire sparks proceed in all directions, thus from that self the pranas (speech, etc.) proceed, each towards its place; from the pranas the gods (Agni, etc.), from the gods the worlds" (Kaushitaki-Upanishad).[21] Being in this state, a man interflows inside himself, is identified with the state of infinitely remote future of organization of the universe. It seems that a certain harmonization, a revise of current processes with a purpose, with the "future order" takes place.

But this is not a fantasy. This is a consequence of analysis of the mathematical models of complex evolutionary behavior. An automodel variable ξ is described by the following formula:

$$\xi = x / a t^n ,$$

where x is spatial variable, t is time variable. The processes in the center of a structure correspond to $x = 0$ ($\xi = 0$) if t is finite or $\xi = 0$ when $t \to \infty$.

In principle, a possibility of such a state exists for everybody (when, at the time of a profound sleep, the cooling of body occurs, the slowing down of all processes running in the organism take place), but a long stay in this state is possible only for some people. This is a rational explanation of the irrational.

Thus, the applied approach allows us to see real features of the future organization, even of a remote future organization, by analyzing the present spatial configuration of complex evolving structures in a certain type of fast evolutionary regimes.

COEVOLUTION, COLLABORATION, PARTICIPATION

The world remains indefinite for us, it is filled with mysteries. One of the greatest from

21. Kaushitaki-Upanishad. http://av.rds.yahoo.com/_ylt=A9ibyJ6HaARDRPMA.1trCqMX;_ylu=X3oDMTBvd…p://www.tantra.co.nz/tantrahome/spirituallibrary/kaushitakiupani.htm

them, which is still far from being revealed, is a mystery of a human being, his complexity and nonlinearity. This is the mystery of his sleeps and dreams which were called by "The Bible of a savage"[22] by Lucien Levy-Bruhl as well as the mystery of this peculiar state—the dreamless sleep when a man returns to a united source, to a fore-medium, in which all is already available in an implicit form, or, on the contrary, sticks to a super-organization, glance at the infinitely remote future and, perhaps, this experience rebuilds somehow his psyche.

In order to efficiently act in the uncertain, complex and unstable world, it is necessary to take into account the context—the nearest and sufficiently wide one—of phenomena and events under consideration, i.e. to know how to contextualize our knowledge. Speaking about the necessity of change of guiding lines of thinking and about the vital reform of a system of education, Edgar Morin notes: "Cognition of the world as an integrated world becomes both intellectual and life necessity … Cognition of isolated and disconnected informational data is not sufficient. One needs to arrange these data in a corresponding context in which they make sense".[23]

One should develop a holistic vision. "Think globally in order to efficiently act locally"—this is a slogan of the present time. One needs to understand ways of integration and mutually coordinated and harmonious development of various complex structures in the world.

Co-evolution is not simply a process of adjustment of parts to each other by formatting a complex whole, of their resonant positional relationship and of synchronization of tempos of development, but it is enactive cognition of the world by a human being, synergism of cognizing and constructing subject and of a medium surrounding him. This is also an interactive connection between human organizations and single individuals, the universal collaboration, complicity and solidarity, concerted efforts in construction and rebuilding of the world, and thereby of one's own mentality. This is disclosure of universal affinity of all with everything and of mysterious connection between the past, the present and the future.

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22. L. Levy-Bruhl, Primitive Mentality, Ams Publishers, 1975.
23. E. Morin, Les sept savoir nécessaires à l'éducation du futur, Paris, UNESCO, 1999, pp. 15.