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Non-anonymous, Collective Territoriality in a Fish, the Moorish Idol (Zanclus cornutus): Agonistic and Appeasement Behaviours. Unpublished manuscript by Konrad Lorenz from February 1979

Teleosemantics and the Critique of Adaptationism

The Synergetic View of Human Creativity

On Natural Selection and Hume's Second Problem

Man's Special Position in Nature. The Relationship between Biological and Cultural Development

Evolution, Categorization and Values

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The Synergetic View of Human Creativity

Abstract

The heuristic value of synergetic models of evolving and self-organizing complex systems as well as their application to epistemological problems is shown in this paper. Nonlinear synergetic models turn out to be fruitful in comprehending epistemological problems such as the nature of human creativity, the functioning of human intuition and imagination, the historical development of science and culture. In the light of synergetics creative thinking can be viewed as a self-organization and self-completion of images and thoughts, filling up gaps in the nets of knowledge. Insight, fast and sudden solutions of scientific problems, instabilities when "an idea is in the air" are considered as examples of blow-up regimes in the cognitive field.

Key words

Attractors, blow-up regime, complexity, creativity, discovery, evolutionary epistemology, mind, nonlinearity, self-organization, synergetics, topology.

Synergetics as a promising research program

Synergetics, or the theory of self-organization and evolution, which originated mainly in the natural sciences (nonlinear mathematical analysis, nonequilibrium thermodynamics, the theory of deterministic chaos and fractal research), is increasingly demonstrating its usefulness in analyzing cognitive and cultural processes in humans. Synergetics is fruitful in unravelling some mysteries of the human consciousness and human psychology. The philosophical content of the synergetic concepts and ideas is rather rich. It 's reasonable to make an attempt to build synergetics into "the body of culture" carrying out a comparative analysis of the synergetic notions and historical and cultural images. The theory of self-organization is a new interdisciplinary (or multidisciplinary) trend of scientific research. It is the theory that mostly determines a character of the modern post-nonclassical stage of development of science. The rapid development of the theory is connected with the names of such scholars, as HAKEN (1978, 1996), PRIGOGINE (PRIGOGINE/STENGERS 1984), KURDYUMOV (1989, 1990), LASZLO (1995), MANDELBROT (1982), MORIN (1992), VARELA (MATURANA/VARELA 1988).

Within the framework of synergetics, some laws of evolution and self-organization of complex systems are in the process of investigation now. The theory might be used as a general methodological tool, since it is oriented towards the search for common patterns of evolution of complex systems of any kind, regardless of concrete nature of their elements or subsystems. The synergetic models can be applied to understand human cognitive and cultural activities as well as the management of complex sociocultural systems (KNYAZEVA 1998).

Synergetics can be considered as one of the modern, most promising research programs. The development of synergetics entails deep changes in the conceptual net through which we comprehend the world. A new synergetic worldview is in the process of formation. It means a shift of paradigm, a radical conceptual transition from being to becoming, from stability to sustainability, from images of order to chaos generating new ordered evolving structures, from self-maintaining systems to fast evolution through a nonlinear positive feedback, from evolution to coevolution, reciprocal evolution of different complex systems. The new synergetic style of thinking is evolutionary nonlinear and holistic. This is a modern stage of development within the traditions of cybernetics and the general theory of systems. However, many elements of the latter have undergone important changes since their appearance.

Synergetics is a multi-faceted phenomenon in modern science. The epistemological dimension of synergetics constitutes the synergetics of cognition, the application of evolutionary nonlinear, syner getic models to the comprehension of the human

cognitive and creative processes. The investigations fall into the frames of Evolutionary Epistemology (EE) (RIEDL/DELPOS 1996; OESER 1988, 1996; VOLLMER 1984, 1994; WUKETITS 1991).

Two different research programs have been distinguished in EE (OESER 1996, p16–17; WUKETITS 1991). The first program includes the investigation of the human cognitive capacities as products of biological evolution. The second program has an aim to explain the development of science in structural analogy to biological evolution. The application of synergetics to epistemology is relevant to the second research program "evolutionary theory of science", but our current attention in the light of synergetics is focused mostly on the individual level of the scientific knowledge development.

Models which are derived from evolutionary biology are still being widely used in evolutionary epistemology. Synergetics elaborates more profound and fundamental evolutionary models which are based on interdisciplinary knowledge. The application of such models might open up new perspectives of research in the field of evolutionary epistemology.

Several metaphorical notions or thought-images, could be verbalized within a synergetic approach in relation to human beings. These are as follows:

- patterns of self-organization and geometries of human behavior;
- fractal pictures of historical events;
- individual (or sociocultural) mental landscapes, in which yesterday–today–tomorrow are simultaneously and totally available;
- situations "here and now" as those places where an unknown past meets an emergent future;
- cognitive maps of human mind and human action;
- distribution and topological configuration of already occupied social niches in the collective social activities;
- pictures of "thickening of innovations" in culture (the splash of talented people) and "rarefying of innovations".

It seems that the images originating from synergetics could become points of knowledge growth in the humanities.

Basic model and its methodological consequences

The methodological consequences presented here are based on the analysis of the results of mathematical modeling and computational experiments with the evolutionary processes in open nonlinear media (or systems), conducted by the Moscow Synergetic School at the Keldysh Institute of Applied Mathematics (Russian Academy of Sciences) headed by Sergei P. KURDYUMOV and at the Institute of Mathematical Modeling (RAS) led by Alexander A. SAMARSKII. A number of these results have been obtained and proven in form of mathematical theorems. Therefore, the new synergetic notions and their applications to epistemology have a solid foundation in the mathematical developments.

The synergetic models of burning and heat conduction (diffusion) processes are the most widely used models claiming to be capable of explaining many paradoxical features of self-organization. The process of self-organization is mainly connected with the appearance of localized (despite heat conduction) sources of burning (chemical reactions): dissipative structures arise on an active (burning) medium. Self-organizing structures of burning serve as one of paradigmatic examples of synergetics.

The scholars of the Keldysh Institute of Applied Mathematics and of the Institute of Mathematical Modeling (both of the Russian Academy of Sciences) managed to discover mechanisms of localization, structure-formation in open nonlinear media (systems) and their evolution (reconstruction, integration and disintegration) (see ACHROMEEVA et al. 1989; KURDYUMOV 1990; SAMARSKII et al. 1995 for more details). The internal mechanism of the structures generation is an interplay between two opposite factors in a medium: a nonlinear source and a dissipative factor. On one hand, the work of a nonlinear source leads to creation of inhomogeneities in a continuous medium. The nonlinear source can be of a different kind: source of energy, information or infection. It can be an active medium in the nuclear reactor which generates an avalanche flow of neutrons, or it can be a source of knowledge (for instance, an influential scientific school which creates new knowledge spreading over the scientific community) or a center of infectious diseases. Nonlinearity means the following property of the source: the more is a deviance from equilibrium, the faster the process goes. You may imagine how a skier is going downhill and the hill is becoming more and more steep. Moreover, it may be a distributed nonlinear source which acts in every local area of an open medium (complex system) and produces self-stimulating growth all over the space of the medium (system).

On the other hand, there is the factor which dissipates, scatters about inhomogeneities in the medium. It can be of various nature as well: diffusion, dispersion, hydrodynamics, etc. It can be diffusion

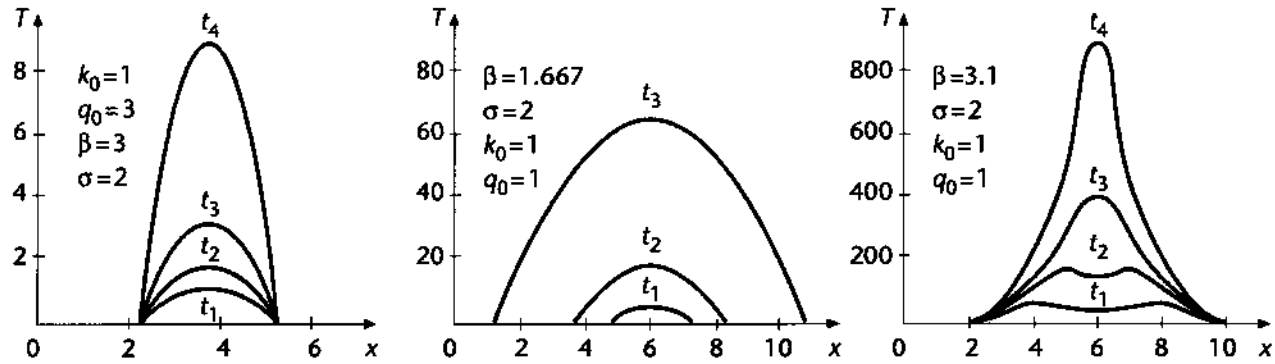

Figure 1: S-Regime (left), HS-regime (middle), and LS-regime (right).

of neutrons, or diffusion (dissemination) of knowledge, or diffusion (spreading) of infectious diseases.

The basic model used is as follows:

$$\frac{\partial T}{\partial t} = \frac{\partial}{\partial x}\left(k_0 T^{\sigma}\frac{\partial T}{\partial x}\right) + q_0 T^{\beta}$$

where $\sigma > 0$, $\beta > 1$, $\tau > 0$, $-\infty < x < +\infty$.

σ is coefficient of nonlinearity of diffusion in the equation. It is indicator of dissipative processes of different kinds. β is coefficient of nonlinearity of a source. It shows a strength of factor which creates inhomogeneities in a corresponding continuous medium.

Depending on a result of competition of these two complementary factors, three various regimes of the processes development can be established in a corresponding open nonlinear medium (system; see figure 1).

If $\beta = \sigma + 1$, i.e. a work of nonlinear source is in conformity with dissipative processes in a medium, the process will develop in S-regime.

This is a mode of the process development with peaking when the process becomes localized and develops with peaking inside a certain area, the fundamental length L_s. It is a kind of "standing wave" of burning.

If β is less than $\sigma + 1$, i.e. intensity of dissipative, scattering processes is more than the strength of nonlinear source, HS-regime of evolution will be established. This is a type of the process development in an open nonlinear medium when there is no localization (localized structures), all heterogenelties are washed away. The evolutionary regime is a "wave of burning" which infinitely spreads over the space. It is a "diverging and growing wave of burning".

If β is more than $\sigma + 1$, i.e. the factor creating heterogeneities in a medium (work of nonlinear source) is considerably stronger than the dissipative, scattering factor, evolution occurs in LS-regime. This is a certain type of the process development with peaking in an open nonlinear medium when the increasingly intensive development of a process occurs in a more and more narrow area near a maximum. In this case we observe a "converging and growing wave of burning": the process develops very fast, while its effective area of localization diminishes.

The main feature of the LS-regime is that it develops slower than the S-regime. The feature is reflected in its name: "L" means "lower" than the S-mode. On the contrary, "H" in the name of the HS-regime means "higher" than the S-mode.

The third case is the most interesting. The above mentioned nonlinear equation has here a set of qualitatively different solutions, i.e. eigenfunctions of different complexity. Their number is described by a simple formula:

$$N = \frac{\beta - \sigma}{\beta - \sigma - 1}$$

The set is defined only by inner properties of a corresponding medium and can be considered as a mathematical representation of a spectrum of possible evolutionary paths (structure–attractors) of the medium. If we consider our paradigmatic example of self-organizing structures of burning, we have a spectrum of different forms of localized burning, so to say "crystals of burning". The phenomenon has been investigated by the Moscow synergetic school and is termed an "inertia of heat" ("inertia of burning") (ACHROMEEVA et el. 1989).

A number of general and important consequences can be derived from the model (KNYAZEVA/KURDYUMOV 1994). This quite simple mathematical model is very profound. It reflects and describes some general features in the behavior of complex systems: an interplay of two complementary factors

in the systems and ways of localization of processes, structures construction in them.

First. Synergetics discovers laws and conditions for very fast, avalanche-like processes, blow-up regimes. The above described S-, HS- and LS-modes are main kinds of blow-up regimes. These are processes when some characteristic parameters (temperature, energy, information etc.) infinitely grow during a finite period of time. $Q(t) \to \infty$, when $t \to t_f$. t_f is the blow-up time, time of peaking. Of course, the infinite growth is impossible in real systems of the world. But the rapid growth of the characteristic values in several orders, sometimes even in several times, allows to observe a number of astonishing effects which have been predicted by the theory of blow-up regimes.

Blow-up regimes are under investigation now in more than sixty different fields of research, starting from plasma physics (laser thermonuclear synthesis) and meteorology (catastrophic phenomena in atmosphere), ecology (rapid growth and sudden dying out of biological population), neurophysiology (the modeling of signal propagation along neural nets) and epidemiology (spreading of infections). There are similar blow-up regimes in human psychology, social and cultural development. The growth of information and the population on the Earth proceed according to hyperbolic rather than exponential law, i.e. the processes occur in blow-up regimes.

It is important to understand how we can initiate such processes in open nonlinear systems, for instance on the field of human brain and consciousness, and what are requirements for avoiding the probabilistic decay of developed complicated structures near the moment of their maximal growth (moment of peaking).

Second. Synergetics reveals the creative role of chaos in the evolutionary processes of nonlinear complex systems. There must be a certain degree of chaos and destruction in the world. Small fluctuations, i.e.chaos on the micro-level of a complex system play an essential role in determining actual trends ("aims") of processes which occur on a macro-level of the system. Chaos is a mechanism underlying the choice of one evolutionary stabile structure-attractors. The macro-organization emerges from a disorder,from chaos on micro-level.

Dissipative processes, being a macroscopic manifestation of micro-chaos, constitute a necessary complementary factor in our model of structure–formation in open nonlinear media. Dissipation acts in the same way as a sculptor, who chisels and shapes a statue from a block of marble.

Order and chaos, organization and disorganization, constructive force (a nonlinear source) and dissipation seem to be well-balanced in the world.

Thus, it is senseless to resist chaos, or to strive for complete eliminating undesirable, chaotic elements from the world. They are necessary conditions for self-organization.

Besides, chaos serves as a basis for integration of relatively simple evolutionary structures into more complex ones. It is a mechanism for coordinating their tempos of evolution. Chaos, fluctuations on micro-level, can also be a way of evolutionary switching, making a transition from one evolutionary regime to another one possible.

Third. The evolution of complex structures undergoes an alternation of various regimes of process development. There can not be sharp growth of a structure without a threat of its fall and destruction. There are some universal laws which govern these rhythms. They are peculiar to living beings as well as to complex structures in inanimate nature. There are cyclical changes of state: upsurge – slump – stagnation – upsurge – slump, etc. Only obeying these "life rhythms", or oscillatory modes, complex systems can maintain their integrity and develop dynamically.

The synergetic models used here allow to describe such mechanism of self-maintenance peculiar to complex structures. In addition to the HS-mode with peaking, there is a HS-regime of "cooling" with decreasing intensity of the processes and infinitely scattering wave. For open media (systems) with strong nonlinearity, periodic change of two opposite regimes, the LS-mode with peaking and the HS-mode of "cooling" takes place with high probability.

Thus, under certain conditions a mode of localization and structure–formation, i.e. the LS-regime, is established in an open nonlinear medium. The mode keeps chaos in a definite form. But developed localized structures turn out to be unstable with regard to chaotic disturbances, fluctuations on a micro-level. The fluctuations destroy an available synchronization of speeds in different fragments of a complex structure, and the structure comes to be in danger of a decay. There is a possibility to avoid the process of decay, if a change-over to an opposite evolutionary regime occurs in good time. This is the HS-regime of "cooling" and diverging wave, a renewal of some old tracks. The mechanism of auto-oscillations between these two complimentary regimes (HS- $\leftrightarrow$ LS-) resembles the oriental image of Yin–Yang.

Fourth. One of the most astonishing consequences of synergetics is the notion of discrete spectrum of evolutionary paths. If we choose an arbitrary path of evolution, we have to be aware that this particular option may not be feasible in a given complex system. Only a definite set of evolutionary pathways is "allowed"; only certain kinds evolutionary structure–attractors can emerge. This is a kind of evolutionary prohibition rules (KNYAZEVA/HAKEN 1997).

According to our models, localized meta-stable structures arise in the LS-regime with peaking. The estimated number of possible structures can be quite large, but it is limited. The spectrum of possible structure–attractors is by no means a continuous one. The spectrum corresponds to a set of eigenfunctions of nonlinear equation describing the evolutionary processes in a certain complex system.

Here the question of pre-determination of evolutionary processes arises. Although the future states of complex systems actually escape our control and prediction, and the future is open, not unequivocal, there are definite spectra of "purposes" of development, i.e. of evolutionary structure–attractors, in open nonlinear systems. There is, so to speak, a "tacit knowledge" on the part of complex system themselves, because these spectra are determined exclusively by inner properties of the systems.

Thus, the future is open in form of spectra of predetermined possibilities.

The evolutionary structure–attractors as possible forms of future organization determine the course of historical events. The future is in some sense available in the present. Patterns precede processes. They can be interpreted as a "memory of the future". All the attempts that go beyond one of possible basins of attraction are futile attempts. Everything which is not in accordance with the structure–attractors will be wiped out, annihilated. For example, a human can fight unconsciously against those forces (some latent attitudes and plans as structure–attractors) that "pull him" from the future, but all these attempts are doomed to failure.

Fifth. Further consequences of the synergetic models under consideration include some new principles which govern the emergence of complex evolutionary totalities from simpler elements. A complex structure is an integration of structures of "different ages", that is: structures at different evolutionary stages. The principles which govern the integration of such structures of "different ages" are gradually being revealed. The integration of relatively 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". The term "tempo-world" proposed here signifies "a world having a certain rate (tempo) of development". The rate of development is the most important characteristic in the process of assembling of a complex evolutionary whole.

Sixth. Due to synergetics we acquire knowledge how it is possible to multiply reduce time and efforts in order to generate, by a resonant influence, the desirable and, what is no less important, feasible structures in a given complex system. It proves that managing influences must not be energetic, but rightly topologically organized. Weak, but proper, so called resonant, influences upon complex systems are of great efficiency.

This feature of complex organizations had been guessed thousands years ago by the father of Taoism, LAO-TSU. It was expressed as the weak defeats the strong, the soft defeats the hard, the low defeats the loud. Considered from the modern point of view, complex systems turn to possess a property of selective topological sensitivity. They demonstrate unexpected strong replies to excitations which are relevant to their inner structural organizations, i.e. to resonant excitations.

The creative mind from the synergetic point of view

The task of applying synergetic models for a better understanding of cognitive evolution and the growth of scientific knowledge is part of the problems raised by evolutionary epistemology. There are only few publications devoted to the subject so far. E.g. the works of HAKEN (1996), HAKEN/STADLER (1990), KRIZ (1997), VOLLMER (1984).

To consider the creative mind from the synergetic point of view is a challenging, but difficult task. As HAKEN puts it, "Creativity appears to be the deepest of all puzzles concerning the brain. It means the birth of thoughts that have never been generated before and, in particular, whose generation was extremely unlikely. One may compare the creation of a new idea to a jigsaw puzzle" (HAKEN 1996, p304–305).

The application of synergetics to the human cognitive processes is currently under discussion. Synergetics can be applied, because it is oriented to the revelation of the universal patterns of evolution and self-organization of complex systems of any kind.

Synergetics tries to construct certain bridges between inanimate and animate nature, between the quasi-purposes of natural systems and human rationality, between the birth of something new in nature, the so called "creativity of nature", and the creative and imaginative capabilities of a human being.

There is a complex mutual connection of conscious and unconscious processes, purposeful and spontaneous ones, the processes of organization and self-organization in human mind. Cognitive activities can contain synergetic mechanisms, which occur regardless of the scientists' intentions and free creative aspirations. The mechanisms concern these processes which are realized, so to say, "above the creating minds".

In relation to the development of scientific knowledge and creative processes on the individual level, it is reasonable to search the synergetic mechanisms in those processes which are not under the control of consciousness, which occur on both subconscious and unconscious levels. If we consider the growth of knowledge on the level of collective activity of the scientific community, the mechanisms of self-organization are connected with some unpredictable consequences of the scientists creative work as well as with the integration of the actions of individual scientists into general trends of scientific research. To underline the relevance of the synergetic approach to the evolution of scientific knowledge three arguments ahould be noted. These are as follows:

- first, the role of the cooperative, coherent effects in science (for instance, an appearance of a new scientific paradigm is connected with the establishment of some coherent, synergetic patterns of behavior),
- second, the fruitfulness of the approach developed by post-structuralists (LYOTARD, DELEUZE, DERRIDA, KRISTEVA),
- third, the long approbation and the constructive value of information theory. Formation of structures of scientific knowledge can be described in terms of the theory.

In the light of synergetics, some peculiarities of cognitive and creative activities can be reinterpreted and seen in an unusual way. The alternative ways and the scenarios of creative thinking, the latent attitudes and pre-determinations, self-completion of the whole images, deliverance from gaps in available nets of knowledge are the most important of these prculiarities. In this connection, it's worth to compare the functioning of human intuition with meditation in yoga and Buddhism. Here a number of new heuristic images could be proposed and investigated, namely:

- how to erase the old traces of memory and to make room for something new;
- consciousness as a treasure-house carrying in itself traces of the past activities and complete images of the future;
- an hierarchy of subconsciousness – consciousness – super-consciousness as a connection of different tempo-worlds (these are worlds developing with different rates);
- the rhythms of the creative activities which are similar to the Yin–Yang rhythms of the universe;
- a peculiar state of a meditating man, i.e. human being as a device extremely sensitive to all happening in the universe, a kind of resonance of a meditating mind with universe;
- a danger of splitting of the human consciousness due to the construction of a super-complex structure on a field of consciousness–unconsciousness during the meditation experiments;
- ways of starting the "adventures of consciousness", facilitating the intuitive activity by the topologically rightly organized influences upon the human brain and mind.

The functioning of creative intuition and imagination in general can be considered in the light of synergetics as a process of self-organization and of self-completion of visual and mental images, ideas, notions, and thoughts. The term of "self-organization" means here a *spontaneous* (accidental, unpredictable) *growth* of structures of new knowledge as well as their *own growth* which is determined by inherent laws. The self-completion of visual images and ideas is the filling up gaps in the nets of knowledge and the self-construction of a whole from parts.

Cognitive chaos, in the sense of an openness to multiple alternatives, plays a positive, stimulating role in creative thinking. At the initial stage of creative intuition, a maximal widening of the creative field takes place. The maximally possible variety of elements of knowledge seems to be embraced. Besides, the proper balancing of the main and the subordinate, the essential and the non-essential, that is the radical revaluation of all cognitive values in front of the creative aims (they may be conceivable in a more or less degree) is the base for productive choice of an idea. The initial wandering over a net of mental steps serves as a good preparation to the innovative leap of thoughts.

The notion of evolutionary attractors which determine the trends of development of available knowledge is of great importance for the explana-

tion of the mechanisms for creative thinking. If a system falls into the cone of certain attractor, it will inevitably evolve towards this relatively stable state.

The central thesis can be formulated in the form of a paradox: new knowledge is emergent, it is not derivable from the elements of the available conscious knowledge, and at the same time the knowledge is latently pre-determined in the present elements. The translation of knowledge from the potential to the actual is non-trivial and means the event of discovery. The appearance of a specific creative state—an inspiration—means, from the synergetic point of view, hitting the field of one of the creative attractors. The notions in their essential features concur with the notion of attitude in Gestalt–psychology, namely: anticipation, determining tendency, latent attitude, organizing principle, gradient of purpose, etc.

The mechanism of self-organization and self-completion of the visual and mental images includes, first, the purposefulness to an emerging whole. Of course, there is no certain image of the whole, but only a direction to the whole. The attitude (a plan, a main idea or a conjecture) serves as a "guiding thread" of the search. This is an attractor for creative activities.

Second, the selection, the cutting off "all that is unnecessary" takes place on the basis of the initial increase of variety, the revaluation of cognitive values. The latent attitudes taking a selective role. The mechanism of creative thinking is not an accidental sorting of variants.

It is a choice of the main element in order to organize a whole structure. The self-organization occurs around a key element. The intellectual creative work as well as creative writing are connected with the pitiless exclusion of many ideas and images which were admitted a little bit earlier during the stage of cognitive chaos.

Third, the mechanism of self-organization in creative thinking can be presented as a process of filling up gaps in the nets of knowledge, a self-completion of ideas and a self-assembly of a complete image. Not simply the instantaneous organization of a whole structure takes place, as it was assumed by Gestalt-psychologists. According to the synergetic models, creative thinking is the growth of a whole from its parts as a result of spontaneous and intrinsic complication of the parts. The flow of thoughts and images becomes complicated because this is a way of realisation of ist inner potentials. The flow builds itself spontaneously. Fourth, the scientific discovery might be interpreted as a reorganization within a field of questions. It might be seen as a crystallization of knowledge, an transition to a new structure. A successful creative work in science often leads to whole series of new knowledge crystallizations. This process to a great extent is irreversible. Discoveries influence their creator, they transform his personality. A multitude of talent crystallizations may occur in the individual life of a truly creative scholar.

Blow-up in the cognitive field

Insight. Fast and sudden solution of a problem. Insight, i.e. very rapid and sudden finding of ways how to solve a problem, is one of the most astonishing events in human creative activities.

Insight is still hardly explainable by pure logical means. A huge concentration of cognitive activities serves as a prerequisite, a necessary, but not sufficient, pre-condition for unexpected flashes of insight. A similar concentration, a kind of tightening into a point, constitutes a due stage of meditation in practice of yoga as well as of CHAN and ZEN Buddhism.

Here one could try to apply the synergetic model of the LS-regime with peaking. A localized meta-stable dissipative structure converges to a center in the regime. In addition, the structure develops tremendously fast when it reaches a blow-up point. Near the blow-up moment, changes occur only in a narrow area around a center of the structure. The main fragments of the structure are already stopped, "frozen" processes which, in a sense, have fallen into the past. A final architecture of the structure includes these "frozen pieces" of the past as well as the squeezed, swiftly completing (near the blow-up point) future. Insight really means an innovative crystallization of knowledge as well as a breakthrough into the future.

A culminating moment of insight—an enlightenment, or an Aha-experience—looks as the most mysterious one. In our mathematical model, there is an infinite growth of function near the blow-up point.

There is a special condition for establishing the LS-regime in an open nonlinear media: a nonlinear source should act more intensive than a dissipative, scattering factor. In order to stimulate the work of intuition and to create conditions for insight flashes, a human has to concentrate his own energy. He has to organize such a blow-up regime, when the inner sources of energy are stronger than factors of distraction, scattering and dissipative flows of an ordinary way of life.

As a result of intensive mental activity a highly complicated structure of the LS-regimes, probably with a number of different maxima of intensity, may develop in a field of consciousness–subconsciousness. The structure becomes unstable near the blow-up point and is exposed to danger of decay.

A breach of synchronization between different fragments of the complicated structure (different maxima of intensity of the processes) may lead to the rupture of interactions between them. The extremely complicated structure developed in the hierarchical field of consciousness may disintegrate into a number of separate and isolated consciousnesses.

In this connection it's worth to remember repeated warnings in the Eastern studies that one should be occupied with meditation only under the supervision and observation of a teacher, Guru, and that it is dangerous to follow this path of meditation completely independent, especially for the first time. What was the sense of these warnings? Was it, perhaps, a conjecture about the danger of disintegration of the complex structure in the field of consciousness? Was it the threat of its splitting? Some scientists who investigate human creative abilities actually argue that genius people often have various mental diseases, including schizophrenia (literally means from Greek "to split the mind"). They try to find schizophrenic deviations in EINSTEIN's activity and draw up whole lists of geniuses who supposedly suffered from mental disorders (DESCARTES, PASCAL, NEWTON, KANT, SCHOPENHAUER, NIETZSCHE, etc.).

According to the modern theory of self-organized criticality which is a special point of interest at the Santa Fe Institute (New Mexico, USA), any complex organization is wise, but very fragile. It is poised on the "edge of chaos" in such a way that the best next step towards its further complication and even improvement may lead to a destructive avalanche (KAUFFMAN 1995, p29). In this sense, a genius who operates with complicated structures of knowledge poises between the wisdom and the madness. The complicated cognitive structures evolve to a dangerous edge of chaos.

Human creativity is subjected to certain rhythms. The break-through to a new and the fast growth of knowledge, the explosion of creative activities usually follow the periods of delay and stopping, the slowing down of processes. According to the synergetic models, the HS-regime of "cooling" and "scattering wave" precedes the LS-regime of localization, the rapid growth and the formation of structures. The experience of thousand years in the study in creativity shows the necessity of the stage of relaxation against the back-cloth of an intensive mental work and the turning to another forms of activities or to the regime of sleep.

Therefore, it is senseless to hasten the events. Until the stage of spreading over the old tracks in the HS-regime, the revival of the processes in subconsciousness and the maturing of hypotheses and ideas have not been passed through, there can be no stage of the LS-regime when the fast formulation and verbalization of something already matured in subconsciousness takes place. Until there was no dipping into a slowed down world of subconsciousness, there will be no active work of consciousness.

Instabilities. The idea is in the air. The situations when "an idea is in the air" happen rather often in science. These situations lead to simultaneous, or parallel, and independent discoveries. The examples of such discoveries are numerous in the history of science. It's well worth mentioning the dispute between NEWTON and LEIBNIZ about the priority of development of mathematical analysis, the simultaneous construction of non-EUCLIDEAN geometry by Russian mathematician LOBACHEVSKY and Hungarian scholar BOLYAI, the parallel developments in special theory of relativity obtained by EINSTEIN, LORENZ and POINCARÉ.

These situations look like it is not people who are looking for ideas, but the ideas themselves are looking for people. The very scientific medium prepares and 'pushes forward' its heroes, because corresponding discoveries are completely matured in its depths.

Such kind of situations were described by DUHEM: "The idea is in the air, carried from one country to another by a gust of wind, and is ready to fertilize any genius who is disposed to welcome it and develop it, as with pollen giving birth to a fruit wherever it meets a ripe calyx. In the course of his studies, the historian of the sciences constantly has opportunities to observe this simultaneous emergence of the same doctrine in countries far from one another, but no matter how frequently this phenomenon occurs, he can never contemplate it without astonishment" (DUHEM 1991, p255). He gives an example: "The system of universal gravity germinate in the minds of Hooke, Wren, and Halley at the same time that it was being organized in the mind of NEWTON" (DUHEM 1991, ibid.).

Is there a synergetic analogy of such situations generating discoveries? According to synergetic comprehension of evolutionary processes, "the idea is in the air", "spirit of the times" ("Zeitgeist") and

the other similar clichés are ways of describing a specific state of the scientific medium, or a peculiar mental disposition in the corresponding scientific community. This is the state of instability.

Instability means a high sensitivity of a scientific medium towards small changes and advances in solutions of scientific problems. Synergetics shows that a medium in such a state of instability can (due to a nonlinear positive feedback) repeatedly multiply small fluctuations and perturbations and develop them into some new macroscopic ordered states. In the states of instability, there is a mutual connection of different levels of reality. Depending on the instability of the scientific medium, a certain connection between the level of individual creative activity and scientific discoveries on the one hand, and the level of activity of scientific community and scientific innovations on the other hand, can be established. In such states, small shifts on the individual level may lead to appearance of a new collective cognitive pattern. The very medium in which scientists work in such a state of instability spawns scientific innovations. It is possible to supposedly find even a mathematical equivalent to these situations in the history of science. If β is more than $\sigma + 3$ (the work of nonlinear source in a open medium is essentially stronger than the action of dissipative factor), i.e. there is an idea with very good prospects, a corresponding nonlinear equation has a non-localized solution of falling amplitude. This mathematical solution turns to be unstable to small deviations. A small group of scholars or even a single scientist may drastically change the situation. The level of understanding of a certain scientific problem begins to increase very rapidly. A new trend in science may appear. At the initial stage of the LS-regime with peaking, even some decrease of intensity and some scattering of processes may be observed. But when this scattering wave fills up a whole "effective area of localization", as it should be at the developed stage, the process starts its fast growth.

The situations generating multiple and simultaneous discoveries are sometimes described in a similar way. American psychologists SIMONTON draws the following picture: "Discoveries and inventions become virtually inevitable (1) as prerequisite kinds of knowledge accumulate in man's store; (2) as the attention of sufficient number of investigators is focused on a problem" (SIMONTON 1988, p136).

Boom. Explosion of investigations in a scientific field. An explosion of investigations, or so-called boom of activities, can sometimes be observed in specific fields of science. Synergetics could propose an interpretation of such a phenomenon. There are some reasons to apply the synergetic model of avalanche-like growth, development in LS-regime with peaking. The characteristics of the process seems to be as follows:

- there is very fast increment of knowledge, or rapid rise in the understanding of scientific problems and methods of their solution;
- in spite of an observable increase in the number of scientists and scientific schools involved into investigation of corresponding problems, a certain localization of the process takes place. It means that only few scientific schools or eminent single scholars determine a real level of current research in the field;
- if there is a complicated localized structure with several maxima of intensity of the process (a competition of several scientific schools or scholars in a scientific field subjected to rapid growth), some further development of the process leads to a gradual rapprochement of different leading centers (maxima) within this complex configuration of the engaged scientists. According to our model, we have "many-headed" structure of burning with maxima of intensity drawing closer to one another. A proper interpretation of the feature of avalanche-like processes in application to epistemology could be a subject of further research.

Synergetics as a positive heuristics: how far can we go?

Trying to explain some purely human phenomena, such as human creativity, synergetics challenges the humanities. It leads to a profound question. How could the synergetic intentions to reveal some universal patterns of evolution and self-organization be justified? How is synergetics as a new worldview and a new way of transdisciplinary and cross-professional communication in general possible? Because the theory which explains all explains nothing. Wolfgang PAULI once set for himself a rule: "If theoretician says 'universal' it just means pure nonsense". It can be argued however that synergetics is something more than a kind of intellectual yoga, a kind of sophisticated exercises on the mental field.

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The development of synergetics as a positive heuristics has a profound background. Synergetics has rather good elaborated "hard kernel" in form of already described evolutionary mechanisms of the complex systems. Some results have been proven even as mathematical theorems.

Two fundamental discoveries form the basis of the new theory of self-organization and complexity as well. These are the discovery of strange attractors and the discovery of blow-up regimes. Both of the discoveries have profound philosophical impact. They open a possibility to build a bridge between synergetics, which originated mainly in the natural sciences, and the humanities (cognitive sciences, psychology, epistemology, etc.). Due to the interdisciplinary character of the fundamental discoveries, synergetics moves towards a new dialogue between the natural sciences and the humanities.

Thus, I have tried to show some innovative achievements of synergetics in the field of epistemology. The synergetic models of the evolution of scientific knowledge considered here have, so far, mostly a phenomenological character. But they enable us to comprehend some epistemological problems in a new light and also indicate promising avenues for further research. The synergetic aspect of consideration is an evolutionary nonlinear and integrated, holistic one.

Synergetics does not teach us to be wise, it discloses the evolutionary wisdom of nature. Synergetics is a wisdom of a soft management, management through advices and recommendations, through weak, appropriate influences.

As a matter of fact, it is a self-management and self-control.

Synergetics in general opens the possibility to understand how to imitate nature in solving conflicts, in assembling parts into a whole, in developing from one stage to another. Synergetics uncovers evolutionary, historical strata of wisdom in each of us. It shows that temporal transformations of a structure can be distributed in space.

Synergetics prompts that it's possible to reveal and to put into account still latent, hidden structures in a complex system and that there is, as a rule, a lot of such unrevealed possibilities of evolution and that the path into the future is not pre-determined.

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