

TRUTH AS NONLINEAR PROCESS

Modern changes of the epistemological foundations for nonlinear science are considered. Regarding truth as a process and taking in account that nonlinear dynamics is fundamentally multi-variant; author suggests the understanding of scientific truth as nonlinear process to correspond the specificity of researched processes of self-organization and of self-organizing cognitive processes.

Keywords: truth, process, nonlinearity, epistemology, postnonclassical science, self-organization.

I am going to consider in this paper the changes of context and foundations of knowledge in modern science. I will appeal to gnoseological researches by Pavlo Kopnin, namely, to the studies about truth as a process [6]. I will show that his realistic interpretation of this Hegel's idea [2, c. 216] is especially heuristic for adequate understanding of postnonclassical scientific knowledge in comparison with knowledge of previous stages of New Time science: classical and nonclassical ones. I will reflect on the changes in epistemological foundations of the ideals and norms for scientific researches of postnonclassical science objects: complex nonlinear systems, capable to self-organization.

Academician V.S. Stepin defined the nonlinear science, becoming of which takes place during modern global scientific revolution, as postnonclassical [10]. During this revolution, as well as during previous global scientific revolutions of New Time, related to appearance of classical and nonclassical science, the proper type of scientific rationality were produced. It means that system of foundations of science changes: scientific world picture, ideals and norms of scientific research and philosophical foundations of both. It needs especially to emphasize that classical and nonclassical types of scientific rationality do not disappear after appearance of postnonclassical one. They continue to work successfully in researches of their objects.

Philosophical and methodological researches of postnonclassical science were found out lots about the system of its foundations. So, in particular, by efforts of founders of nonlinear science, the world features were realized from the point of its new nonlinear world picture. I. Prigogine, for example, wrote about complexity, temporality and integrity of both the entire world and its objects, understood as the systems in their becoming [23].

Herman Haken named such becoming of a new whole the self-organization, which is created by co-operative effect of the collective coherent action of many medium elements, subordinated to the parameters of order of this new whole. He gave the name "synergetics" to new scientific trend of researches of self-organization in both natural processes and human activity [18]. In course of time this trend was defined as transdisciplinary, for the reason that synergetic reconstruction of self-organization appeared applicable to the objects of many disciplines.

I will concentrate my attention on inevitable for self-organizing systems existence as the processes. It would seem processes always were the objects of science, at least, in New Time. So, Galileo, unlike Aristotle, applied mathematics for description of mechanical motion. However, consideration of nature as mathematical universe, typical for all previous linear science, determined a search of the law-governed as the steady in the examined processes. This approach can, having processes as an object (not only mechanical motion, and the changes, described by thermodynamics and electrodynamics), concentrate attention on unchanging laws, expressed by mathematical equations, and formulas of their solutions in general form.

So why I. Kant wrote in "Prolegomena", that the object of natural science is nature, as it subordinates to general laws [4, c. 68]. Thus, science had deal, foremost, with a necessity, determining the essence and expressed in laws. Contingency was connected with initial and scope conditions. Consequently, knowledge of essence gave the steady result of cognitive process, even when the objects of cognition were the changes.

Methodologically it was expressed in relations of explanation, prediction and description of scientific facts. Explanation as function of theory had a common logical structure with a prediction and both were the logical conclusions of the explainable phenomenon from the general laws of theory. These conclusions were obtained due to the solution of equations at certain casual conditions that determined the display of unchanging laws. Description of the explainable phenomenon was often preceded to its explanation and was based on other theoretical language, in particular, on language of device theories.

However not any result of cognition can be considered as the knowledge. On Sergiy Krymsky's definition "knowledge is a result of cognition with realization of its truth" [7, c. 33]. Really, even if a result of cognition is not error, the statement which expresses it, if we do not know whether it is true, is not knowledge yet. Many epistemological problems, related to definition of truth, its criteria and methodological problems of verification and falsification of scientific theories are connected with this circumstance.

Not touching these problems for awhile, I will consider the cognitive changes, connected with transition to nonlinear science. These changes are well described by I. Prigogine. He stressed that in area of nonlinear sciences, in addition to regularity, it is needed to take into account the events [9, c. 53–54]. In classic science all events were the display of laws, but Prigogine meant completely other events. The question was about the events of choice between equal, but different possibilities that appeared during becoming and development of the nonlinear system. In theory these events are expressed by the special points of branching in the graphics of solution of nonlinear equations (points of bifurcation in case of two branches). A choice by chance between the variants of development was implicit to such cases. Here we deal with that Hegel named the "real necessity", i.e. "necessity that contains chance" [3, c. 197].

Mathematically the solution of nonlinear equations cannot be got in a general view. Solutions have got by calculable methods, i.e. each time at the defined numeral values of parameters. So, now we do not have a general formula with that we would associate unchanging essence as basis of theoretical explanation.

Solution of nonlinear equation is iteration formula. Some of iterations in description of nonlinear dynamics can be connected with choice by chance in the special points. And as small differences in initial conditions are blown up due to non-linearity, to ignore these differences it is impossible. To avoid them it is also impossible, because they are

provided by quantum fluctuations. Thus, idealization, grounding stability of theoretical result in linear science, in nonlinear science no longer works, and stability, if it is still present on occasion (for example, for limit cycles as steady attractors), in any case is dynamic stability. And as we talk about nonlinear dynamics, sooner or later in its description the events of choice by chance must appear in a point of branching. It means methodologically, that by logical structure explanation coincides with description.

A prediction on the old scheme of exact definiteness of future value of parameters by law no longer exists. A predict function of nonlinear theory realizes itself quite differently: not on determination of effective cause, that is formed in every point of bifurcation and acts as the real necessity, including a chance [15], but rather due to determination by attractor as a special purpose cause in nonlinear medium till it become chaotic [5] and then in determination of results of competition of attractors in dynamic chaos [Paitgen and Richter 1986].

Thus, knowledge about development of nonlinear dynamics fundamentally is a process, because each time when this development takes place even by a well-known formula, it makes happen differently, especially in forming of fractals. These fundamentally complex structures that are formed in the field of competition of attractors in dynamic chaos have a scale invariance or self-similarity [20].

This knowledge turns out by means of computers and often it represents by computer simulation of nonlinear dynamics. Development of nonlinear dynamics on base a certain formula appears very quickly there and allows squeezing information at reproducing of complex images on computer screens. It means the knowledge acquires operative character, because computer imitates the process of calculation that in principle is accessible to the human person, though extraordinarily hard. Such first calculable solutions of nonlinear equations were carried out at the beginning XX of century by Henry Poincare, certainly, without computers.

Such way of knowledge to exist causes some methodological problems, the resolving of that is impossible without the revision of epistemic foundations of methodology. I used to write [17] with reference to M. Mamardashvili [8] about impossibility to save the idealizations of distinction between unchanging essence and the changeable phenomena, that are only appearance of essence which is indifferent to its own appearances. When we regard self-organization as becoming of new whole in a nonlinear medium, we deal with forming not only appearance of essence but becoming of essence itself.

This revision of epistemological foundations is a base for the new understanding of description and explanation procedures in nonlinear science. Here successfully works not consideration of growing knowledge as row of theories, but those methodological models of science development that is elaborated by historical school in methodology of science, in particular methodological model of the research program by I. Lacatos [19]. In a hard core of program there are certain suppositions about nature of the investigated phenomena, and the methodological means of positive and negative heuristic are contained both in a core and in the protective belt of hypotheses.

As I used to demonstrate [17, p. 36], Synergetics could be considered as transdisciplinary scientific program. Here as knowledge it is impossible to regard only synergetic theories of self-organizing processes in different sciences. Knowledge about methodological procedures of subject activity is important also. So, without replacement of the methodological reduction principle by H. Haken's principle of sub-

ordination, the very possibility to understand the cooperative processes of self-organization does not exist at all.

It would seem, to consider all these processes adequately it is enough to accept after Hegel an idea about truth as a process [2, c. 216], to avoid many methodological problems. However, as history of philosophy of science showed, without preliminary rethought in a materialistic or realistic way, application of Hegelian ideas to sciences about nature was not succeeded. And Hegel himself, as it is generally known, did not see a fit such application of dialectics. And not only because, that only spirit is capable to develop, according to his opinion. Eventually, scientific cognitive activity in a sense is also spiritual.

But within the framework of the Hegelian book about a concept despite all its dialectics of absolute and relative in truth as a process, nevertheless there is an absolute idea as last instance and aim of process of cognition, as absolute truth. Consideration of approximation of absolute truth with relatively true knowledge to what researchers are attracted by Hegel, put the truth out of cognition. Successive K. Popper entered for it the special third world of the truths of science [22, p. 439–495]. V. Lenin ignored this problem at all. Pavlo Kopnin commits real break-through to the realistic understanding of truth as a process in that part of epistemology, that he names, on clear ideological reasons, Lenin's theory of truth, but Lenin himself was very far to it.

Unlike the predecessors, Kopnin keeps truth wherein it only can be: not out of cognition, but in its process. Regarding absoluteness and relativity as features of cognitive process, he shows that absolute – what is saved in the process, and relative – that is eliminated from it in course of time. At any moment cognition contains certain unity of absolute and relative. And although with development of cognition absolute is accumulating itself in it, separation of absolute from relative fully is impossible. Principle of concrete truth requires taking into account that those judgments, which could just be corresponding to reality, can become false at the change of circumstances.

A question about authenticity of knowledge decides similarly certainly: justified belief there is knowledge with the certain limits of its applicability. However the comprehension of such limits takes place also in the process of development of cognition: from creation of new theories to finding out the very possibility to clarify the limits. Thus, well-known English physicist Michael Berry reported in Congress on Logic, Methodology and Philosophy of Science in 1991, that for realization of limits between applicability of geometrical and waves optics, it is needed to use nonlinear optics. This example is especially representative, taking into account that geometrical and wave's optics was created in the XVII century, and nonlinear in the XX century, three hundred years later.

Kyiv's epistemological school appears useful for understanding of postnonclassical knowledge. Fundamental feature of such knowledge – existence as a process – does not exclude the consideration of its truth, but on the contrary, assists to it with matching understanding of truth. Though Kopnin's consideration of truth as a process is still linear, this process is opened to future. It makes so the possibility to regard truth as a nonlinear process also. Then theoretic prediction of alternative variants of nonlinear dynamics in special (bifurcation) points we can regard as scientific truth, especially if it includes the knowledge about conditions of realization each of variants or both of them. However, contingency of real choice is impossible to avoid. So, theoretical true knowledge is knowledge of possibilities.

It is typical not only for nonlinear science. Linear statistical laws also connect the sets of possibilities in necessary way. Difference can be clarified by the comparison of rela-

tion between necessity and possibilities in linear and nonlinear theories. Linear statistical laws cover the set of possibilities and possibilities are appearance of necessity. So there is strict prediction of probability as measure of transition of possibilities to actuality. Nonlinear equations have few solutions, at least two. Realization of possibilities originates the new necessities. Both possibilities are equally probable. Knowledge about these possibilities is scientific truth despite of which possibility realizes by chance this or other moment. Such understanding of truth as nonlinear process corresponds to situation in nonlinear science.

Firstly it is because of postnonclassical science has as the object the processes of self-organization with their always real necessity, contained choice by chance. So, theoretic knowledge must reconstruct all variants of nonlinear system behavior in different circumstances. Just such knowledge is capable to work as true prediction of results of human activity in different variants of certain conditions. It means people can act to get the desirable variant of nonlinear dynamics. It sounds closer for providing the base of human freedom by scientific truth, than fatal prediction of linear scientific theories. However, contingent influence by inner or outside "noise" on the choice by chance between opportune and accident possibility is inevitable. So freedom connects with risks, as human experience shows always.

Postnonclassical science is human commensurable, i.e., it is impossible to avoid the participation of humans both in the investigated processes, such as ecologic ones with account of influence of technique, and in postnonclassical researches themselves just because of inevitably great importance of small human influences. That's why V.S. Stepin considers the realization of objectivity for postnonclassical knowledge relative not only to facilities of observation but also to the human values of cognizing subject [11, c. 619–640]. In certain sense the process of cognition itself can become the article of such postnonclassical consideration. Thus modern evolutionary epistemology uses synergetic models regarding an idea as an attractor in the medium of becoming scientific knowledge. Approach of evolutionary epistemology comes from abstracting from the certain subjects of cognition.

But self-organization of postnonclassical knowledge can be considered from other point of view. The question is about self-organization of scientific knowledge in the environment of scientific communication, especially for polydisciplinary scientific societies that are organized to resolve the complex problems. There must be corresponding methodological foundations for such self-organization. These foundations can be originated by such transdisciplinary programs as synergetics. By the base for self-organization of scientists to communicative society can be a scientific world picture with its philosophical grounds and ideals and norms of scientific researches realized on corresponding philosophical foundations.

Examining organization and self-organization of scientific communities, we regard science as the social institute. It would seem, in our time of government orders, research grants and branching network of universities there is no room for self-organization in scientific community. Really, many of that in scientific institutes what was once formed by self-organization, presently are reproducing on the basis of organization. But science as the phenomenon of culture is characterized with permanent tension between science as culture, reproducing the subjects and knowledge, and novelty as specific feature of scientific cognition [8]. So, organizational efforts of scientific managers are constantly complemented by self-organization of scientific community. It is especially obvious for becoming of new paradigm. New ideas quickly become fashionable, and a fashion in any

sphere of life is the phenomenon of self-organization. Efficiency of new ideas becomes basis for self-organization of new scientific association often out of scopes of existent scientific disciplines.

The modern examples of origin of many public organizations of scientists working in the transdisciplinary area of nonlinear science are interesting in this sense, in particular Ukrainian synergetic society. Its members organize the scientific conferences and participate in the scientific conferences of other such national and international scientific associations.

This self-organization, foremost, is the means of conditioning for scientific communication. And already in the communication of different disciplines representatives incorporated in the devotion to the new ideas, there is self-organization of scientific knowledge takes place. I observed sometimes, how during scientific discussions in such associations which are open for the origin of new knowledge, there is birth of new senses. And although such new senses are expressed by certain persons, it is done due to scientific communication. Often scientists, who are lucky to find a new thought, themselves evident about it. That openness to the new that arises up in the group of representatives of different disciplines or subdivisions of the same discipline especially assists to "brain storming". Then various self-understandable is got out from depths of unconscious, being put under a question by rethinking of his grounds, caused by new facts and new ideas. So, self-organization of scientific knowledge connects with self-organization of scientific community.

Prominent Russian mathematician S.P. Kurdyumov and his coauthor, Moscow philosopher H. Knjazeva wrote, concerning such self-organization: "development of science, as well as any other complexity organized system, has nonlinear character. Non-linearity of scientific progress is expressed, in particular, in multi-variant approach and alternativeness of development of scientific knowledge" [5, c. 179].

This multi-variant approach, the branching of cognitive process is in principle assumed by dialectical point of view. But however under influence of classic ideal of rationality, realism, which comes from the presence of the privileged cognitive position ("God's eyes view" [25] presupposes the linearity of scientific progress finally. Indeed, if to accept the correspondent theory of truth, it seems that must be only one variant of knowledge with accordance to reality. Then from many possibilities of development of science must remain only one. So, turning back, we see one line of development, and the fork of possibilities remains for the future. However, such consideration unobvious proceeds from obsolete conception of truth. Realism with a "human face" [25], that takes in account the certain cognitive position of certain subject, opens possibility to confess as true not one, but few variants of scientific development.

Science history knows the great number of synthesis of opposite points of view. Thus, corpuscular and wave approaches to understanding of light, which arose up in times of Newton, after many changes during development of physics were in the end synthesized as unity of discrete and continuous, particles and fields in the central concept of quantum electrodynamics – "quantized field". Y. L. Klimontovich brings other example in his editorial afterwards to Russian translation of Prigogine's book "From Being to Becoming" [23]. The question there is about the way of Boltzmann and way of Poincare in consideration of dynamics of the complex systems. Henry Poincare considered it is necessary to trace the dynamics of motion in all its details. L. Boltzman offered the statistical approach to consider, basing on averages, the systems with many particles. Now these approaches appeared not reciprocally

denying, as seemed before. Watching of nonlinear trajectory of order parameter in dynamic chaos, finally, when a trajectory fills all phase space, replaced with possibility for application of statistical approach and appropriately the probabilistic prediction.

Such examples from history of science, it is possible to increase. But I think that an epistemological problem is clear: how to define truth, to take into account the branching of cognitive process and not lose the relative truths got in different branches?

There are, at least, two approaches. One of them suggests the refusing of correspondent theory of truth. This possibility is carried out by H. Putnam in the "internal realism" [24, p. 144–145]. Based on M. Dammit's understanding of truth as justification, he underlines that the best justification must be each time determined on the basis of analysis of concrete situation. This way has something common with a constructivism. In case of Putnam it brought him to the so-called "pragmatic realism".

Characterizing advantages of moderate constructivism, H. Komar in our common article wrote: "It is especially obvious are the consequences of acceptance of concept "reality" as objective, unique, external, independent of man, when it is used to the questions of freedom and ethics. No wonder that just rationalism along with the idea of world unity generated a formula: "freedom is the comprehended necessity", while from constructivism position is sharply realized as never the actuality of thesis "my freedom is over wherein freedom of other human beings". Internal limitations are set by the means of (self-) organization of human as a conscious creature, by a biological language, by his autopoiesis, therefore the "roots" of modern "tree of cognition" are biological, and "fruits" as well as two thousand years before, are ethical" [13, p. 79].

To position of constructivism the supporters of synergetic view on the world and cognition are tending. Thus, V. I. Arshinov [1], characterizing cognition of the self-organized systems, uses as evident image of them the known picture by M. Esher, on which a hand draws a hand which draws it.

Not denying advantages of constructivism approach, I want to underline that possibilities of realistic approach in understanding of postnonclassical knowledge are not exhaust. Mainly – not to remain on classic position of simply certain unchanging truth. To develop the understanding of truth as a process in spirit of Kyiv philosophical school means to recognize the non-linearity of such process. Then possibility to remain on realistic position appears, combining it with the postnonclassical type of scientific rationality. On these grounds ethic principles can deserve to become as the basis of communicative ethics which has now important value as rational mean of settlement for many conflicts of contemporary world.

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ИСТИНА ЯК НЕЛІНІЙНИЙ ПРОЦЕС

Розглянуто сучасні зміни в епістемологічних засадах нелінійної науки. Вважаючи істину процесом і беручи до уваги фундаментальну багатоваріантність нелінійної динаміки, авторка пропонує розуміння істини як нелінійного процесу, щоб забезпечити відповідність як досліджуванім процесам самоорганізації, так і когнітивним процесам, здатним до самоорганізації.

Ключові слова: істина, процес, нелінійність, епістемологія, постнекласична наука, самоорганізація.

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ИСТИНА КАК НЕЛИНЕЙНЫЙ ПРОЦЕСС

Рассмотрены современные перемены в эпистемологических основаниях нелинейной науки. Считая истину процессом и принимая во внимание фундаментальную многовариантность нелинейной динамики, автор предлагает понимание истины как нелинейного процесса с тем, чтобы соответствовать как исследуемым процессам самоорганизации, так и самоорганизующимся когнитивным процессам.

Ключевые слова: истина, процесс, нелинейность, эпистемология, постнеклассическая наука, самоорганизация.

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Received Editorial Board 10.01.17