Global Evolutionism: Theoretical and Methodological Problems

Ilya V. Ilyin and Arkadi D. Ursul

This article deals with the general scientific concept of global (universal) evolution, in which the self-organization of material systems acts as a comprehensive and fundamental permanent process of progressive development in the visible Universe. The major problem in the study of this type of evolution seems to be the main trajectory of evolutionary processes in the Universe, within which a continuous self-organization of material systems takes place, from the Big Bang to the social stage of evolution, and which has an indefinably long social and natural continuation. It is assumed that global sustainable development will fit not only into the evolution of the biosphere and coevolution of the planet's geospheres, but also into the global evolution, becoming the most active factor in the self-organization of material systems in the Universe.

Keywords: *global evolutionism, global processes, global, multiverse, self-organization, social and natural development, sustainable development, superline, Evolutionary Global Studies, evolutionics.*

The problem of global (also called universal) evolutionism (known also as the Big History approach [see, *e.g.*, Grinin, Korotayev, and Rodrigue 2011]) attracts more and more attention on the part of academic community and becomes not just a popular topic, but one of the most fundamental and promising research projects and areas of scientific study. This problem is covered in special university courses and is already a part of the curriculum in a number of institutions of postsecondary and postgraduate education. Many periodicals, especially journals focusing on the methodology and philosophy of science, generalization and synthesis of knowledge in natural, social and other sciences, pay more and more attention to the publications and topics concerning the type of evolutionism analyzed in the present article.

And still we should agree with Leonid Grinin that so far there have been quite a few works studying the most fundamental characteristics, laws and mechanisms of evolutionary dynamics. Moreover, we must agree with this author that the evolutionary approach is, in the broadest sense, one of the most important and effective ways of conceptualizing and integrating our increasing knowledge of the Universe (and the multiverse), society and thinking. Without such a metaparadigm, evolutionists working in different fields will be unable to understand each other (Grinin 2011: 90). And although here we rather talk about evolutionics (or evolutionistics as Grinin calls it), however, this remark refers to global evolutionism as well.

Here it is worth paying attention to the difference between the two concepts: evolutionics (evolutionistics) and global evolutionism, which many researchers do not differentiate. Evolutionics (evolutionistics) is a general theory of the development of the systems of nature, society and thinking, continuing the philosophic theory of development

at the general scientific level, sometimes even using the tools of mathematics, computer science, *etc.* whereas global evolutionism focuses only on the continuous and progressive development happening in the Universe.

Modern science needs research projects and programs that would consolidate various, increasingly differentiating areas of science and research directions. Multiple scientific schools and movements, pluralism of opinion and competition, which recently have been given unreasonably great in our view attention (and even have been artificially promoted and propagated for well-known reasons) have not been able to provide a unified scientific outlook and have greatly reduced the role and status of science in society.

Having rejected the old ideologization of science and monopoly of a certain philosophical and methodological doctrine, scientists began to look for their own ways. Many of them have found out that science requires diversity as well as unity that serves as a foundation for consideration and arrangement of numerous scientific research projects and results in a systematic and integral form of knowledge, and which could be called a world view, an outlook, a concept, a principle, an approach, *etc.* For a long time this role was performed by General Systems approach, Cybernetics, later by Complexity Studies (Synergetics), *etc.* And only the deep and expanding studies of global (universal) evolutionism made it clear that many, if not all, approaches are integrated into a certain conceptual integrity and general scientific paradigm expressing a new idea of development both in the world and in the evolution of the Universe, which is important for modern and future science at the interdisciplinary general scientific level.

Approaches, methods and other means of research used for the study and creation of this 'conceptual evolutionary integrity', its laws, trends and fundamental features are inter-disciplinary, and the concept of the universal (global) evolution, that is global evolutionism, itself has an integrative and general scientific status, actively participating in the formation and consolidation of the integrity of science. The concept studied herein is a continuation and the most effective area of transdisciplinary and integrative search for new scientific knowledge about development and is a general model of evolution, uniting philosophic and scientific, general as well peculiar forms and means of accumulation of knowledge into a comprehensive concept-hypothesis. This is accompanied by the formation of a new synthetic area in scientific methodology, which could theoretically unite many research programs and scientific projects.

Of course, we are dealing with a question of the status of global evolutionism as a form of knowledge in modern science. The concept of 'universal', or 'global', evolutionism is a specific theoretical formation with quite a limited empirical verifiability and interpretation, although, to a considerable degree, this form of knowledge can still claim the status of truth (and not just a role of a hypothesis or a model) with regard to developing natural and socionatural realities. This theoretical construct that appeared at the stage of post-nonclassical science still lacks sufficiently exact and precise explanations and especially predictions, because it is not fully reflected in the existing system of theoretical knowledge.

Let us determine our position with regard to the terms 'global' and 'universal' that are almost equally used to name the type of evolutionism discussed here (Ilyin and Ursul 2009). It may seem that only processes occurring on our planet with a certain 'global integrity' may be called global processes. In this sense, global processes are not just the processes occurring on the Earth, but the planetary-scale processes, that is, embracing the whole planet. However, it is important to pay attention to the existing etymological dichotomy and linguistic ambiguity of the term 'global'. The term 'global' originates not from one, but from several languages: in particular, from Latin ('globus' means

'the globe') and French ('global' means 'universal', 'taken as a whole'). In English 'global' also means 'world', 'world-wide', 'general' and 'universal', however, 'the globe' still has the Latin meaning ('the globe'). Therefore, it makes sense to take Latin and French lexical meanings as the main etymological meanings.

It is also worth noting that one of the early 'model conception' of the Universe as of a kind of 'celestial globe' in the form of an image of celestial spheres with stars and other celestial objects on them comes from the same Latin meaning.

Let us, however, turn from etymology to the meanings of terms that are already fixed, although not yet finally. In modern science, the term 'global' is mainly used in two 'spatial' senses: 1) global as planetary, referring to the whole globe and 2) global as all-encompassing, universal, comprehensive, taken as a whole, and in this sense is it extended to the whole world, or the entire Universe. Accordingly, global processes can be thought of in these two basic meanings: 1) global processes as the ones happening on the globe, that is planetary processes 2) global processes as the ones happening in the entire Universe, at least in its visible part.

In recent research, the term 'global' has been used in the meaning of embracing some space and getting a systematic integrity, 'given' by this or that space (the globe, the Universe). This meaning, which we will call a spatial globality, is important for the understanding of globalization and other global processes.

But there is another meaning of the term 'global' which implies that a process (or an object) has some universal content characteristic, property or parameter that all existing processes and objects obey. For example, all objects of the material part of the Universe have gravity or three-dimensional space. Or all people inhabiting the planet, even if they are not yet united into some global and integrated system, obey in their development some common social rules. We can say that the rules that are inherent to all people with no exception and their communities (societies) are also their global characteristics, in the sense that they are inherent to the whole social dynamics and development.

Comparing these two meanings of the term 'global', one can guess that the second meaning of the term turns out to be more profound and comprehensive; because if some social processes have not yet gained their global integrity, for example, in the spatial aspect, they have from the very beginning and by their very nature some universal content properties, which in this case are attributive characteristics common to the whole humankind. It is clear that the qualitative criterion of globality is stronger and more significant than the quantitative one. Ontologically, this 'attributive globality' refers to the nature and content side of an object or a process, to its nature and qualitative determination, and it primordially and always exists in them (at least since they appeared). In this sense, globality as an attribute of a material process or an object is its internal and 'existential' characteristic. But the globality of a process in the spatial sense does not always exist, which is evidenced by the research of the phenomenon of globalization examined within Global Studies.

It is also worth mentioning here that the 'earthly' and 'cosmic' meanings of globality are hardly worth opposing and contrasting each other. And this comes from the very trends in scientific development connecting terrestrial and space problems. Let us give just one example. Since the end of the last century, after the discovery of multiple planets around other stars, now called exoplanets, or extrasolar planets, we now understand that planets exist in the galaxy in a great number (now more than a thousand of them have been discovered). It has also been discovered that the characteristics of a large number of extrasolar planets are similar to the Earth and Jupiter planets of the Solar System. Planetary science develops as a complex of sciences studying planets, their satellites, as well as our star system as a whole, extrasolar planets and other planetary systems in the Universe.

It is very likely that some of the similarities and parallels will soon appear between Global Studies and planetary science, especially if we admit that global natural processes in a certain perspective can be included into Global Studies. Global Studies in 'the exoplanet expansion' will also in the course of time start to gain the cosmic status, although there are other lines of connection between the earth and space, for example, in such emerging area as Cosmo-Global Studies.

The title of the present article also reflects this pluralism of meanings, as 'Global Evolutionism' is often referred to as 'Universal Evolutionism'. In this case, the term 'universal' stems from the Latin word 'universalis' meaning 'universal, comprehensive and extending to the entire Universe'. At the same time, the proponents of a different naming may refer to the fact that in French and even in English the term 'global' means 'universal', 'taken as a whole', 'extending to the Universe', 'the Universe as a whole'. Here we use the terms 'global' and 'universal' with respect to evolutionism as equivalents. And sometimes we can even use the word combination 'global and universal' with regard to evolutionism and evolution.

Global evolutionism is the foundation of modern scientific outlook and a form of knowledge about the global (universal) evolution, in which self-organization of material systems serves the main permanent process of progressive development in the visible Universe (Teilhard de Chardin 1965; Ursul 1967; Faddeev 1970; Ursul and Ursul 1986; Kazyutinsky 1988; Moiseyev 1991, 2001; Fesenkova 1986, 1994; Popov and Kraynyuchenko 2003, Nazaretyan 2004; Grinchenko 2004; Haytun 2005; Chernikova 1987; Getmanov 2004; Ursul 2005; Ursul and Ursul 2007, 2012; Kazyutinsky and Mamchur 2007; Barlybaev 2008; Panov 2008; Grinin, Markov, and Korotayev 2009, 2010; Baksanskiy and Liseev 2011; Chaisson 2001; Christian 2004; Jantsch 1980; Laszlo 1987; Spier 1996; Grinin *et al.* 2011a, 2011b). Global evolution is a continuous self-organization of material systems, first in abiotic nature and then in biological and social systems of the Universe.

The modern scientific worldview, which is to a large extent more systematic than it was in the last century, has also become more evolutionary, at least for the material part of the Universe. At the same time, this outlook contains a fundamentally non-evolutionary part in the form of the cosmological ideas of the dark parts of the Universe and especially of the dark energy that constitutes three-fourths of the material content of the Universe.[1] That is why we can hardly speak about a 'self-organizing Universe' or about its progressive development, as some scientists previously assumed. The permanent and progressive orientation is inherent only to a special trajectory which is called the superline of the global evolution.

The evolution of the Universe and global evolution as a continuous process of material systems self-organization begins with the Big Bang as the moment of formation of an expanding Universe about 13.7 billion years ago from a compressed (until that time) superdense hot formation (initial cosmological singularity). But the knowledge about this evolution is based only on the study of a few percent of the mass (energy) of the whole Universe, that is including only the baryonic form of matter. The rest invisible, 'dark' part of the Universe (including dark energy and dark matter that make up about 96 % of the energy of the Universe) were literally out of sight of researchers.

The global evolution can hardly include the 'dark' part of our Universe, so it makes sense to limit this evolution and any other evolutionary processes in the Universe only to

[1] Dark matter has two forms: a dark mass, or a hidden gravitating matter, constituting 22 % of the energy density of the Universe and dark energy. The contribution of this form of matter to the energy density in the Universe is about 74 %, while ordinary matter accounts for about 4 %, including the stars that account for 1 % (see Surdin 2007: 29, 426).

the baryon forms of matter, that is its material and luminous part. This is because the 'dark' part of the Universe practically does not evolve in the sense that modern science gives to the notion of 'evolution' in the study of the visible part of the Universe. These concepts suggest that the respective forms of matter and their specific material formations have some directed changes in the content of the system, usually irreversible. However, we have no information about these changes in the 'dark' part of matter, though we can assume that they may exist, but they exist in an unusual and incomprehensible to us form (which can be considered a 'protoevolition' as a new phenomenon, which is close to the usual meaning of the evolution). Therefore, astrophysicists, cosmologists and philosophers who study and interpret the phenomenon of 'dark matter' tend to conclude that this part of our Universe does not evolve (but has a significant impact on the global evolution), despite the fact that there are certain changes, for example, in the dark mass.

Such a conclusion, if it is confirmed further, will have a significant impact on the scientific outlook and on many of our philosophical views. In fact, assuming that most part of the Universe does not evolve in the 'traditional' sense, we will have a completely different image of our Universe. Evolution in general, including global evolution, seems to occur according to a kind of a 'leftover' principle dictated by the 'dark' fragments of the most components of the Universe. We may talk about some unknown to science laws of the allocation of matter forms in the Universe (like a negentropic pyramid).

The universal (global) evolution, being characteristic of our material Universe, distinguishes from all directions of development only one – the main for it continuously progressive direction – as the trajectory of a permanent self-organization, because only this very trajectory leads to the emergence of higher levels and stages of development of material systems. It is along this trajectory, or the superline, that those forms and levels of development (which do not interrupt, but progressively get more and more complex) existed during the whole time of evolution in the Universe. It is just for them that the universal and invariant principles, trends and laws of progressive development are defined, and due to them we can understand and explain the emergence of life and intelligent beings. These laws also allow us to forecast a further interaction of the social stage of evolution with the nature of the Earth and space. The development of global evolutionism as an interdisciplinary scientific concept and as an important fragment of the scientific outlook goes in line with those studies that represent the core for the generation and synthesis of scientific knowledge and the development of a unified science at the time of the noosphere formation.

In principle, this main progressive branch of development (the superline) in the Universe is of particular importance for the evolutionary Global Studies, since it is just along this line that the evolutionary processes (that can be used in Global Studies, and, above all, in global management) take place. The superline can be characterized by a 'saving' (and safe for the highest stages of evolution) type of permanent progressive development when, for example, separate biological or social systems, selected by certain circumstances, persist in the course of evolution and continue to exist through self-organization after another bifurcation. Permanent progressive evolution is a 'safe' type of self-organization leading to the emergence of new, higher structural levels and stages of development of material systems.

Evolutionism develops as a broad worldview and methodological concept (already having explications in the form of evolutionics [Urmantsev 2009], or evolutionistics, according to Leonid Grinin [2011; Grinin *et al.* 2011a]) and as a universal (or global) evolutionism as a part of it, but the most important in the scientific aspect. The evolution as a de-

velopment in a broad sense includes conflicts, crises, and collapses of systems, *etc.* However, at the entrance to main line of evolution (the superline) a kind of selection is performed, when only material structures enriching their information content gain 'potential for the future'. These structures, after all interactions (including the crisis-conflict ones), turn to the coevolutionary interactions with some other material structures surrounding them, which constitute the medium of existence and development. This is 'required' by a strange attractor that has a positive influence on the process of self-organization of the evolving structure: as non-coevolutionary structures are destroyed after the phase of bifurcation. The coevolving, and thus preserved, material structures in a very narrow (and further more and more narrowing) range, or 'a security corridor', get opportunity to continue the evolutionary 'relay-race' along the global evolution superline.

Are there any crises and disasters along this superline? The question is rather difficult and no clear answer has been found yet. There are various types and forms of development around the superline, and this is quite understandable. However, it is the continuous progressive development that can unite into one potentially endless superline all the evolutionary processes in abiotic, biological and social systems within the Universe that go in different directions. A phase of regressive development appearing in this way can completely destroy this line, and, most probably, it would not exist now. Any regressive period taking place on the superline of the permanent evolution may only slightly influence this line, which might have happened more than once in the form of various crises that 'tested' the superline strength, especially during the bifurcations and polifurcations.

The superline owes its existence to all other Universe, this follows from the fundamental principles of Complexity Studies and Cosmology. However, we can assume that only a permanent accumulation of the information content of self-organizing systems takes place along the superline, and, logically, there should be no 'information holes', loss of negentropy, because this may lead to the disappearance of the superline continuity that has existed from the very beginning of the Big Bang.

Apparently, the superline should be regarded as an evolutionary corridor of the crisis-free and catastrophe-free progressive development, which provides a preservation and increase of negentropy and information content of the evolving systems for billions of years. At the same time the superline itself is the main attractor of this crisis-free and sustainable type of progressive development that is realized through self-organization. But this is only a formulation of the problem, and we understand that this needs further research and discussion.

The superline (a mainstream in a sense) of the global evolution is empirically detected as a continuous trajectory of progressive self-organization, which goes from the lower levels and stages of material formations to the higher ones. This is facilitated by the use of information approach to the global evolution, which was realized mainly in the research paradigm that comes from the attributive character of information giving it the same ontological status as to energy. Within the framework of this paradigm, the principle of a strong correlation between energy and information is accepted, that is the energy processes are more or less information processes (and *vice versa*). At a certain stage of evolution in the Universe either energy or information processes come to the forefront, however, with higher levels of organization and system complexity, the role of information and of the information criterion increases significantly.

It can be assumed that in the largest fragment of our Universe – the dark energy 'realm' – information is available in the minimum amount (some researchers believe that there is no information there at all). And this is due to the fact that information as a charac-

teristic feature of material formations reflects movement and diversity in them. Information appears to be inseparable from evolution and changes that are either absent in the dark energy or are only observed in the minimum possible amount.

In identifying the superline, a principle of presentism (Saveliev and Poletayev 2003) is used (tracing the past in the accomplished present), when the present influences the representations of the past. In academic research papers (it is obligatory in theses) the presentism means that a problem in its current state contains in a compressed form its earlier, previous forms. Not everything that has already happened in the evolutionary processes in the Universe lies along the superline, many evolutionary phenomena lie beyond this line.

In the biological evolution, the biogenetic law of Haeckel-Muller points to a certain extent to a progressive direction of the evolutionary process (ontogeny is a rapid and short recapitulation of phylogeny) (Muller and Haeckel 1940). In other words, according to this law, every living creature in its ontogeny repeats to a certain extent (in a modified and compressed form) the forms it passed through in the phylogeny. This is certain evidence of the origin of animals of the same type from a common ancestor, with characteristics being not of adult ancestors, but of the embryos.

However, the superline holds only the line which is characteristic of a human being, whose embryo in the process of embryogenesis has in the early development the traits characteristic of the fish. Then it turns from an ichthyoid organism into an organism resembling a monkey fetus and later acquires human traits.

The superline is directed from the biological systems of the past to humans, and it cuts off many other families, species and even kingdoms of living creatures. The biogenetic law points to this to some extent. For example, plants, insects and arthropoda in general (that have the largest number of species if compared with other animals), apparently, lie beyond this trajectory, although they influence it to some extent.

Something similar can be observed at the chemical stage of the evolution: at the level of chemical elements, some of which lie outside the superline. Of more than 110 elements, existing in nature and discovered, more than ten are of no importance for the functioning of living organisms. Only 81 elements are involved in the formation and functioning of living organisms. The main are such chemical elements as hydrogen (which appeared in the first fraction of a second after the Big Bang), carbon, oxygen and nitrogen, while others, often being in microscopical amounts in our body (*e.g.,* there are traces of nickel, cobalt, molybdenum and other metals formed at the stellar stage of the evolution), influence human health, when an excess or deficiency of an element causes a disease, with a certain amount becoming poisonous (mercury, arsenic, thallium and polonium, with polonium isotope – 210 being especially toxic, *etc.*).

The view on global evolutionism, prevailing in recent years, is connected with Complexity Studies that applied many of its principles and laws from inanimate nature to the biological and social environments (Knyazeva and Kurdyumov 1994, 2002; Nazaretyan 2004, Popov and Kraynyuchenko 2003). The Complexity Studies approach to the study of global evolutionism uses the concepts and techniques of this discipline for revealing the laws of the systems self-organization as a spontaneous emergence of the complex ordered structures. There are other approaches to the study of universal evolution too, which are not analysed herein.

The global evolution is one of the least explored and the most interesting problems in modern science, which attracts scientists' increasing attention. It becomes clear that in the foundation of the Universe and its evolution, there are certain principles and trends, which

must influence the part of the Universe that has acquired intelligence and socio-cultural form of its life and evolution.

It is important to distinguish between universal evolutionism and planetary evolutionism (Vitol 2002), whose understanding, in our opinion, is limited by the scale of the planet Earth and its evolution and does not attempt to reveal permanent and stable trends, self-organization, principles and laws as the universals of the progressive development of all existing heterogeneous structures of matter. Many authors refer the term 'global' to the broad scale of the Universe or even to the notion of the multiverse,[2] which is now replacing the notion of the Universe, that is to the cosmological space dimension, and there is no generally accepted opinion about the use of the concepts discussed yet. For this reason, we equally use the terms 'global evolutionism' and 'universal evolutionism' for characterising the permanent progressive evolution in the Universe. The term 'global' will not refer only to the studies of global processes, as it is accepted in Global Studies analyzing globalization, global issues and other planetary processes taking place on the globe. Here the term 'global' can go beyond its 'planetary' meaning and 'sky-rocket' to space.

In our view, global evolutionism in the broadest sense should focus on the common invariant trends, laws and models of the permanent self-organizing processes that manifest themselves at the different levels of matter organization (structures). This concept is based on the idea of universality, globality and continuous self-organization as a special kind of evolution of different structural levels, on finding the interrelations between increasingly complex evolving structures.

In view of what has been mentioned (and the arguments that will be provided further), we prefer to use the term 'global' to characterize the type of evolution under consideration. However, this does not mean that it is the only correct solution to this terminological problem. The future will show which term will be more acceptable. That concerns not only this term, but also a number of other terms used in this work. The concept 'global evolutionism' should be distinguished from the concept 'Evolutionary Global Studies' that we recently introduced, which means an interdisciplinary conceptual approach to the study of global (planetary) processes and systems in an evolutionary perspective. What Evolutionary Global Studies, in contrast with global evolutionism, focus on is not the processes of permanent self-organization in the Universe, but the planetary global processes: self-organization processes, as well as other evolutionary processes. The negative degenerative processes will be the focus of attention in Evolutionary Global Studies as the most important (threatening) for the future existence of humankind and development of an anti-entropic global activity.

As a concept, the 'global evolutionism' sums up all scientific knowledge accumulated before and in the particular area related to the study of the problem of development and finding general scientific approaches, principles, laws and trends. As a conceptual and theoretical basis of this synthesis of knowledge into a holistic formation, the type of evolution under consideration represents an idea and a problem-hypothesis at the same time. This is a problem-hypothesis of our view on the dynamics of the Universe that has already had a significant integrative and activating effect on the whole problem and conceptual structure of science.

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[2] The term 'multiverse' means all multiple simultaneously existing mini-Universes ('local' Universes), together with a certain ancestor medium from which they originated (Panov 2008). Among the multiple mini-Universes of the multiverse there exists our Universe, which is often equated with a metagalaxy as a habitable space supersystem. This new scientific concept is discussed in the books: *The Hidden Reality: Parallel Universes and the Deep Laws of the Cosmos* (Green 2011); *Universe or Multiverse?* (Carr 2007), *Our Cosmic Abode* (Ris 2002). In the latter work, the multiverse is analyzed only as an ensemble of many Universes.

Within the problem under discussion, a subjective component, which expresses the personal knowledge and opinion of those, involved into a scientific discourse, plays an important role. Since as an idea, problem and hypothesis, 'global evolutionism' is far from being complete and requires further development of this work, an assumption that this word combination denotes a coherent system of the core of scientific knowledge (and of the communicative integrity of the scientific community) might be more appropriate.

Global evolutionism does not pretend to be the 'truth' (and especially the ultimate truth), it is rather a knowledge-based, virtual and theoretical model, the value of which is still not clearly defined. In our view, the problem under consideration is an important structural element of modern science and of the scientific outlook of the beginning of the 3rd millennium and is at the same time a principle (foundation) and an imperative of the development of scientific knowledge. We believe that in modern science global evolutionism can act as a conceptual and paradigmatic core integrating interdisciplinary knowledge about the processes and invariant trends of the evolution in abiotic, biological, and social systems.

We can agree with Stepin that 'the concept of universal evolutionism is based on a certain bulk of knowledge obtained in the framework of specific scientific disciplines and at the same time it includes a number of philosophical worldview patterns. It belongs to the layer of knowledge which is denoted by the term "scientific outlook"' (Stepin 2006: 333).

At the same time, universal/global evolutionism goes beyond both philosophy and ideology and the scientific outlook and scientific disciplines. Universal (global) evolutionism, focusing on the main continuous superline of the progressive development in the Universe, turns out to be, *per se,* the layer of knowledge that belongs to the so-called general scientific knowledge and draws to its orbit of research mainly the fragments of the above-mentioned forms of cognition that have not acquired either general scientific status. For example, even within the scientific worldview, this type of evolutionism distinguishes both a general scientific aspect and the layer of this general scientific aspect that focuses on the continuously happening progress in the Universe. It is this continuous process of self-organization, which has not fully explained yet by modern science and philosophy, that turns out to be the attractor of all knowledge accumulated by science during the cognition of the world.

The scientific outlook defines a place of a science or a scientific school in the general system of scientific knowledge, performing a function similar to the one performed by a world map or a globe that allows you to find the location of a certain object. Global evolutionism, being only part of this outlook, goes further: it shows in what direction scientific knowledge should ideally go further in order to get to the main trajectory of development and to contribute to it as much as possible.

One of the important factors attracting scientists' attention to the problem of global evolutionism is related to the need to resolve the fundamental contradiction in the history of science that reflects two directions of the real process of development in the Universe. One of them was discovered by sciences studying abiotic systems (physics) and was presented in the form of the second law of thermodynamics demonstrating that an isolated physical system evolves to an equilibrium state, which means increasing entropy, degradation of a system to a state of chaos.

The second direction of development, a progressive one, was demonstrated by sciences learning the highest levels of the development of matter, first of all, Darwin's evolutionary theory and social sciences. For a long time, these two directions did not adequately correlate with each other and caused reciprocal criticism until the time when the Complexity Studies approach (and previously the thermodynamics of open non-equilibrium sys-

tems) and Global Evolutionism appeared. Within these scientific areas it became possible to explain the existence of two directions of development as mutually dependent. The progress of some of open systems is achieved through the negentropy of the environment and energy dissipation into the same environment resulting in its increasing entropy.

The established correlation between the two directions of development united sciences studying abiotic, biological, and social systems into a single evolving whole, and showed that the explanation of the relationship between progress and regress in open systems lies within the framework of general scientific approaches that are characteristic of all these fields of knowledge. And the Universe itself, viewed from this perspective, is an open system, rather than closed (note that the latter would imply the 'heat death of the Universe'). From a perspective of general scientific approaches, many scientific concepts have turned out to be interconnected within a single general scientific concept of global evolution. In the Universe, a process of continuous (permanent) progressive development can take place only because it is an open and rapidly expanding system. Openness implies a possibility of progress through self-organization, and all these processes must occur at the expense of other systems, which are connected with the evolving system and which represent its environment (conditions and resources).

This applies to the Universe, at least, to our 'observable' Universe, which due to the fact that it is a place where a permanent process of progressive development happens, must be not only an open, but also rapidly expanding Universe, that is a universum (or a mini-Universe in the multiverse), which 'aspires' to a greater openness. This is the way how a synergetic relationship between the openness, the expansion of the Universe (the latter was established and explained by the theory of the expanding Universe through the discovery of dark energy) and global evolution is realized. In principle, continuous progressive development would not be possible without the openness and expansion of the Universe (both in the gnoseological and ontological aspects).

At the same time, along with universality, the feature of temporal permanence (or even temporal integrity) of self-organization as a progressive branch of evolution comes to the forefront in the universal and global evolution. Let us once again point out that global evolutionism focuses on the global and universal nature of progressive evolution, and not on evolution (development) in general, which was previously a subject matter of the philosophical theory of evolution. While globality and universality were inherited by global evolutionism from philosophy, the focus on the permanence of progressive development is what differentiates it from all previous doctrines and theories of development both in philosophy and in specific sciences. Evolutionistics (Grinin), or evolutionics (Urmantsev), focuses on the universal and general characteristics and trends of development, and not only on the progressive ones. They study these issues in greater detail than philosophy.

A number of research articles addressing the problem of global evolutionism from different angles and perspectives of many scientific disciplines have been published recently. However, this multifarious research contains a very few works revealing the role of humanity (and other hypothetical representatives of the social stage of evolution), in collaboration with nature in the broad, not only planetary, but also cosmic scale. In our opinion, what is important for global evolutionism are not only the general characteristics of transition from the lowest structural levels and stages of the evolution of matter, but also their interactions with each other and, above all, the interaction of nature and society in all periods of time (the tempoworlds: the past, the present and the future).

In the elaboration of global evolutionism, considerable attention should be paid to the issues of social and natural evolution in both earthly and cosmic dimensions. And this is far from being accidental. The fact is that modern people in their nature-cultivating-and-

exploiting activities have already gone to the framework of limitations that are 'permitted' by nature from the perspective of the principles of global evolutionism. There is the sword of Damocles of the global cosmic catastrophe threatening people, and it is important to analyze from a perspective of global evolutionism whether or not 'a horse hair' holding this sword can tear in the 'market-feast' of modern civilization. Is not it time to take measures to return the humans, busy with nature-cultivating-and-exploiting activities, to the mainstream of natural development, where they will be guaranteed the survival and further progress?

The development of society and nature, that is a guided change of natural systems with the inclusion of the social components (individuals, society, humanity, other possible representatives of the social stage) is one of the central problems in the study of global evolution. Evolution of society and nature is the development of such complex systems as 'people-nature', 'society-biosphere', 'humanity-space', *etc*. In this work, it is important to determine how social and natural systems, involved into the process of global self-organization, influence it and what the prospects of this influence not only in the planetary, but also in the cosmic future are.

The planetary sense of anthropospheregenesis that turned humanity into a powerful geological force, in particular, lies in the fact that it has become a factor of the global evolutionary processes that can be comparable to life (in terms of power it is still of a lower order[3]). The transformation of the humankind into a geological factor of evolution on the Earth required a relevant, not a local or regional, but global view of its further development and interaction with the nature of the planet.

Since the philosophy of science to a large extent deals with global evolutionism, it extends its subject matter, following the emergence of new scientific problems, disciplines and the appearance of integrative trends in science. If we take natural science, in the first half of the 20th century philosophers largely focused on such traditional fields of knowledge of nature as Physics, Chemistry, Biology, *etc.* In the second half of this century, the focus of philosophy of science began to move towards a 'synthetic' natural science, to such research areas as Cybernetics, Computer science, Aerospace, *etc.*, where methods used in exact sciences dominated. The last decades saw the emergence of complex areas of research: Complexity Studies, Social Ecology, Social Informatics, Global Studies, Noospherology and others where the socio-humanitarian and philosophical components are an integral part of these areas of scientific research. The development of these areas led to the discovery of new social and natural laws (and even integrative and general scientific ones) reflecting the sustainable trends of the co-development of the system society-nature and prospects for the harmonized interaction of its components.

Global evolution is a unique and irreversible process of continuous self-organization in nature and of nature itself, the 'baton' of progressive development, which is now passed on to society. The appearance of the latter suggests that further continuation of the main trajectory (the superline) of the global evolution goes on to intelligent social formations, to the social level of evolution, and nature 'takes a back seat'. Meanwhile, global evolution, even with the participation of social intelligence, still remains a mostly natural process, and only in a small part it is a socio-natural, rather than purely social phenomenon. Social

[3] By weight of the extracted and processed raw materials (100 Gt / year), human economic activity still takes an intermediate position between the synthesis of organic matter by biota – some 1000 Gt / year, and volcanic activity, which gives about 10 Gt / year of volcanic material. Thus the capacity of the biota is much higher than of the geological activity of man.

evolution, which is the focus of attention of social sciences, is only a historically conditioned abstraction from the real socio-natural processes of evolution that are, of course, not always associated with global evolution.

The above-mentioned trend is associated with the process of inclusion in the scope of research not only of the subject matters (objects) of the natural sciences, but also of the interaction of the biosphere with humans and society. Moreover, there is an emerging trend of studying humans and society from the perspective of natural sciences, which can be seen in the spread of a Complexity Studies approach to the study of social objects, in the view of humankind as a part of nature in the global environmental studies, in the study of the problem of extraterrestrial civilizations from the perspective of natural sciences, *etc.* Nature in such studies is not regarded as an external, with respect to society, inert environment, but as an active component of the socio-natural interactions considerably influencing the social activity through environmental and other natural constraints. This is a response to the need to assess the impact of natural-scientific knowledge and environmental factors on human activities and the prospects of its development at the exit from the crisis, especially in solving global problems. It is in the way to the unity of science reflecting the formation of the coevolutionary system 'humans – society – nature' that the concept of sustainable development claiming to become one of the main directions of scientific research in the 21st century appeared.

Since human activity has already become a planetary geological factor and, thus, from the perspective of Global Studies – a global activity, it has already gone beyond the limits of the earth's shell, in which it appeared and evolved. Herein it means going beyond all the geospheres, including the boundaries of the biosphere, both in space and deep in the planet. For the conservation of the natural environment surrounding people in the broadest sense (*i.e.* not only the biosphere), it is important to carry out activities within the global carrying capacity of ecosystems – the concept that previously made sense in the biosphere. This concept is already expanding its content, and such concepts as 'geological carrying capacity' and 'carrying capacity of the cosmoecosystems' will have to be added to it. Going beyond these 'carrying capacities' is more dangerous than that in the event of breaking carrying capacities of ecosystems in the biosphere. This is explained by the fact that there is a powerful regulator and stabilizer of the environment in the biosphere – the biota, and outside the Earth's biosphere, and especially in space the natural homeostatic factors and mechanisms such as the Le Chatelier-Braun principle are not as effective.

If we go beyond the temporal limits of what has been happening in the last decades or even centuries into broader time periods, we can see the global processes and the emerging global systems (structures) that appear due to them in quite a different way. The evolutionary view allows to reveal certain directed transformations of all global processes, structures created with their help (having not only global spatial scales, but also global importance), and even the emergence of new, largely as a result of human activities and the development of the social and natural stage of evolution. From the perspective of the evolutionary approach of Global Studies used herein all global processes and systems have progressive, regressive, cyclical or other directions of development.

The development strategy denoted as 'sustainable development' is designed as a planetary evolutionary process, which aims at preserving civilization and the biosphere, and their mutual coevolution. Transition to sustainable development from the beginning is a global process, which, however, is becoming a new form of global development that becomes the focus of attention of emerging future Global Studies. If all the modern forms of this development are spontaneous in nature, the transition to sustainable development becomes a globally-managed process. This makes the study of this form of global development of

particular interest to Global Studies and Evolutionary Global Studies, in particular (Ilyin and Ursul 2009, 2011a, 2011b; Los, Ursul, and Demidov 2008; Baburin, Muntean, and Ursul 2011; Romanovich and Ursul 2006; Ursul 2011).

The anticipatory management actions on a global scale will perform the following general global functions. First of all, the means and trends that already exist (or are emerging) and promote the effective transition to sustainable development should be supported and encouraged. In addition, it is necessary to switch on such mechanisms of global governance that will initially slow down and further significantly reduce the negative outcomes and trends that stand in the way of progress to the new global goals.

A transition to this new 'sustainable' type of the planetary social and natural evolution will significantly influence any social activity, as it should be carried out in such a way as to satisfy the basic principles and to achieve the main goals of sustainable development, to realize the possibilities of meeting the needs of present and future generations, and thus, to create conditions for the future existence of civilization that emerged and have been evolving on the planet Earth.

In the way of the social and natural continuation of the global evolution some new stable trends appear; those trends allow to make some assumptions and create a series of scenarios and models, paths and opportunities for the further global self-organization of matter in the Universe. Theoretical and methodological study of the future of the social and natural evolution in the light of finding the universals and vectors of development in the Universe (multiverse) allows giving better supported search and normative predictions about the future of human civilization and its interaction with the nature of the Earth and space.

The emergence of the social stage of development requires a more thorough analysis of the further continuation of the progressive evolutionary line either with the involvement of the social stage or without it. The latter option is realized if the social stage disappears from the progressive development line as a randomly appeared 'low-entropy product', located in the periphery of the main self-organizing evolutionary line in the Universe. Besides, modern people are nearly killing themselves, exacerbating the global problems and hastening the anthropoecological planetary catastrophe.

When exploring the problem of social and natural development in the global evolution, particular attention should be paid to the adopted at the UN level model of sustainable development, which has fundamentally socio-natural and saving innovative character. Although there are many definitions of sustainable development, we can assume that this is a kind of conserving and safe type of advancing and progressive development of the 'society-nature' system. Sustainable development is a type of evolution where both the civilization and the biosphere can be preserved indefinitely long in a social and natural system in the course of time and where their coevolutionary coexistence is realized. Moreover, the vector of a civilization process is directed to further progressive self-organization and formation of the noosphere. It is clear from the synergetic perspective that this should occur at the expense of their environment and therefore it is important to determine the cosmic prospects of the socioecodevelopment.

It is also clear this can hardly ever be achieved within the model of unsustainable development, since unsustainable development can lead to multiple crises and disasters. Unsustainable development is a degrading development and it may end in a global catastrophe.

So the question is which path should people follow? Standing at the bifurcation point, you can further follow one of the two main paths. Either to hold out, survive and continue to live or to perish in the depths of the global-cosmic cataclysm. If further spontaneous development comes true, people will go away from the main line of the universal evolution, confirming the idea put forward by Shklovsky in his book *The Universe. Life. Intelligence*

(1974) that the social stage is a by-product of the evolution in the Universe. The researchers supporting the spontaneity of the further existence of civilization without its transition to sustainable development adhere to the same point of view of the humankind inevitable death as the end of its history. In this case, the world history will not only finish, but will not fit into the global evolution, and the development in the Universe will go on without the involvement of human intelligence.

However, if the human race ends up the progressive evolutionary line, this will contradict one of the stable and general trends that can be clearly seen in the preceding evolution of matter, at least in the way of action of the information vector of the global evolution. This means the preservation of previous structural levels at higher levels, and their coevolutionary interaction with a higher stage. Therefore, it is clear that for the process of self-organization to continue in the Universe along its main line, the social stage should remain and continue its safe and permanent existence and progressive development in the social and natural coevolutionary form with all other (preceding and surrounding) material structures. It is this working hypothesis that is accepted for the further view of the prospects of continuation of the evolutionary line of the self-organization processes including the social stage. And this will require a new approach to the consideration of development of the social stage, different from the one that has been offered until recently in the social sciences and the humanities.

In social sciences the periods of specialization and differentiation of science used a rather limited approach to the study of the social stage, which was opposed to nature and transformed it more and more. Man in the anthropocentric social science was proclaimed the crown of creation and the master of the surrounding natural environment, considered primarily as a resource for development. Recent studies show that the goals and values of such an approach run counter to the future of humankind.

Accordingly, the social and socio-natural evolution was conceived in the context of the view on the society, developing according to its own logic and, in fact, independently of nature and more and more actively transforming it. This view of social development and socio-natural interactions is inherent mainly to the technological and Western type of culture and civilization. It is important to understand how we must change the thinking patterns and human values, ways of development, ideals and norms in order to realize the possibility of saving the humankind (without depriving it of the opportunity to safe and progressive life in the future).

Understanding global processes from the perspective of 'sustainable evolutionism' will allow us to consider these processes within the field of Global Studies, as well as to rank them in order of priority in an appropriate way. Indeed, the concept of sustainable development radically differs from all previous ideas of the civilization development because it was the first to put forward the environmental imperatives and ensure security in a broad sense as priorities. All other concepts of the future reconstruction of the world did not deal in any fundamental way with issues of nature and society relationship, as well as the security issues going beyond the state level and especially the issues of global security assurance which become a priority with respect to the civilization survival.

It is also important to understand that in the 21st century a possible transition to such global and system-based socio-natural process as sustainable development will mean to some extent the coevolutionary development of the global social and natural systems. It is not worth reducing to the indication of the fact that this future model of development can ensure the survival of the humankind and its indefinitely lasting non-regressive development in the conditions of the environment conservation. It is not just a long-term extension

of the development of society and nature, but also a further 'contribution' to the continuing global evolutionary line that acquires its socio-natural life in the form of the planetary 'society-nature' system.

In the global evolution studies, the humankind destiny both on the Earth and in the Universe is of main interest for us. Most probably, a pragmatic person will not consider this ideological problem interesting, because it goes beyond the present moment and transports you to an almost unpredictable and uncertain world of the cosmic and even cosmological future.

We believe that a transition to sustainable development will give people a chance to fit into a global universal evolution, to become not just a new factor, but also a leader of this permanent and progressive evolution. Elsewhere, a conclusion was made that this requires access to space and its broad exploration (Ursul 1967; Faddeev 1970). But now, it has become clear that such an exploration is impossible without coping with the global challenges on the planet, without a transition to sustainable development of society and nature. The priority should be given to the transition to sustainable development because it gives an opportunity to the social and natural self-organization to fit in the global evolution and become an integral part of the universal process of progressive development.

An adequate representation of the global-universal evolution is important for the development of science in general, for social, natural and technical sciences, and for others, especially the general scientific and interdisciplinary areas of scientific research. Global Evolutionism is one of the main attractors in the accumulation of scientific knowledge, which not only obtains information from other research areas, but is also a conceptual core, a part of the scientific worldview synthesizing knowledge in the above-mentioned areas of scientific research and, potentially, for the science as a whole.

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