The Theory of Evolution

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From a Space Vacuum to Neural Ensembles and Moving Forward

By

Oleg Bazaluk

Cambridge Scholars Publishing

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This book first published 2016

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN (10): 1-4438-8721-8
ISBN (13): 978-1-4438-8721-2

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PREFACE

In the book the author defines evolution as continuous and nonlinear complication of the structure of matter, types of interaction and environments; analyzes the existing approaches to the research of evolution in modern science and philosophy, the extent of development of the factors and causes of evolution. Unifying interdisciplinary researches on evolution in cosmology, biology, neurobiology and philosophy, the author represents his vision of evolution in the model “Evolving Matter” which allows us to consider not only the regularity of transition of a space vacuum in neural ensembles, but also to see our Universe as a complex, non-uniform organization. The book contains systematized interdisciplinary information on the theory of evolution, and clarifies the new world view offered by the author.

INTRODUCTION

In previous works dating back more than a decade, the author has perfected the arguments that have been developed by him since the year 2000, regarding the evolutionary model of the Universe – Evolving Matter [Bazaluk, 2000; Bazaluk, 2002; Bazaluk, 2003; Bazaluk, 2003a; Bazaluk, 2005; Bazaluk, 2006]. The peculiar results of these research studies were stated in the works: "Cosmic Travels - Travelling Mind" and "Philosophical Problems of Cosmology" [Bazaluk, 2012; Bazaluk & Vladlenova, 2013], in which the author represented the latest versions of the model. Approbation of the ideas took place during many scientific and philosophical meetings of various formats. However, the main discussions took place in the course of communication with members of the International Society of Philosophy and Cosmology (ISPC) (organized in 2004) (http://www.bazaluk.com/) and in the journal "Philosophy and Cosmology" (http://ispcjournal.org/) (published since 2004).

In the present research the author analyzes the existing approaches to the researching of evolution, and the degree of development of its factors and causes in modern science and philosophy. Unifying interdisciplinary researches on evolution in cosmology, biology, neurobiology and philosophy, the author represents his vision of evolution in the model Evolving Matter. The author defines evolution as continuous and nonlinear complication and represents it as a formal model. The formalization of the factors and causes of evolution allowed for their operation in the construction of certain logical models (schemes) that led the author to the open-ended conclusions explored here, which are essentially different from modern ideas of the evolution of our Universe.

In the course of writing the book, the author solved the following tasks:

1. Carry out a general historical-philosophical analysis of the theory of evolution in cosmology, biology, neurobiology and philosophy;

2. Clarify the meaning of the concept of evolution; define evolution as continuous and nonlinear block complication of the structure of

matter, types of interaction and environments; argue characteristics of this definition;

3. Unify the factors and causes of the evolution of the Universe, biological life and humanity; represent their universality at the scale of evolution of any state of matter;

4. Prove that evolution of the Material World is a consequence of the variability of the factors and causes of evolution (Evolution of Evolution);

5. On the basis of the unified and variable factors and causes of evolution, offer the systematization of knowledge in the evolution models of Inert Matter, Living Matter and Intelligent Matter;

6. Having taken as the basis of the features of construction of evolution models of Inert Matter, Living Matter and Intelligent Matter; formalize them and extrapolate on a cosmic scale. Represent the received results in the model Evolving Matter.

Unfortunately, to carry out all of those tasks within the framework of scientific methodology is not feasible. Therefore, in cases of retrospection and extrapolation on a cosmic scale, philosophical methodology that carries out the function of intellectual reconnaissance in cognition was used. This admits more arbitrary interpretations of scientific facts in accordance with the scale of the Universe. Thus, the logic of the book's content is based on *scientific and philosophical methodology* [Bazaluk, 2012] that, in the opinion of the author, allows one to consider evolution of the Material World, even beyond the scale of our Universe.

PART I:

HISTORICAL AND PHILOSOPHICAL ANALYSIS OF THE EVOLUTIONARY THEORIES

CHAPTER ONE

THE CONCEPT OF EVOLUTION

In everyday life, speaking about *regularity* or *historicity* of processes and phenomena in the world around us, we first of all agree to the existence of a process of evolution. In classical, conventional understanding, evolution (from the Latin. evolutio - deployment) is a theory about changes in society and nature, their direction, order and regularities [Great Encyclopedic Dictionary, 1999]. In the 18th century Georges Buffon, a French naturalist, authored his monumental thirty-six volumes of Histoire Naturelle, and in doing so substantiated the thought of the "unity of type", the structure of all living beings and their common roots. However, only two great personalities of the 19th century: Jean-Baptiste Lamarck and Charles Darwin, defined and argued two different directions of the evolutionary theory - transformism and natural selection.

The famous Russian scientific historian Yuri Tchaikovsky, who analyzed vast strata of research works written before the works of Jean Lamarck and Charles Darwin on the theory of evolution, said that ideas of evolution had passed a difficult path and in any case, did not start with the works by Lamarck and Darwin. The first ideas of evolution arose in religion, in ancient cosmogonies - the myths about the birth of the world. Schools of the first naturalists (Pythagoreans, Heraclitus, Empedocles), Ancient Greeks (Socrates, Plato, Aristotle), theologians of the Middle Ages (Pierre Abelard, Albertus Magnus) greatly enriched the evolutionary ideas of new facts, details and approaches [Tchaikovsky, 2006]. As a historian of science Yuri Tchaikovsky believed that the founder of evolutionism was actually a British lawyer, theologian and financier Matthew Hale, who had written a natural-philosophical treatise "Origin of Mankind by Natural Propagation" in the second half of the 17th century. The treatise was published after his death in London in 1677. In this work the word "evolution" was first mentioned in the biological sense (though only in one place) [Tchaikovsky, 2006].

Between 1794 and 1796, Charles Darwin's grandfather Erasmus Darwin wrote and published the scientific treatise "Zoonomia" which, according to

many researchers, is the main evolutionary work of the 18th century [Tchaikovsky, 2006]. At the end of the 18th century the works of Immanuel Kant, Johann Herder, Carl Kielmeyer (the latter taught the great French naturalist Georges Cuvier) and others, laid the foundations for the German school of evolutionism.

Thus, before the works of Lamarck and Darwin, evolutionary ideas, to a varying degree, had been developed for more than one millennium. In 1809 the published work "Philosophy of Zoology" by Jean-Baptiste Lamarck, and 50 years later Charles Darwin's book "The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life" summed up the results of the evolutionary ideas of the time, and planned new directions for research [Darwin, 1986].

In modern science, four major evolutionary ideas (or approaches) are predominant:

1. Lamarckism (a direction that emerged in the second half of the 18th century, based on the works of Jean-Baptiste Lamarck) has, in a broad sense, various evolutionary theories ascribed to it (mainly those emerging in the 19th and early 20th centuries), in which the main driving force of evolution (in its changing types) are considered to be inherent to organisms, and in the aspiration to perfection. As a rule, major importance in such theories is also attached to the impact of "exercise" or "non-exercise" on the evolutionary fates of organs, as it is assumed that the effects of exercise or non-exercise can be inherited [Vorontsov, 1999: pp.201-210];
2. Geoffroyism (a direction which emerged in the early 19th century, based on the classic works of the French zoologist Etienne Geoffroy Saint-Hilaire) is an evolutionary concept in biology, postulating that the reason for evolution lies in the expedient and heritable reactions of fetuses to environmental changes. The representatives of this direction place emphasis mainly on the initial stages of ontogeny as the most important for the process of transformation of life forms;
3. Darwinism (a direction which emerged in the middle of the 19th century, based on the works of Charles Darwin) is a direction of evolutionary thought, according to which the main (although not sole) factor of evolution is natural selection;

4. Nomogenesis (a direction which emerged in the early 20th century, based on the works of the Russian zoologist and geographer Lev Berg) involves a central feature, which is the recognition of the natural character of variation of organisms, and sees this as the basis of the evolutionary process.

Russian specialists in the field of evolutionary theory Kirill Zawadzki and Eduard Kolchinsky, after logically combining the possible classifications with the results of historical-critical analysis of the different concepts of evolution, came to the conclusion of the existence of the following major doctrines: 1) uniformism; 2) variaformizm; 3) neocatastrophism. In the work "Evolution of Evolution" they systematized a great number of evolutionary concepts created during the process of developing the theory of evolution, and relating to the above three doctrines [Zawadzki & Kolchinsky, 1977].

The stages of the formation and development of the theory of evolution have been considered in a large number of scientific reviews. For example, they are in Yuri Filipchenko's work "Evolutionary Ideas in Biology: A Historical Survey of the Evolutionary Theory of the 19th Century" [Filipchenko, 1977]; in the large-scale research work "Science of Life Development: The Experience of the Theory of Evolution" by Yuri Tchaikovsky [Tchaikovsky, 2006]; in the scientific and popular-scientific works of Russian biologist Alexander Markov [Markov, 2010; Markov, 2011; Markov, 2011a]; in Eduard Vitol's analytical article "The Structure of Modern Evolutionism" [Vitol, 2012; Vitol, 2012a]; in the research of the biologist Michael Golubovsky [Golubovsky, 2000]; in the monographs of the philosopher Sergey Haytun, along with the author's conclusions[Haytun, 2005; Haytun, 2006]; and are featured in many other reviews, too.

To understand the amount of work that researchers are faced with in trying to capture the process of evolution merely at the scale of the Earth, we should consider the following figures. If the periodic table of the famous Russian chemist and inventor Dmitri Mendeleev includes "only" 92 elements (without transuranic elements), then by the mid-90s of the 20th century mineralogists already knew about 36,000 species of natural minerals. Moreover, biodiversity, forming a modern biosphere at the species level, is estimated as a number between 1.5 and 3 million species by different authors, representing about 3% of the total number of species that have existed over the 3.54 billion year history of the Earth's biosphere

[Severtsov, 2005]. It should be added that each individual in any form is unique, and add to that the features of the development of the human brain and social, sociocultural and linguistic diversity, and then again add to that all of the Universe with each one of its mysteries and features of development. All this huge, multifaceted knowledge of planetary and cosmic evolution needs to be combined by one single theory.

Based on the classic research works of Charles Darwin and his predecessors, many generations of scientists in the past have proved at least *five major directions that lead our understanding of the theory of evolution to a qualitatively new level*:

Firstly, in the 30s and 40s of the 20th century there was a fusion of what were originally two separate directions of thinking; genetics by Gregor Mendel, and Charles Darwin's population-based evolutionary approach. As a result this fusion formed the developing, and up to the present time, *synthetic theory of evolution* which examines not only changes of forms (evolution of organisms), but also the development of the contents of living organisms; molecules and genes. The basis of a new direction was laid down by the works of Sergey Chetverikov, Nikolai Vavilov, Ivan Schmalhausen and Nikolai Timofeev-Ressovsky in the USSR, Thomas Morgan, Hermann Muller, Green Wright, Ronald Fisher, Theodosius Dobzhansky, George Stebbins, Ernst Mayr and George Simpson in the USA; and John Haldane and Julian Huxley in England [Krasilov, 1977].

Secondly, from the late 19th to the early 20th century, thanks to the works by Rudolf Clausius, Ludwig Boltzmann, Albert Einstein and others, the laws of thermodynamics were added to the basis of the theory of evolution, and they gained physical and mathematical justification. Later, through the works of Alexander Fridman, Edwin Hubble, George Gamow, Yakov Zel'dovich, and many others, the physical and mathematical sides of the theory of evolution became the basis of modern cosmological concepts. According to the words of astrophysicist Vladimir Strel'nitskij: "...in this century astrophysics became "fully evolutionary science". The theories of evolution of the Metagalaxy (the expanding Universe), galaxies, stars, interstellar environment, planetary systems were created, and all these theories "are stitched" well together into a single evolutionary sequence of events" [Problem of Search for Life, 1986: p.51].

Thirdly, in the second half of the 20th century, as a result of a deeper understanding of the laws of thermodynamics, as well as thanks to the

research of Jules Henri Poincare, Edward Lorenz, William Ashby, Ilya Prigogine, Hermann Haken, Jean-Marie Lena and many other scientists, it was found that in general, all the existing systems in the world contain both elements of order and disorder. A model of dynamic chaos was developed and proposed by a pleiad of researchers that united fully deterministic and principally random systems. This model became the basis for better understanding the evolution of different systems combining mechanics, thermodynamics and a model of development of biological systems. It showed that chaos at the micro level can lead to ordering at the macro level. Moreover, it was found that in a variety of real-life situations, ordering cannot be separated from chaos, and chaos is in a super complex association with ordering. Chaos and order "live" together [Gorbachev, 2000]. In the scientific area were introduced such concepts as "self-organization", "synergy", "non-equilibrium thermodynamics", "attractor", "fluctuation", "open system", "bifurcation point" and many others.

Fourthly, an essential point in the understanding of the process of evolution, especially the evolution of complex systems, was reached thanks to a deeper understanding of the Fibonacci numbers and Bohr's complementarity principle (the complementarity principle is one of the most important principles of quantum mechanics, formulated in 1927 by the Danish theoretical physicist Niels Bohr. According to this principle, for a complete description of quantum-mechanical phenomena it is necessary to apply two mutually exclusive ("additional") sets of classical concepts, the totality of which gives comprehensive information about these phenomena as holistic. For example, the additional, in quantum mechanics, is spatiotemporal and energetic, impulsive systems.). As was noted by Professor Vladimir Gorbachev: "... essentially, the Fibonacci numbers are becoming a backbone factor of the harmonic self-organization of a living organism. In this sense, evolution is not simply adaptation of an organism to external conditions and its desire for harmony, [but is the] proportionality of the entire body as a whole and functioning of its internal organs as parts" [Gorbachev, 2000: p.38].

It should also be noted that through the harmonious development of an organism as a whole, as well as its parts, it is well aligned with the universal: Bohr's complementarity principle for all of modern science. As applied to the considered problem, he rejects the possibility of the understanding of life and its evolution through the isolation and examination of body parts: defining more precisely one side of a living object, we lose absolute clarity in the understanding of the other one.

Fifthly, while the synthetic theory of evolution considers the deployment of life as a process of divergence of species, the American biologist Lynn Margulis created a modern version of the theory of symbiogenesis in which she reasonably argues that the formation of new complex essences through the symbiosis of previously independent organisms has always been of a more powerful and important evolutionary force. The theory of symbiogenesis (the symbiotic theory, the endosymbiotic theory, the theory of endosymbiosis) explains the mechanism of occurrence of some organelles of a Eukaryotic Cell: mitochondria, gidrogenosom and photosynthetic plastids. According to Lynn Margulis and Dorion Sagan: "Life got the upper hand over the planet, not in the battle, but gradually enmeshed it in its mesh" [Capra, 2003: p.226].

However, despite the undoubted successes in the research of evolution and the evidence of the fact of evolution, philosophical and scientific understanding and even intrascientific (multidisciplinary) understanding, it would seem that a uniform process at the scale of the Material World is significantly different. In the early 20th century, in the article "The Concept of Evolution and Crisis of Evolutionism", the well-known Russian biologist and philosopher Alexander Lyubishchev wrote: "When about one and the same, on the basis of generally identical materials, such diverse opinions are expressed, then it is natural that the question arises; it is no mistake. May be it occurs because one puts in the word a completely different context." [Lyubishchev, 1982].

In this work, defining different contents of evolution and indicating the opposite concepts, Lyubishchev emphasized four main antitheses, aporias [Lyubishchev, 1982]:

- Evolution (transformism) and constancy;
- Evolution (preformation) and epigenesis (Preformation and epigenesis are the concepts of natural philosophy, designating opposing views on the formation of an embryo: preformation describes initial availability of all the structures in an embryo which then grow into organs, epigenesis, on the contrary, indicates that development of an embryo involves the emergence (from structureless matter) of all its organs.);
- Evolution and revolution;
- Evolution and emanation (Emanation in philosophy is a conceptual term for the origin of the Universum (Universe) by the expiration of it, from the transcendent First Principle, the One (Godhead)).

At the beginning of the 21st century the famous Russian biologist and specialist in the theory of evolution Vladimir Levchenko, developing the ideas of Lyubishchev, Schmalhausen, Berg, Lima de Faria and others, pointed out that "evolution" as development (in cosmology) and "evolution" as evolution (in biology) are, in fact, different things referred to with a single word, in view of that fact, there are long processes of change to be considered [Levchenko, 2003; Levchenko, 2012].

Understanding of evolution in philosophy and science varies (cosmology, biology, and neurobiology), and as a consequence, these variations lead to different understandings of the factors and causes of evolution. As a result, evolution of the Material World loses its integrity, consistency and commonality, and it turns into "conceptual chaos" in which the specialists of various disciplines oppose and explain uniform processes and phenomena for the whole of the Material World, but do so from the standpoint of their specialization.

From the author's point of view, the formalization of evolution, as well as the factors and causes, enable the combination of scientific and philosophical conceptions of evolution and allow for its representation as a formal universal model as closely aligned as possible to the doctrine - variaformizm [Zawadzki & Kolchinsky, 1977]. Relying on scientific and philosophical methodology, this work attempts to imagine the process of evolution, and the development of evolution, i.e. in a uniform understanding for cosmology, biology, neurobiology and philosophy.

CHAPTER TWO

THE CONCEPT OF EVOLUTION IN THE MODERN SCIENTIFIC THEORIES

Traditionally, evolution of the Material World is considered in cosmological and biological theories, as well as in philosophy. In the past few decades, evolution started to be considered in neurosciences, in particular as neuroevolution. Let us consider what meaning is nested into the term "evolution" by modern cosmological, biological and neurobiological evolutionary theories (models, concepts).

I. The Concept of Evolution in the Cosmological Models

The Ukrainian specialist in the field of cognitive philosophy, Iliana Vladlenova considers that the use of cosmological simulation is a necessary limit caused by the "...complexity of processes and phenomena occurring in the Universe, as well as an increase in the pace of mathematization and the expanding of its scope" [Bazaluk & Vladlenova, 2013: p.51]. In Vladlenova's understanding, the cosmological model is "...object-deputy of object-origin, which provides a study of some features of an original, giving information about its most important features" [Bazaluk & Vladlenova, 2013: p.51]. Cosmological models are physical and mathematical models, attempting to describe *the development* of the Universe as a whole.

At present in cosmology, the Big Bang Theory is universally recognized, explaining the two most significant facts of cosmology: the expanding Universe and the existence of cosmic background radiation. Based on the Big Bang Theory, the modern Standard Cosmological Model was built: the Lambda-CDM Model (Lambda-Cold Dark Matter). The alternative to the Standard Cosmological Model of the Universe is the Stationary Model of the Universe, which formed the basis for Newton's cosmological model.

The principal difference between the Standard Cosmological Model and the Stationary one regarding the evolution of the Universe is that the former is based upon Einstein's gravity and geometrical representation theory, while the latter is based upon the achievements of the classical mechanics of the 17th and 18th centuries and explains the movement and interaction of studied cosmic objects on the basis of mechanical laws.

In the modern Standard Cosmological Model Lambda-CDM, the evolution of our Universe is presented as a catastrophic process of rapid expansion, accompanied by an intensive fast varying gravitational field. In the course of perturbation expansion, the spontaneous birth of the space-time metric occurred in a parametric manner, from vacuum fluctuations [Bazaluk & Vladlenova, 2013].

Iliana Vladlenova identifies the following stages in the development of the Standard Model of evolution of the Universe [Bazaluk & Vladlenova, 2013]:

- Fridman's theory;
- De Sitter's cosmological model;
- The model of the Universe as association theory;
- The cosmological model of chaotic inflation;
- Brane cosmological models;
- Kaluza-Klein cosmological models;
- Supersymmetric cosmological models;
- Cosmological models in String theory (ekpyrotic and pre-explosion scenario);
- The model of loop quantum gravity.

The birth of each cosmological model expanded scientific and philosophical understanding of the evolution of the Universe, and to a varying degree aspired to reach dominance over the Standard Model.

We will not consider the shortcomings of cosmological models in terms of their scientific adequacy (this question is raised in many scientific and philosophical works already, e.g. in the works of Steven Weinberg [Weinberg, 2004; Weinberg, 2013]), we are interested in how is evolution represented in these models? We must take into consideration that until recently cosmology remained more of a philosophical discipline than a scientific one, and only due to results obtained from particles in physics being related to the theory of the Early Universe have cosmological

models acquired the status of scientific models. Perhaps, therefore, between philosophical and cosmological views on the evolution of the Universe there is much similarity.

Considering the concept of evolution in the Standard Model (with the great number of cosmological models having formed it), we can note the following:

1. The Standard Model relies on consideration of the structure of space and time, and the *regular* formation of substances, fields and their derivatives. That is, it tries to recreate exclusively *Physical Reality*, as the correlation of "objective reality" (physical world) with the content of the categories of the subject and object of knowledge. Currently, in the methodology of modern physical knowledge, Physical Reality is understood as three closely interconnected realities "Objective Reality" (the physical world), "Empirical Reality" (the observed or experimental) and "Theoretical Reality" (the world of constructs, theories and models). Thus, in the Standard Model of evolution we see the *regular* formation of substances, fields and their derivatives.

2. In modern cosmological models there is no clear separation of the factors of evolution. For example, in the theory of British physicist James Jeans Hallwood, he identified the main factor in the evolution of the Universe to be gravitational instability: matter cannot be distributed with a constant density in any volume [Hramov, 1983]. In the Standard Model Lambda-CDM the major factors of evolution are the accelerated expansion of the Universe and the spontaneous creation of space-time metrics.

3. In cosmology, the division of evolution is accepted to involve: 1) evolution in a microcosm, which is considered by quantum physics and its main theories – quantum mechanics and quantum field theory; 2) evolution in a macrocosm, which is described by the general theory of relativity and other pre-quantum theories. To create a theory that combines evolution in both a microcosm and a macrocosm has not proven possible yet.

4. The Standard Model postulates the absolute dynamic dominance of the *exotic states of matter* – vacuum-like dark energy and non-baryonic cold dark matter. This led to the main parameters of cosmological models being determined by substances of unknown origin, and the observed substances in conventional forms (stars, gas, and dust) account for only a small

fraction of the total mass density. To explain the observed structures in the framework of the Standard Model, the dominant hidden mass in non-baryonic form and also in a cosmological vacuum are added [Bazaluk & Vladlenova, 2013].

Moreover, as was noted by Iliana Vladlenova, the model of chaotic inflation, which is used by a significant number of physicists, manifests itself in the presence of an infinite number of other Universes that occur in a scalar field, in different areas, at different times, forming a space-time foam; so-called "entrances" in the tunnels that exist in the initial scalar field and connect different areas of the Universe and other Universes that are not found. Moreover, for the existence of wormholes, matter is required to have an unusual equation of state, such matter is only a hypothesis [Bazaluk & Vladlenova, 2013].

5. In the Standard Model, there is no clear answer about the causes of evolution. There is a general understanding of the "Big Bang", "inflation", "point singularity", actions of the definite laws, fundamental constants, etc. However, all these "scraps" of knowledge and assumptions only *postulate* and *allow* for a definite amount of meanings which are often presented as "the absolute truth". None of the existing cosmological models is able to articulate and justify the greatest factors and causes of the evolution of the Universe at the scale of Cosmology.

The reason for the evolution of the Universe is the movement of matter, which follows on from the facts of the "Big Bang", or inflation. In cosmology, any movement involves physical interaction. Physical interactions occur as movements of matter, and any movement can include various types of interaction. There is no movement in which there would not be any interaction, as there is no interaction without movement. The interaction and movement are the forms of existence of matter. Physical interactions are transmitted by physical fields with the ultimate speed not exceeding the speed of light in a vacuum. At present, in cosmology there are four conventionally accepted fundamental interactions: gravitational, electromagnetic, strong nuclear and weak nuclear.

6. In the Standard Model, evolution is divided into "early" and "late" evolution of the Universe, i.e. into *Pre-matter* evolution and *Matter* evolution of the Universe. In cosmology the concept of matter is defined clearly.

Evolution of the "early" (Pre-matter) Universe is evolution of a space vacuum. As recorded by the well-known Russian cosmologist Arthur Chernin, though a vacuum is called cosmic, it is present everywhere and appears as it does in the physics of elementary particles, as well as in nuclear physics, where it is the lowest energy state of quantum fields [Chernin, 2001]. The interaction of elementary particles which manifest experimentally happens *only* in a vacuum, such as the Lamb shift of the spectrum lines of atom, and the Casimir effect.

Evolution of the "late" (Matter) Universe is evolution of substance and field. Speaking about substances as a rule, we tend to talk about only one form of matter which manifests itself directly, affected by the properties of the objects around us. However, there is a second type of matter – the field of physical variables, manifesting properties in physical measures by instruments. The possibility of combining substance and field in the concept of "matter" is explained by permissibility of the introduction in both cases of single characteristics as a mass, having the properties of inertia and gravity simultaneously. Therefore, considering the evolution of the "late" Universe, we speak about evolution of matter (the Material World), i.e., evolution of substance and field.

7. Recently in cosmology a lot of scientists have been inclined to adopt the view that the Big Bang is not the *First Principle*, and is the intermediate stage of evolution: the transition from one state of substance and field to another (for example, Leonid Grinin [Grinin, 2013], Akop Nazaretyan [Nazaretyan, 2013] and others).

8. The Standard Model does not consider evolution of living substances (in the terminology of Vernadsky) and the biosphere for separate cosmic objects. The factors and causes of the evolution of the Universe do not correlate with the factors and causes of biological evolution. Accordingly, the Standard Model does not take into account the co-evolution of the cosmos and biosphere (perhaps, Cosmic biospheres), nor the degree of influence of the latter on the evolution of the Universe. Having said that, some research confirms the idea of abiogenesis – the regular transition of evolution of the Universe in biological evolution (for example Vernadsky's ideas about the biosphere, or Gaia J. Lovelock's hypothesis which reveals the close relationship of the geological evolution of cosmic objects with the evolution of Living Matter).

II. The Concept of Evolution in Biology

As opposed to cosmology, in biology, evolution is not considered in models. In our opinion, this is due to the insufficient mathematization of biology, as well as the abundance of factual material that does not require formalization and replacement. If, in cosmology, a deficit of empirical material contributes to the growth of theoretical models that fight for the right to be dominant in the Standard Model, then in biology, in recent decades only one theory has been dominant. Biological evolution is represented by *the synthetic theory of evolution*, which was able to unite most of the accumulated factual materials available. Only in seeking to answer certain questions (for example, questions of the systematic development of common environmental concepts, paleontology, embryology, etc.), do alternative theories (for example, Lev Berg [Berg, 1977], Yuri Filipchenko [Filipchenko, 1977] Alexander Lyubishchev [Lyubishchev, 1982] and others) oppose the synthetic theory of evolution. On the whole, the synthetic theory reveals the factors and causes of biological evolution at the scale of Earth.

What meaning is ascribed by biologists to the concept of evolution?

1. It should be noted that biologists have established the meaning of the concept of evolution and separated it from the concept of "development". From the point of view of biology, "development" is a more fundamental concept, denoting the processes that are aimed at improvement. For example, the famous English zoologist Peter Calow writes: "...development is a systematized process that is largely able to exhibit violating resistance, exerted on it "from the outside" (e.g., experimental effects) or from "the inside" (e.g., mutations)" [Calow, 1986: p.94].

Such development can be evolutionary and revolutionary. Evolutionary development involves gradual, successive changes; revolutionary development involves precipitous, rapid changes. Biological evolution, however, is a natural process by which animate nature develops accompanied by a change in the gene pool of the populations, and the formation of adaptation, speciation and extinction processes of species occur, as well as the transformation of the ecosystems and biosphere themselves, as a whole.

2. In the 19th and 20th centuries, in biology the concepts of the "factor" and "cause" of evolution were developed and defined. Summarizing a vast

amount of the research material on this problem, Kirill Zawadzki and Eduard Kolchinsky offer that a "factor" of evolution refers to "...any part (side, component, element) of the substratum, conditions or the driving force of evolution, which is considered in the process of its study. A factor of evolution can be any relatively discrete process, or a feature of the organization of life, if it is involved in interactions, causing irreversible adaptive transformation of the populations" [Zawadzki & Kolchinsky, 1977: p.29]. For the concept of a "cause" of evolution, Zawadzki and Kolchinsky understand "...the interaction of all factors of evolution, not only necessary and sufficient for the implementation of the evolutionary process, but, moreover, the factors which have an influence on this process from the outside, and cause, for example, a change in its tempo, or a change in the direction of parrying (protective) devices, an increase in the overall system reliability, etc." [Zawadzki & Kolchinsky, 1977: p.29].

As a result of numerous discussions, at present, biologists distinguish between four main factors of evolution: the mutation process, population waves, isolation and natural selection [Zawadzki & Kolchinsky, 1977].

Among the main causes of evolution, Zawadzki and Kolchinsky single out the struggle for existence, and natural selection [Zawadzki & Kolchinsky, 1977: p.44].

3. In biology, evolution is considered principally at the scale of Earth's geological evolution, following in the tideway of a bygone era of geocentrism (from the Greek Γῆ, Γαῖα – Earth). In contrast to cosmologists who boldly extrapolate scant facts regarding the different parts of the Universe, most biologists consider abiogenesis and biological evolution in isolation from the evolution of the cosmos, and deny the fact of the existence of other Cosmic biospheres. The synthetic theory does not suggest extrapolation to other cosmic objects, and accordingly, does not give predictions concerning evolution variants of biological organisms at the scale of the cosmos.

4. The synthetic theory of evolution does not consider abiogenesis as a regular stage of the evolution of the cosmos arising from the Standard Model of the Universe. Moreover, the synthetic theory of evolution in the modern formulation admits two variants of the origin of life on Earth:

a) Panspermia is a hypothesis about the origin of life on Earth as a result of the distribution, from outer space, of microscopic life forms. With this

hypothesis, there is a correlation to the principle of the famous Italian doctor and naturalist of the seventeenth century, Francesco Redi: that living organisms can only be born from living organisms. This principle was laid-down by Vladimir Vernadsky in the basis of his research about the biosphere [Vernadsky 1975; Vernadsky, 1977; Vernadsky, 1977; Vernadsky, 1987; Vernadsky, 2002].

b) Abiogenesis is the transformation of non-living nature into a living, for example, through a transitional state – bioinert substance. Scientific studies of the 20th century laid a strong evidence base on this hypothesis. We can note the research works of: the Soviet biologist and biochemist Alexander Oparin [Oparin, 1968; Oparin, 1977]; English biologist, and one of the founders of the synthetic theory of evolution, John Haldane; the British physicist and sociologist of science John Desmond Bernal [Bernal, 1956; Bernal, 1969]; American biochemist Sidney Walter Fox [Fox &Dose, 1975]; American biochemist and Nobel Prize winner Melvin Calvin [Calvin, 1971]; Nobel Prize winning American physicist and physical chemist Harold Clayton Urey, and many other scientists.

5. The synthetic theory admits the influence of the cosmos on the evolution of the biosphere. Herewith, it does not investigate the effect of feedback – the evolving biosphere's effect on the evolution of star systems and galaxies, i.e., on the cosmic processes. Focusing on the study of biosphere as a planetary force, the synthetic theory of evolution excludes the study of biosphere as a cosmic force, influencing the development of the cosmos.

6. In biology, as well as in cosmology, microevolution and macroevolution are considered. The term microevolution is usually understood as the totality of transformations of populations, occurring even within species; macroevolution is the process of the formation of large systematic units: of the types – new genera, of genera – new families, etc. In contrast to cosmology, in which the evolution of Microcosms and Macrocosms are considered as separate, irreducible (incompatible) theories, in biology, micro- and macro-evolution is considered as one theory – the synthetic theory of evolution. Moreover, after lengthy discussions, biologists came to the conclusion that in principle, micro- and macroevolution are a uniform process with the common factors and causes of evolution. Kirill Zawadzki and Eduard Kolchinsky summarized that the study of microevolution is the foundation of cognition of the causes of macroevolution [Zawadzki & Kolchinsky, 1977].

7. The synthetic theory considers the evolution of Man and Society within its competence. According to the theory, co-evolution of nature and society is limited by the planetary scale and explained by the laws of organization of the biosphere. From the point of view of the synthetic theory of evolution, the development of the biosphere and the noosphere is carried out under the same laws and within one (biological) evolutionary theory.

III. The Concept of Evolution in Noogenesis

From our point of view, to consider the concept of evolution at the scale of human society (socium), it is more convenient to use the concept of noogenesis.

The concept of noogenesis was first brought into scientific use in 1955 by the eminent French anthropologist and philosopher Pierre Teilhard de Chardin [Teilhard de Chardin, 1955; Semenova, 2009]. Unfortunately, he did not give a clear definition of this concept, thus in the following decades the concept took on not only contradictory meanings, but was also substituted by other concepts, such as “anthropogenesis”, “cephalization”, “neuroevolution”, “social evolution”, etc. In our view, etymologically, the concept of noogenesis is more suitable to all-encompassing evolution of the mind, the technosphere, society and culture, both in the global and cosmic scales. Therefore, looking ahead, we will not only rely on the initial meaning, but also fill it with modern scientific and philosophical argumentation, freeing it from fuzzy theistic debates.

Unfortunately, until now, many dictionaries, reference books and other information resources interpret noogenesis as part of biological evolution (e.g., Yuriy Tchaikovsky [Tchaikovsky, 2006]). In some sources, when considering the evolution of Man and Society, neuroevolution is not mentioned, only sociocultural evolution is written about. Other sources are passed over silent even about sociocultural evolution, and much is said about the evolution of technology, the third type of sources are only about paleontological excavations and the evolution of morphology, as if Man fundamentally has no other differences from animals.

In the early 20th century, the famous Russian-American sociologist Pitirim Sorokin wrote that “...all the interacting centres and all the processes of interaction can be divided into three basic forms: 1) “non-organic”, interacting centres and the interaction of the physical and chemical (the

inorganic world) are studied by physical and chemical sciences; 2) living "organic", interacting centres and the interaction of the biological (the organic world, the phenomena of life) are studied by biological sciences; 3) Finally, the interacting centres that are gifted by psyche, consciousness, and mental interaction, that is, the exchange of ideas, feelings and volitional acts (the phenomenon of culture, the social world) are studied by social sciences" [Sorokin, 1992: p.28].

In Chapter 7 we will give, from our point of view, sufficiently convincing argumentation concerning a fallacy in the consideration of noogenesis at the scale of biological evolution. Not only Pitirim Sorokin, but also a pleiad of scientists, representing various scientific disciplines, believe that the evolution of society is a qualitatively new stage in the development of the Material World (e.g. the research works of K. Tsiolkovsky, V. Vernadsky, A. Chizhevsky, N. Holodny, P. Teilhard de Chardin, V.Kaznacheev, L. Gumilyov, N. Moiseyev, B. Porshnev, A. Maneev, B. Kordyum, L. Leskova, S. Haitun, A. Ursul, A. Nazaretyan, S. Krichevsky and many others). They believe that noogenesis should be considered as neuroevolution (evolution of mind), and as a sociocultural evolution, and as an evolution of technology (technosphere).

Let us consider the concept of evolution in noogenesis:

1. In noogenesis the concept of evolution is considered, at least, in three forms:

a) As neuroevolution. In neuroevolution the emphasis is on the research of the development of neurons, neuronal populations, the nervous system and neural ensembles. Neuroevolution is a new direction in the study of the evolutionary process, barely numbering two decades of active research, so speaking about the notable achievements in neuroevolution, especially against the backdrop of the achievements of the Standard Model of the Universe and the synthetic theory of evolution, is not necessary. Over the past decade, in our opinion, the main association was with neuroevolution – namely, the evolution of Man and Society.

b) As sociocultural evolution (evolution of society). The history of research into sociocultural evolution dates back a few thousand years, and it started from the philosophy of ancient India, to the modern large-scaled generalizations of Samuel Huntington [Huntington, 2003; Huntington, 2003a] or Fernand Braudel [Braudel, 2008]. In this case, there is a shift