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FUNDAMENTAL ECOLOGY IN THE CONTEXT CHANGE OF SCIENTIFIC PARADIGM

Abstract. *The article is devoted to the search for criteria for the definition of ecology as a fundamental science on the example of the emergence of scientific paradigms: quantum mechanics, nonequilibrium thermodynamics and synergetics. The features of the field device of matter on the basis of the continual electromagnetic field are analyzed. This opens up new perspectives for fundamental ecology in carrying out studies of the real interaction between the components of nature. The continual electromagnetic field of the aquatic environment is considered as the determining condition for the formation of the living matter. The conclusion that the water environment and the gravitational field is a universal system-forming space necessary for the emergence of the life process is substantiated.*
Key words: *fundamental ecology, living matter, continual field, synergetics, technogenic influence.*

Self-consistent systems and continual electrodynamics

The concept of primary matter in physics is builted on the basic ideas of the existence of particles, which are associated with the concepts of atom and matter, on the one hand, and on the other hand, with the field – a special form of matter through which the interaction of matter particles and material bodies is determined at a distance.

Further development of this ideas led to the emergence of the concept of a self-consistent field in physics and was first formulated of the study of a multielectron atom, and subsequently transferred to plasma and aqueous solutions of electrolytes. This field was interpreted as the averaged field of a set of moving electrically charged particles, but in general electrically neutral systems. For atomic systems, the methods of quantum mechanics were used, and for methods of statistical physics, for plasma and aqueous solutions of strong electrolytes.

It is shown in [8] that charged of particles of matter can also be referred to self-consistent systems. *The features of self-consistent systems are determined by the fact that the field distributions in them depend on the properties of the space in which they are located and are related to the characteristics of the field, its structure*.

Since the late 19th and early 20th centuries, many scientists have been working on the idea of constructing a theory of structural particles using the equations of classical electrodynamics (Maxwell's equations). Among them are such famous scientists as G. Lorentz, G. Mi, D. Hilbert, G. Weil, A. Einstein. "Maxwell's equations in their original form did not allow, however, to give such a description of the particles, because the corresponding solutions contained a singularity. Therefore, theoretical physicists have long tried to achieve the goal by modifying the Maxwell equations. But these attempts were unsuccessful"[1, c. 213].

Here is what Einstein wrote about G. Mi's efforts to construct a continuum theory of moving electrons: "Mi attempted to eliminate this disorderlyness of the theory by trying to develop a continual theory of electrical particles. In this theory, the current density components were considered as continuous functions that are related to the "field" like the components of the electromagnetic field itself, and thanks to additional field equations this behavior of the current density is completely causally determined. Although this attempt has so far been unsuccessful, it continues to be a leading program even outside a purely electrodynamic area (Weil, Eddington)" [2, p. 199].

The idea of continual theory reflects the possibility of constructing a field concept of matter, reducing, in essence, the materialized part of the primary matter to the field, determining the primacy of the field (the continualy field) in the construction of material objects. If this concept is true, then some dualism disappears in the fundamental concept of materiality in physics, and the possibility of the existence of a single field, supported by many scientists and, in particular, actively supported by A. Einstein, becomes obvious. Here is what the author of the General Relativity wrote: "Since the general theory of relativity implies the description of physical reality by a continuous field, neither the concept of particles, or material points, nor the concept of motion can be of fundamental importance. A particle can act only as a bounded region of space in which the field strength or energy density is particularly large" [3, p. 725].

This idea was not realized, although many scientists fought over its embodiment.

But in the middle of the 20th century physicists were carried away by searches for the peculiarities of the structure of elementary particles of primary matter, the formation of the universe, the development of the nucleus, and forgot about the equally complex and mysterious problem of the formation of thinking matter-living matter. But the idea of a unified field theory has gone to the background.

The attempt to construct of a continual theory within the framework of the modification of Maxwell's equations is doomed to failure in advance because they are based on experimental data summarized in the form of four laws well known from the school course of physics. The equations of classical physics can only be finalized, using experimental data, new or well forgotten, but so familiar and simple that, as it were, not deserving of attention. But G. Cavendish's experimental research on the electrical properties of conductors, which he conducted before Coulomb's results, is known. A simple connection was established between the charge (electrical characteristic) on the conductor, its capacitance (this it can be considered as a property of the space on which electricity is distributed) and the value of the potential (field characteristic). In integral form, this is the establishment of a self-consistent distribution of electricity (charge) on electricity-conducting systems. This experimental fact is independent of the known four laws of electrodynamics and can be used as a basis for obtaining a differential equation for the distribution of a self-consistent field in conducting media.

The starting point of the system of equations of the continual electrodynamics is the experimentally grounded idea of a self-consistent distribution of electricity on conductors and in conducting media (plasma). Using the formal technique of four-dimensional recording of the obtained differential equation for the electric component of the self-consistent field, it is easy to obtain the corresponding equation for the magnetic component of this field. Thus, four equations of classical electrodynamics can be supplemented by two equations of the self-consistent field,

without changing the fundamental system. This expands the possibilities of electrodynamics in describing of aggregate the present set of electromagnetic systems.

In these papers, the possibility of constructing a unified field concept of self-consistent systems within the framework of continual electrodynamics was investigated. The equations of classical electrodynamics find fields by specifying the distribution of sources (fields), and the equations of continual electrodynamics operate with the properties of space-the ability to contain, accumulate, transform, conduct it in accordance with A. Einstein's idea: "... Empty space, i.e. space without a field does not exist. Space-time does not exist in itself, but only as a structural property of the field" [4, p. 758].

In [7, 8], a field approach was used in the framework of the continuum electrodynamics equations to study the properties of structural matter particles and the interaction of ions in aqueous solutions of electrolytes. The unified concept of the continual theory, which is valid for describing a number of properties of the microworld, turned out to be productive when it was used to describe the properties of a cold plasma (aqueous solutions of electrolytes).The difference is that if the continual theory reflects the field aspect of the properties of matter for microsystems, but then, when it is transferred to macrosystems, the continually (field properties) is refracted at the macro level to the property of a self-consistent distribution of volumetric electricity and fields from a system of charged particles.

At this level matter already exists in two formations in the form of matter (particles, ions) and field (self-consistent).

It is the equations of continuum electrodynamics that make it possible to specify the direction of scientific research in the fundamental ecology of living matter when studying the totality of the corpuscular and field aspects of its properties.

Historical excursion – the dynamics of notions about ecology

At the present stage, the science of ecology is often perceived through the prism of a practical approach, that is, of the damage that the human activity brings to the environment. This discord the original formulation of ecology primarily as a science, given by Haeckel as far back as 1866: "By ecology we mean the sum of knowledge relating to the economy of nature: the study of all animal relationships with the organic and inorganic components of the environment, including necessarily its friendly or hostile relationship with animals and plants with which it comes into contact. In a word, ecology is a science that studies all complex interrelations and relationships in nature, considered by Darwin as the conditions of the struggle for existence" (quoting from [5]). And if in the nineteenth century technogenic problems were practically not felt, the community was practically in a natural habitat (it is possible to model the system as ideal), the twentieth century appeared before a person in a completely new situation – with the consequences of his of production activity – with problems of community exit from the natural environment habitat in the natural system he has changed. And this requires the development of new approaches and the study of the underlying causes of the impact of the changed conditions and the consequences of such changes.

The problems are now so acute that the concept of fundamental ecology has fallen out of the scientific context. But the task before the ecology was put by of another – it was seen as "a science that studies all complex interrelations and relationships in

nature". All the achievements in the field of habitat protection are based *on the use of already existing knowledge on the types of technical threats and objects of impact*. Ecology has evolved into an applied knowledge branch with safety rules developed, there was a reformatting of the original understanding of ecology in society.

But the current pace of development of the community puts on the agenda the issue of expanding the tasks before the science of ecology, which would allow to expel possible threats. In particular, for of living systems, taking into account new knowledge in the emergence and functioning of living matter, its interaction with high-frequency radiation, which is not so obvious as with other technogenic components (chemical, radioactive, acoustic, mechanical, etc.).

What is under influence? There is a concept of "living matter". This term has a philosophical content, but it acquires a specific meaning precisely in ecology, when a question is posed it is about of the concept of "living matter" and its distinctive features. In [6], an analysis is given of differences between living and physical matter. This difference consists in the presence of an aqueous solution of electrolyte in practically all living objects and is obvious influence of external fields on water systems, as described by many researchers. And the fact that the electromagnetic field in water systems is self-consistent (continual) and this plays a special role in the structuring of biological systems in the context of "living matter", but somehow in the scientific literature was not very noted and was not investigated studied in detail.

The problems of safe living are in close connection with modern environmental concerns. The pace of technological development of the production and living space is so great that it is necessary to realize the danger of the influence of technical devices on the environment and the person before ascertaining the sad cases of impact. Let's recall the discovery of X-rays, which was considered safe at first, and many doctors paid with their health for innovative zeal.

In this connection, the principal moment in solving the problem of security is the study and mastery of methods that allow predicting the possible impact of man-made devices on living objects. It is important to disclose the content of the concept of "environment" as a material system – substance + physical fields – especially of technogenic origin. And this can be done by examining the directions of development of scientific and technical thought, which are actualized at the present time.

But this also poses a new challenge in training specialists in the field of ecology – to move from protective measures to scientific research of the danger of using only the developed technogenic directions, technical means and methods of influence. Will not superfluous for environmentalists were interested in the latest scientific research in order to take part in monitoring and predicting the consequences of the introduction of new scientific research.

In [7] the problem of the field device of matter was investigated. The problem was express more than a hundred years ago, but due to fundamental difficulties it could not be solved within the framework of classical views. Using the methods of continual electrodynamics allowed to eliminate some difficulties and show that the structural particles of matter from which the substance is built are field formations [8, 9].

This makes it possible to explain the interaction of biosystems with landscape systems of at the field electromagnetic level, even if to exclude technogenic radiation [10]. This factor, in our opinion, should be taken into account when forming the notions of a safe environment, bearing in mind that the primary electromagnetic field

of the structural particles of matter exists and is determined, at least, by the environment, and, as may be supposed, by cosmogenic circumstances. The characteristic frequencies of the oscillations for (free particles) of the proton and neutron lie in the range: $.4 \cdot 10^{24} - .3 \cdot 10^{25} Hz$, and for the electron: $.2 \cdot 10^{21} - .1 \cdot 10^{22} Hz$. But this is another level of awareness of security (or danger), which requires an expansion of the notion of ecology in the context of studying living and primary matter within the framework of the field concept. Obviously, it is necessary to distinguish the section of fundamental ecology from the field of applied research, bearing in mind that the field concept of the structural particles of matter is at least theoretically justified [8, 9].

Any design of these particles (atoms, molecules) defines it as electromagnetic, with its own oscillation spectrum (for example, for isolated atoms – the optical range), which in many ways can determine the energy-information exchange between the components of the ecosystem.

The concept of "***ecology***", which for the first time was used by Haeckel, in our opinion, is a very broadly formulate direction of research, which is practically difficult to realize in its entirety, given the complexities of "relationships ... with ... components of the environment" as well as those introduced by man. For more than 140 years ecology exists and develops has been conceived within the framework of the paradigm proposed by Haeckel. In support of this, several modern definitions can be cited.

In [11], a definition is given – *ecology – the teaching of the relationship of organisms with the environment,* and in [12] – ecology *is an interdisciplinary field of knowledge about the structure and functioning of multilevel systems in nature and society in their interconnection*.

In [5] – *ecology is the science of the interrelationships of living organisms and their habitat,* and in [13] the author characterizes the ecology *as a science about the laws governing the formation, development and sustainable functioning of biological systems of different rank in their relationships with environmental conditions.* In these definitions, there is no new content and generalization. It should be noted that in the above new definitions of ecology only modern coloring, some a sounding and concretization are given.

The biological orientation of the definitions is also evident, which goes back to the works of the founder. The goals are blurred by the abundance of definitions and different directions: the ecology of microorganisms, the ecology of fungi or engineering ecology, chemical ecology, etc., etc. It is impossible to list everything in this work, and this shows that the ecology has not been formed into an integral science and is fragmentary. It is necessary pick out the fundamental motive, the basic idea and the vector of scientific direction.

The purpose of scientific research is to identify new laws, according to which objects can be transformed in human activity. But the impression that ecology does not go beyond ordinary knowledge [11].

If we turn to scientific research, the results of which led to new knowledge and generalizations, but they are connected with the introduction of new of generalized terminology. For example, V.I. Vernadsky in [14] with the expansion of ideas about the biosphere and the transition to the noosphere, instead of the concepts "biological systems", "organisms" was use the concept of "living matter". It has become some generalized idea of the totality of the earth-inhabiting beings, including man with his

thought activity. But, note that V.I. Vernadsky was not the first, who came to the need to introduce a new concept.

Back in 1901, the famous Russian scientist – physicist N.A. Umov [15] made a report "Physico-mechanical model of living matter". He noted that among the laws of thermodynamics there is no "law or concept that would include the processes of life in the processes of nature ... The physical-mechanical model of living matter is slenderness."

Such a law was opened in 40 years and was formulated in the works of I. Prigozhin, H. Khaken [16, 17] on the basis of development of thermodynamics of irreversible processes. It is obvious that at the present stage of knowledge development the of "slenderness" can be fully correlated with the term "self-organization", which arose on the basis of work in the field of thermodynamics of irreversible processes.

The discovered by them laws have made it possible to advance considerably in the understanding of the formation of living matter and its inseparable connection with the surrounding space.

It should be noted that during the first decades of the 20th century, a scientific paradigm shifted in physics. There appeared such directions as quantum mechanics, the theory of relativity, which led to a new understanding of space and time, to the inapplicability of the Newtonian mechanics to microsystems.

In [18] E.S. Bauer (20–30th years of the XX century) "Theoretical Biology" the following statement is made: "Biology is a science ... about the laws of motion (in the broadest sense of the word) of organized living matter". However, this definition of biology does not disclose the content of "living matter", but there is an obvious attempt to change the paradigm in biology.

Such an understanding of biology, if it had taken root, would have allowed a deeper review of the current problems in the environment and formed a section of fundamental research, but this was not done for various reasons.

Why did not the paradigm change in ecology happen? In our opinion, the lack of a clear idea of the difference between the two concepts of "living matter" and "primary" or "physical" matter did not allow expanding the research range in the ecology..

The subject of the study of fundamental ecology

It is necesssry to precisely define the subject of research for this, it is necessary to clarify the content of the concept of living matter, concretize it.

What is known today? All biological systems are composed in 70–80% of water or, more precisely, an aqueous solution of electrolyte, in which a self-consistent electromagnetic field is formed [19, 20]. The achievements of the thermodynamics of irreversible processes indicate the possibility of the formation of self-organized systems. And biological systems are formed in an aqueous medium against the background of the action of a self-consistent second-level field, the field of solution ions. All this is generalized in the form of the definition of living matter [6]:

Living matter is a two-level self-organized system, it, unlike physical, includes both the first level of self-organization, and the second level of self-organization, which is determined by the exceptional existence of a self-consistent field of aquatic environments.

In [6], the definition of ecology as a science was formulated as follows:

Ecology is the science of the forms of living matter and its movements, which is part of complex systems, the interaction of this form of matter with primary matter and technogenic factors

In the definitions presented is visible direction of ecology as a science for the study of biological systems, *but already at a fundamental level – as living matter*. What is the object of research in this proposed paradigm?

In the fundamental view of physics about matter, two aspects are defined: substance and field. For living matter, perhaps, we should also look for two components. The question is, can an idea true for physical matter – substance + field – be transferred to living matter – the living matter + the field of living matter? But the field aspect of the structural particles of matter (theoretically grounded in [8, 9]) in dilemma the "substance-field" puts the field ***as the fundamental factor for of all matter***. Thus, the "field of living matter" can acquire a finished physical meaning. Of course, this requires strenuous additional research.

The current rates of development of science and technology put the issue of the development of a direction in the ecology that would allow forecasting threats that go beyond the experience accumulated by the applied ecology. In works [20, 21], scientific data of scientists that worked in the direction of studying the fields of bioobjects, as well as the effects of external fields on similar systems were analyzed.

As a result of the analysis, a special vulnerability of living systems to the influence of high-frequency radiation became apparent.

When studying the fields of living matter, many authors note the role of "field self-organization of biosystems" linking the electromagnetic field with of information saturation.

In [22] the thought is considered that *"the hierarchical organization of the biosystem corresponds to the basic principle of self-organization, that is, the presence of a non-local self-consistent potential, the effect of which manifests itself in a complex but closely interrelated EMF construction, creates the most stable form of organization of the biosystem that allows it to function as an holistic organism against the background of the environment and in indissoluble unity with it. "* It is difficult to disagree with the statement, although the idea of "self-consistent potential" was used in physics long before the publication of the cited work. Here we are talking about plasma, solutions of electrolytes, colloidal systems and internal fields in biosystems.

At the influence of external fields on of the living matter, scientists note the almost complete openness of the biomaterial to low-intensity radiation. This is what the well-known researchers [23] draw attention to:

"The very low energy required to exert a significant influence on the functioning of organisms, the specificity of this effect, the high reproducibility of the results - all led scientists to hypothesize *... that EMR is not a factor that is accidental for living organisms that such signals are generated and used for certain purposes by the body itself, and external irradiation only imitates the signals produced by the body. "*

After the analysis of the action of waves in the millimeter range and low intensity, the researchers came to the conclusion: *"... that, penetrating into the body, these radiation at certain (resonant) frequencies are transformed into information signals that carry out manage and regulation by recover or adaptive processes in the body"* [23].

The field structure of matter makes it possible to reflect on the fact that this idea should be developed, but at the level of continual electrodynamics. Is it possible the existence of such a form and laws of electromagnetism that would allow self-consistent description of the harmonious existence of currents and fields, providing a thought process in living matter and interaction with external sources?

All objects without exception are subject to high-frequency influence. But the number of bioobjects is so great that the study of the influence of damaging factors for each object, taking into account the peculiarities of its structure and device, becomes an unbearable task.

It is necessary to find some single factor that is common united for a given manifold. For a substance, such of a factor is its atomic structure. For living matter, such of a formation may be a macro or protein molecule, but not in a narrow biological sense (at least at the initial stage), but as some structure prone to the formation of macroobjects possessing different properties. Under given conditions, which are determined by the properties of space, someone structures are formed, and for other properties of space, others are formed. For living matter, under the properties of space should be understood as an aqueous solution of the electrolyte surrounding the molecule and is creating a self-consistent background – the second-level field necessary for the formation of a particular structure. Note that studies [8, 9] have shown that it is the properties of space that, to a certain extent, interdependently form physical fields that become possessors of certain structural properties.

Macromolecules, protein formations are those "atoms" of living matter, of which, in the aquatic variety, under the influence of the second-level continual field (with a minimum effect of gravity) is formed, what is called life is formed [9]. Note that the formation of the primary matter occurs of from particles in a vacuum also in the minimal gravitational field.

The creation of a new paradigm in physics was determined by studies of the thermal radiation of a solid body and line spectra of atoms (the theory of relativity is not touched because of its remoteness from the problems in this study for living matter). But there an investigation of the emission spectra of protein molecules and their interaction with external fields of high frequency, but of low intensity, may be of great interest to ecologists. Ecology should come out of the captivity of the guarding paradigm, although this component is immortal, like classical physics, and to turn to of the real situation – the anthropogenic load affects not only human health, but changes it, affecting the systems responsible for species conservation. Directly according to by Haeckel – the relationship of the animal with the inorganic components of the environment. Here, ecology can find its niche.

It is the new paradigm in ecology and formed **on it basis of the fundamental ecology** is must conduct research on the impact of anthropogenic loads today, realizing that the aquatic environment is the center through which formed all the living [9].

The change in the properties of such a center under the influence of various factors can lead to completely unpredictable consequences.

These studies in ecology will *allow new knowledge about the basic laws of nature, on the interaction of elements of living matter with external fields.*

Synergetics and Ecology

One should pay attention to new preferences in modern science, in particular, on ***synergetics***. Some of her ideas in connection with the problem of living matter and ecology were discussed in [19]. Turning to the above definitions of ecology formulated by scientists in different years, it is possible to single out the main motive, which unites them. The main idea reflects the interaction of living matter with elements and systems of the environment and inanimate matter. At the same time is fixed the idea of self-organization in such open systems. Synergetics is a modern scientific theory of self-organized systems and instability phenomena that determine the evolution processes. S.V. Levina writes in his article [24]: "In the second half of the 20th century, thanks to the scientific revolution associated with the name of I. Prigogine, a transition to a new synergetic picture of the world took place, in which from of a unified position is described the majority of global processes and the development of all natural systems. Summarizing a huge number of facts and laws explaining them, scientists faced the new universe. ... We can say that today there is a radical paradigm shift, a new unconventional view is emerging – a synergistic vision of the world." Although no one disputes the contribution to the development of the new scientific trend of I. Prigozhin, the authors [26] point out that V.I. Vernadsky's ideas about the new evolution of the biosphere fit perfectly into the "synergetic vision of the world". "However, synergetics has not yet formed a holistic theory of self-organization, which can equally apply to all systems of the physical world, both natural and technical. The application of this approach to ecological processes, ... taking place in ecosystems of different levels of organization, and being essentially open systems, was not an exception. Synergetics of ecological processes is a relatively new direction in the world of science, its development will make it possible to evolve natural science to an entirely new level, is approximate to the close to concept of Vernadsky's about the noosphere", the authors of [26] note in their introduction, and it is difficult to disagree with this. After all, the methods of synergetics consider processes in real systems, in contrast to the methods of Classical Thermodynamics (isolated, idealized systems). We note in this context that the equation of state of a real gas, taking into account the interaction of molecules and their sizes, was obtained by Van der Waals in 1873 (Nobel Prize of 1910). The nonlinear equation allowed us to approach the explanation of the phase changes of a real gas. And if the ecology of the nineteenth century can be regarded as the science of ideal relationships in nature, then ecology as a science in the 20th and even more in the XXI century especially into account the real properties of the system (nature + technogenic factors).

In the middle of the 20th century, in the framework of molecular physics using the concepts of thermodynamics, it was shown that for open systems, processes that occur with a decrease in entropy are possible, i.e. with the emergence of order. Opens the possibility of forming self-organizing systems and the process of "redistribution" of entropy. From "chaos, order is formed" [16, 17, 26]. This seemingly contradictory thermodynamics fact corresponds to reality and finds confirmation in the existence of solid bodies, crystals, as well as living beings, in the formation of protein structures. *(Note that the word chaos – defines two meanings: 1) the empty infinite world space of the ancient Greeks; then filled with a formless primitive matter, and from this the primitive of matter over time the universe was formed: 2) figuratively, something formless; disorder, confusion [27]).*

If we assume that the Universe is already formed as a result of the Natural phenomenon and its movement is not yet subject to reason, although different theories (for example, the Big Bang) are known, then the notion of "chaos" as a secondary one in modern times has a man-made character for real systems (in contrast to natural phenomena). If chaos arises as a result of some external influence so this is some natural process. Whether it's a chemical, physical or social process. And if the man-made action stops, then the system "must" go into an equilibrium state (possibly new). For example, the effect of self-purification of a body of water is known.

"The order out of chaos" finds its explanation if we consider an open thermodynamic system consisting of several subsystems. Due to the redistribution of energy and particle fluxes, processes in one of the subsystems with decreasing entropy are possible, but with an increase in the entropy of the entire open system. Quantitatively, the increase in the entropy of the system will be greater than its decrease in one of the subsystems. Thus, violations of the laws of thermodynamics do not occur [17]. But, what can be the first cause of formation from of corpuscles of self-organizing systems? *Interaction*.

In [19] attention was drawn to the fact that the structural particles of matter (zero level of self-consistency) are electrically charged corpuscles (nucleus, shell electrons) that form self-consistent systems of the first level – atoms. Self-consistent systems of the second level are formed in aqueous solutions of electrolytes – these are electrically charged particles – ions are positively and negatively charged.

In [28, 29], the idea of the existence of a continual electromagnetic field was developed that allowed describing in the framework of the continual fields concept the properties of self-consistent systems from of charged particles (cold plasma) and the internal organization of the structural particles of matter. The existence of a continual field can be that missing link in the material picture of the world, which allows to harmonize structures from particles – to ensure the creation of "order from chaos." Indeed, structures arise because of the interaction that exists between real particles. The atom can also be considered as a field formation (continual system). Its structure can also be described by the methods of the continual electrodynamics [29].

The idea of self-organization reflects the corpuscular aspect of matter. Representations of chaos are directly based on the idea of disorder, which is possible only in the presence of a multitude of objects whose movement and position in space can not be exactly identified. Although it should be noted that "chaos" is possible either in the primary sense of the word, but this our civilization has passed, or in a figurative sense, but then this a disorder brought from outside and it should not be regarded as an intrinsic property of the system – it come out of balance. *The ideal gas and random motion of its particles can serve as an example of an infinite motion and infinite chaos*, i.e. without self-organization due to the lack of interaction between the particles.

The concept of "chaos" as a driving force in the construction of self-organizing systems is possible only on the basis of the understanding that in such a nonequilibrium process, is exist the various options of interaction of its components in for a sufficiently long period of time. The path from "chaos" to "self-organization" lies through the restrictive role of physical fields, for example, electromagnetic and gravitational, reducing the number of degrees of freedom for the original structures. In the implementation of a structure that is optimal under given conditions,

determining factors are the energy of the system and the interaction between parts (deviation from ideality) [19].

And if the problems of the ecology of the nineteenth century could be studied in the context of the "ideal gas" (in the absence of a noticeable technogenic influence), *then modern ecology obviously should already use the services of the theory of open systems (real), when technological factors can have a greater unnatural role (pernicious role).*

Conditions for the formation of self-organized systems

The idea of the field can serve as a certain antipode to chaos. This is easy to understand with formal consideration. Distributions in time and in space of known to date fields (mainly electromagnetic and not only) are described by partial differential equations, and their distribution is strictly regulated and harmonious. This is confirmed experimentally. The field can serve as a regulating and guiding factor in the formation of self-organizing systems. Chaos in the field is impossible, and the excited state of the field is called a wave. And in any case, the wave can be represented as a set of harmonic waves of different frequencies.

The photon model of the field or the idea of gamma quanta is a corpuscular interpretation of the field, but these particles do not possess a rest mass, and it is hardly possible to justify the formation of self-organizing systems on their basis. And their harmonizing role in building self-organizing structures should not be ruled out.

One can conclude, therefore, that order from chaos is possible only thanks to the field structure of corpuscles (corpuscles – field structures – the idea of A. Einstein), the field nature of particle interaction, which provides a certain direction in the formation of self-organizing systems. We note that the equations of continual electrodynamics [28, 29], which allowed us to describe the field architecture of the structural particles of matter, were obtained as early as 1978 and published in [30, 31]. First, they were considered as the self-consistent field equations for electromagnetic systems applied to the theory of cold plasma physics (aqueous solutions of electrolytes).

Later in [28, 29] it was shown that the field equations of self-consistent systems satisfy the condition of relativistic invariance (Lorentz) and they can be considered as equations of continual electrodynamics. The self-consistency of the dynamic system is already "embedded" in the continuum field equations, and, therefore, it can be assumed that both self-organization and irreversibility for thermodynamic (electrically neutral) systems are predetermined by the action of at least weak, but fields.

Self-consistent systems reflect only a particular case of the interdependent distribution of interacting particles – electrically charged, and self-organized systems reflect a wider range of interacting particles, electrically neutral and with lower interaction energies. But the time for the formation of "order" for of such systems (the formation of structures) is much greater. The emergence of order from chaos is a natural process ***for real interacting systems and irreversibility is a reflection of interactions and a change in external factors*** (for example, a violation in the balance of energies).

The existence of self-consistent, continual subsystems creates the conditions for the formation of more complex self-organizing systems. The following implementation scheme is possible:

– structural corpuscles of matter – electrically charged particles protons and electrons – formations from the continuum field – field structures of zero level. They (field structures) form self-consistent systems of the first level (atoms), which can be considered as self-organizing systems (atoms – electrically neutral corpuscles), although historically they were entrenched in concepts like self-consistent systems;

– the field nature of the interaction between atoms leads *to the formation of self-organizing systems of the first level* from atoms and molecules. This substance, for example, crystalline formations, liquids;

– charged particles of the second level – ions, the most natural environment of their existence is water, they form self-consistent systems of the second level [19]. Their properties are also described by the equations of continual electrodynamics [28, 29]. The existence of a continual field in self-consistent aqueous media, leads to the formation of *self-organizing systems of the second level – protein forms.* Presences the of continual electromagnetic field of ions of aqueous solutions of electrolytes and weak gravitational field [8] is the background on which the formation of self-organizing *living matter* takes place. Perhaps these components in water environments create *the necessary information background and conditions for the emergence of the life process (Life).*

The considered scheme of structuring of self-organizing systems opens the possibility for carrying out a general classification of anthropogenic impact on the components of the environment. For example, this allows us to identify the factors that directly affect the biological component and the direction of possible changes in this component. Since the living organism consists of water, an aqueous solution of electrolyte, i.e. is a self-consistent system of the second level, then such a system is most sensitive to the action of the electromagnetic field. The field changes the equilibrium conditions of self-consistency in the system, which will lead, first of all, to a change in the metabolism of cells, but with prolonged exposure to the appearance of structural changes. This is due to a change in the conditions for the formation of a self-organizing second-level system. This and similar classifications are of great importance in the analysis and systematization of the possible consequences of various man-made disasters [32].

The role of water as a container of self-consistent systems of the second level – aqueous solutions of electrolytes, polyelectrolytes – is fundamental in the emergence of the biological form of matter – of living matter.

New results in the field of the field concept of matter, mentioned at the beginning of the article, show that the biological orientation of modern ecology and, accordingly, safe vital activity, must move to the field of investigation of the interaction of molecular structures with electromagnetic fields of high frequency. And this means the transition to the field of field properties of structural particles of living matter, which, perhaps, will allow us to reveal the effect of the of continual fields of the structural particles of matter (proton and electron) on the stability of biosystems.

It seems interesting that the safe vital activity of a person is directly related to his social status as a thinking subject. And this, according to V.I. Vernadsky, creates a "geological force" that processes the biosphere into the noosphere. This in modern conditions can not be ignored by specialists in the field of providing safe living. Moreover, the results of scientific research in the field of the field concept of matter make it possible to make an assumption about the field device design of think process

Moreover, the results of scientific research in the field of the field concept of matter make it possible to make an assumption about the field design of the result of scientific thinking.

The idea of the "processing power of scientific thought" developed by an outstanding naturalist V.I. Vernadsky back in the 30s of the twentieth century. In the work "Scientific thought as a planetary phenomenon", included in the collection [14], and this is true today, he writes that: "... now, over the past 10–20 thousand years, when a man, having developed a scientific thought in the social environment, creates in the biosphere a new geological force, in it not former. The biosphere has passed, or rather goes into a new evolutionary state – into the noosphere, is being reprocessed by the scientific thought the social humanity".

Such an idea can be realized only by relying on of the field concept of the materialization of thought, defining it as a planetary phenomenon [33]. But, of course, for the physical substantiation of such a concept it is necessary to conduct careful theoretical calculations and experimental support. At least in the context of the continual electrodynamics, in [8] it is to show the productivity of the field concept for structural particles of matter, constructing a theoretical model of the wave nature of a proton and an electron. This gives the chance of ecology to reflect the connection of living and inanimate matter as a property of a single physical space.

In a detailed analysis of the contribution of scientists and many schools to the development of a new scientific direction presented by the authors in [25], would like to draw attention to one feature, as in [26], of connected with the prevalence of the materialized view of the process of synergism. It is clear that considering the social processes of interaction in society and in macrosystems, it is difficult to depart from the use of the knowledge of physics of the microworld in the study of various interacting the social subsystems. But the famous idea of I. Prigozhin about the origin "Order from chaos" is unlikely to be solved without attracting the notion from of the role of the field (not only physical), but also social in a broad interpretation. Examples of the emergence of order from chaos from the field of physics of molecular systems, such as the Belousov – Zhabotinsky reaction, are positive only because of the existence of physical fields of electromagnetic nature in the space where the reaction takes place. But the transfer of the idea of "the order of their chaos" to the study of processes in social spaces without a field (in the broad sense – the idea, the regulatory factor), the harmonizing structure, is unlikely to lead to order.

In the present work, it was mentioned that the structural elements of matter can be considered as field structures of the continual field [7, 8]. This proves that all the systems surrounding us, and ourselves, in fact, consist of field structures [9], and the emergence of chaos and the way out of it without the participation of a field agent are not possible. Harmonization is related to the field architecture of matter as a structural property – micro- and macro- of spaces.

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ФУНДАМЕНТАЛЬНА ЕКОЛОГІЯ В КОНТЕКСТІ ЗМІНИ НАУКОВИХ ПАРАДИГМ

Анотація. Стаття присвячена пошуку критеріїв визначення екології як фундаментальної науки в контексті актуальних наукових парадигм: квантової механіки, нерівноважної термодинаміки та синергетики. Аналізуються особливості польової будови матерії на основі континуального електромагнітного поля, що відкриває для фундаментальної екології нові перспективи у проведенні досліджень реальної взаємодії між компонентами природи. Континуальне поле водного середовища розглядається як визначальна умова для формування живої матерії. Обґрунтовується висновок, що водне середовище та гравітаційне поле є універсальним системоформуючим простором, необхідним для виникнення життєвого процесу.

Ключові слова: фундаментальна екологія, жива матерія, континуальне поле, синергетика, техногенний вплив.

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Стаття присвячена пошуку критеріїв визначення екології як фундаментальної науки в контексті актуальних наукових парадигм: квантової механіки, нерівноважної термодинаміки та синергетики. Континуальне поле водного середовища розглядається як визначальна умова для формування живої матерії. Обґрунтовується висновок, що водне середовище та гравітаційне поле є універсальним системоформуючим простором, необхідним для виникнення життєвого процесу.

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Simonov I., Trofimovych V. **Fundamental ecology in the context changes of the scientifics paradigms** // Environmental safety and natural resources. – 2018. – Issue 1 (25). – P. 77–93.
The article is devoted to the search for criteria for the definition of ecology as a fundamental science on the example of the emergence of scientific paradigms: quantum mechanics, nonequilibrium thermodynamics and synergetics. The continual field of the aquatic environment is considered as the determining condition for the formation of living matter. The conclusion that the water environment and the gravitational field is a universal system-forming space necessary for the emergence of the life process is substantiated.

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