WORLD SPIRIT FROM THE STANDPOINT OF MODERN INFORMATION THEORY

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Abstract

Based on the latest achievements of Neuroscience and the interpretation of information as a dialectical category paired with the category of matter, it is shown that the contradiction between materialism and idealism can be removed. In particular, it is shown that Hegel's views on the World (Absolute) Spirit allow for a consistent rational interpretation based on evidence that the Universe as a whole is an analogue of a neural network. This issue is confirmed by the results of modern theoretical Astrophysics. It is shown that the essence of complex systems of any nature is also revealed through an analogy with neural networks, and the key factor here is the ability of such systems to process information. This ability, in turn, leads to the emergence of mechanisms of evolution that are fundamentally different from those described by Darwin's theory. A fairly complex system acquires the ability to develop and even self-develop due to factors of a purely informational nature. In the limiting case, such an approach leads to a rational interpretation of Hegel's ideas about the self-development of the World Spirit. The potential socio-economic significance of the proposed concept is discussed.

Keywords: materialism, idealism, World Spirit, evolution, artificial intelligence

1. Introduction

The history of the last two centuries, one way or another, passed under the sign of the struggle between materialism and idealism [1-4], and the last direction of philosophical thought in the public mind was inextricably linked with religion. On the contrary, secularism in all its manifestations, in one way or another, appealed either to materialism or to agnosticism.

It is important to emphasize that the confrontation between philosophical doctrines based on materialism and idealism has found its direct reflection in almost all areas of human activity, albeit in an indirect form. The most illustrative examples here are provided by the history of economic theories, as well as the history of their implementation in practice [5]. In particular, the most

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radical form of materialist philosophy - Marxism - turned out to be inextricably linked with the attempt to build a 'refined' planned economy undertaken in the USSR.

For modern society, the problems generated by this confrontation have resulted in the acute problem of 'existential hunger' (or 'the hunger of existential divergence'), which is discussed in the current literature in various aspects [6-8]. A significant portion of people, often unconsciously, feels that human needs cannot be reduced to purely material factors. At a minimum, many people, willingly or unwillingly, wonder about the meaning of life, about man's place in the Universe, etc. Concepts based on traditional religions provided a clear answer to questions of this kind. However, the influence of traditional religions on the formation of the worldview of a significant part of people has either weakened or turned out to be significantly deformed. Radical concepts such as Marxism also attempted to answer the eternal questions, but they too failed. The inability to give an acceptable answer to 'eternal' questions gives rise to a phenomenon that can be interpreted as existential hunger.

It is impossible not to see that the roots of this problem lie precisely in the many years of confrontation between materialistic and idealistic teachings, between the views of the average layman on the world and the position of man in it that are complementary to them.

Materialistic teachings and their widespread introduction into the mass consciousness could not but have an impact, primarily on economic behaviour. More precisely, the majority of representatives of the consumer society economically behave like spontaneous materialists, even if they formally belong to one or another confession [9, 10]. Moreover, even in the symbolic fabric that permeates society, 'signs' have long been dominated, which are inextricably linked with refined consumption [11]. We have to admit that traditional religions (at least in most countries of the core of the world economic system) have largely ceased to perform the functions (both social and economic) that they performed within the framework of the traditional way of life. A clear example in this regard is the situation in Kazakhstan, a significant part of the population of which formally professes Islam. From a consistently Islamic point of view, using banking services (except for banks built on Sharia law) constitutes a grave sin (haram). However, a significant portion of Kazakhstani Muslims uses the services of banks that operate according to normal rules. Moreover, persons who are formally Muslims make up a significant part of the staff of such banks, which is categorically unacceptable from the standpoint of consistent Islam.

Factors of this kind lead to a certain disharmony of the individual, whose spiritual needs remain unsatisfied, which gives rise to existential hunger.

Clear evidence of the existence of this social demand is the increased interest in the occult, Eastern practices, etc., which has become especially widespread, in particular, in the post-Soviet countries [12], although this is also typical for many other countries historically associated with Abrahamic religions [13, 14].

In the philosophical literature of the 20th century, anti-scientist concepts have become quite widespread, criticizing the paradigms of classical science from various points of view. Criticism of scientism, among other things, was and remains connected with the fact that the paradigms of classical science reject other forms of comprehension of the Universe, associated, for example, with transcendence. Moreover, such post-positivists as Paul Feyerabend considered Science as a kind of myth [15], which largely supplanted traditional religious ideas.

Views that are somehow connected with the criticism of traditional religious views have received and are receiving no less widespread, at least in the vast majority of countries in the core of the world economic system, the influence of religion on public life is steadily declining.

Philosophical concepts, developed during the second half of the 20th century were unable to offer to the average man the opportunity to create for himself a holistic picture of the world (this is precisely the opportunity that traditional religions provided). It is significant that the average man is not able to create such a picture for himself on a purely rational basis, more precisely on the basis of understanding the information provided by specific sciences. The tools that ensure the formation of a holistic picture of the world are in one way or another connected with philosophizing.

Of course, the average man was always insensitive to philosophical reflection, but philosophical doctrines assimilated by the expert community influence his consciousness indirectly, for example, through ideas disseminated by the media. Postmodernist philosophy of the second half of the twentieth century did not develop doctrines that could become the basis for the formation of a holistic worldview (albeit in a popularized form).

Clear evidence of the decline in interest in the fundamental issues of the universe is, in particular, a sharp drop in public interest in Philosophy, even as a discipline that is mandatory for study at universities [16].

As the experience of teaching in doctoral studies in Natural sciences and technical specialties shows, doctoral students (i.e. the most successful graduates of the master's program in terms of education) have a very remote idea even about the formal content of the course 'History and Philosophy of Science', which in some post-Soviet countries is officially mandatory for all specialties of the master's degree. Nevertheless, it does not and cannot cause doubts that a person cannot help but need some judgments that give meaning to his existence, or at least serve as the basis for his self-identification and positioning himself in the world, which is impossible without the use of philosophical judgments, albeit in the most primitive form. This need currently remains largely unsatisfied, which we emphasize again, leads to a surge of interest in 'non-traditional' beliefs and practices, an increased interest in various schools of psychoanalysis and everything that allows a person to acquire a kind of surrogate that replaces a true understanding of one's place in the world.

This article attempts to show that the contradiction between materialism and idealism in their classical forms can be removed based on the latest achievements of the Natural sciences and Information theory.

Running a little ahead, we note that the term 'World Spirit' can be filled with quite rational content, which, however, does not exclude the understanding of the World Spirit as an active and active principle, at least setting the course of evolutionary processes on a global scale.

2. Neural networks from the point of view of classical dialectics

Neural networks, which currently form the basis of the vast majority of modern artificial intelligence systems [17, 18], were originally created as a result of attempts to understand exactly how the human mind functions. It quickly became clear that it was possible to offer relatively simple models of biological neurons by abstracting their most important functions. Modern artificial neural networks in the overwhelming majority of cases are built on the use of formal neurons, the functioning of which is described by extremely simple relationships.

The specific form of these relations is not of interest for the purposes of this article. It is important to emphasize something else: the very fact of the existence of neural networks serves as a significant illustration of one of the basic laws of dialectics - the law of transition from quantity to quality. Each of the formal neurons is capable of performing only extremely simple functions. However, combining them into a system really gives a new quality - such networks are able to solve more and more complex tasks. Corresponding examples are abundant in the current literature and are reviewed in [19].

As noted in [20, 21], this fact allows us to look at such concepts as 'complex system' and 'system approach' from a slightly different angle. Recall that the concept of 'complex', which goes back to the works of I. Prigogine, set and still sets [22] one of the main goals of understanding how exactly the processes of self-organization can explain the course of evolutionary processes that ultimately led to the emergence of biological life, and then - to the emergence of human consciousness. All these tasks remain unresolved, but this does not change the essence of the issue. From the point of view of classical dialectics, I. Prigogine's concept should be viewed as an attempt (in many respects, not unsuccessful) to create a formalism that would make it possible to describe the transition from quantity to quality in the language that physics traditionally uses.

From the same point of view, it is permissible to interpret the systematic approach dating back to the works of Leo von Bertalanffy, which is also widely used at present [23]. Indeed, the systemic approach was ultimately based on the idea, more than obvious from the point of view of classical dialectics - a system is something that is qualitatively different from a simple set of its constituent elements. The undoubted merit of Leo von Bertalanffy and his followers is that they de facto tried to translate this philosophical position into a language corresponding to classical natural science, which already in those years was increasingly using the ideas generated by information theory.

The concepts of 'complex' (as a philosophical category), as well as the concepts underlying the systems approach, can be combined on the basis of the interpretation first proposed in [24]. In accordance with this interpretation, any system that is able to perceive and process information is complex one. The key to this interpretation is the concept of a signal, which, apparently, can be assigned the status of a philosophical category. Indeed, there is a difference between 'simple' physical interactions (or processes) and those that, under certain conditions, carry an informational load (up to a semantic one). The most important thing is that the difference between these cases is determined not only and not so much by the physical process itself, but by the properties of the potential recipient of information.

The sounds generated by a faulty car engine will most often be perceived as noise to a non-specialist. But, for an experienced driver, they can tell a lot about the nature of the malfunction. Quite obvious observations of this kind allow for a generalization that is directly related to the problem of the origin of biological life that can give rise to Nous. Namely, all existing attempts to comprehend the mechanism of the origin of Life, in essence, suffered and continue to suffer from methodological limitations. An illustration of this statement is, in particular, the work of D.S. Chernavsky [25].

This question, however, should be asked more broadly. It will sound like this: under what conditions the system will be able to perceive exactly the signals, i.e. make a quite definite qualitative leap in its development, as a result of which the reaction of the system will be determined not by 'physics', but by 'information'? This is precisely the basic criterion for the emergence of 'generalized life', it is precisely such a qualitative leap that creates the prerequisites for the further evolution of the system, which, strictly speaking, ceases to be inert.

For clarity, it is appropriate to give another trivial example. The behaviour of a fox smelling a chicken coop cannot be described in terms of thermodynamics. The impact on the olfactory receptors is purely physical (more precisely, biochemical in nature), but in such an impact a new quality appears, which cannot be reduced to a description given in the language of Biochemistry.

The physical process is converted into a signal only due to the fact that the recipient has quite certain qualities - it is able to process information and use the results of its processing. Therefore, it can be argued that the intermediate link between 'truly inert' and 'truly living' matter is those physical (physico-chemical, etc.) systems that are capable of at least the simplest forms of information perception and processing. As shown by the results of work [26], carried out on the basis of the data obtained in [27, 28], such systems actually are implemented in Nature. Moreover, the corresponding possibilities arise in such systems only due to the fact that the systems of the type under consideration are spontaneously converted into an analogue of neural networks.

Interdisciplinary research devoted to the problems of the physical implementation of neural networks has recently received a different sound in connection with the publication of V. Vanchurin's report [29], in which a very bold hypothesis was substantiated: *the Universe as a whole is a neural network*.

This hypothesis is still very far from becoming generally accepted. However, today it can be argued that there are a number of specific examples showing that complex systems of various nature can indeed be considered as direct analogues of neural networks. Thus, in [30] it was shown that any voting body, for example, the Dissertation Council, begins to function as a Hopfield neuroprocessor, provided that horizontal connections are sufficiently pronounced. In [31], it was shown that any sufficiently large university can also be considered by analogy with a neural network.

These and similar examples confirm the conclusion that follows from purely philosophical reasoning: the criterion for distinguishing a 'complex' system from a 'simple' one is the ability to process information at the system level.

From this statement, compared with the conjecture of V. Vanchurin, a more than non-trivial consequence follows. If the Universe as a whole is a neural network, then there must be a complementary information processing system. Further, the 'universe' system should include all other analogues of neural networks that one can think of as subsystems. Therefore, if we proceed from the assumption that V. Vanchurin's hypothesis is correct not only in the physical (which is provable by means of Theoretical physics [29]), but also in the philosophical aspect, then one of these subsystems should be the human mind.

As shown in [24], the intellect, mind and consciousness of a person should, first of all, be considered as information processing systems. Moreover, such systems, in accordance with the arguments of [24], form a well-defined hierarchy, and higher-level systems either include simpler ones as components, or their components are analogues of those systems that are located at lower levels of the considered hierarchy. Therefore, if such systems as the mind, intellect and consciousness of a person are an organic (in the philosophical meaning of this term) part of the surrounding neural network, then such a network must inevitably have certain qualities inherent in the mind, consciousness and intellect of a person.

This brings us back to Hegel's ideas about the World Spirit. Information processing systems are generated by neural networks - in their physical implementation - and if the Universe as a whole is a neural network, then it is also, at a minimum, capable of perceiving and processing information precisely as a systemic integrity. This reasoning, at first glance, may seem abstract, but there is a very specific content behind it, which is also connected with Hegel's ideas about the self-development of the World Spirit: being the ultimate information processing system, it can draw data only from itself. This can be formulated through the thesis that the World Spirit cannot manifest itself otherwise than through evolutionary processes ('self-development' of the Universe as the carrier of the World Spirit).

Consequently, the constructiveness of the thesis about the World Spirit (when this concept is corrected in terms of the achievements of modern neuroscience) is substantiated, first of all, through its applicability to the description of evolutionary processes.

3. Neural networks and self-development of Hegel's World Spirit

The origin of Life and Nous has been and remains one of the most fundamental problems that Natural science has never been able to solve. There are very ingenious attempts to solve this problem, but they rather demonstrate the methodological limitations of the apparatus used by modern natural science [25, 32, 33].

Let us note that the inability of modern natural science to solve these problems often serves as the basis for the formation of anti-scientist (or closely related) views.

Very indicative in this regard are the views of A.S. Arsen'ev, who in 1992 raised the issue of the global crisis of modernity [34]. In a philosophical essay of 2013 A.S. Arsen'ev, among other things, draws the reader's attention to the fact that the development of civilization is far from uniform, it goes through aromorphoses (qualitative evolutionary leaps [25]). Moreover, he puts the problem much broader, speaking of existing theories of Evolution: "In organic development, the beginning is always the whole, the parts are always secondary. Therefore, all scientific theories of evolution cannot be true, since the standard way of thinking and scientific and technological action is inorganic, it assumes the whole (whether it is conceivable or material) as a construction from its parts." [35]

Based on conclusions of this kind, A.S. Arsen'ev categorically states that Darwinism cannot be a theory of the origin of species, but only a 'theory' of adaptation of already existing species to changing conditions of existence (which is consistent with the point of view of Henri Bergson [36]). Thesis of A.S. Arsen'ev sounds quite unexpected - new species appear in the order of determination of the present by the future, immediately as whole ones, whether they are biological species or whole new civilizations. (As noted above, in biology, this phenomenon is called 'aromorphosis'.) Such qualitative leaps, A.S. Arsen'ev interprets it as "a breakthrough into the empirical existence of whole qualitative forms ready for embodiment from the field of metaevolution and metahistory" [35]. In other words, he believes that qualitative forms (everything that is the result of observed evolution, for example, biological species) appear as a result of processes taking place 'somewhere else', in some worlds that are not accessible to ordinary perception. The conclusions made by A.S. Arsen'ev, from our point of view, should be recognized as quite reasonable (albeit with some reservations). This is all the more justified because judgments of this kind have been 'in the air' for a long time, and researchers have long realized that the tools of specific sciences are limited in their capabilities precisely because features of a complex system as a whole is often not visible behind the details.

Many representatives of specific sciences repeatedly make us remember the parable of the seven blind men and the elephant. In it, one of the blind men, feeling the part of the elephant accessible to him, concluded that he was like a snake, the other like a column, etc.

The inability to see the forest for the trees, aggravated by such negative factors as the increasingly complex disciplinary structure of Science, the ritualization of scientific research, etc., often discredits Science as such. That is why the theses voiced by many researchers (who undoubtedly include A.S. Arsen'ev) often show a shade of anti-scientist views. This remark is essential. The fact is that conclusions that are completely analogous to those that the authors come to, arguing in the spirit of A.S. Arsen'ev, one can come in another way, considering the problems of the evolution of complex systems from the point of view of dialectical positivism, the concept of which was first formulated in [21]. Specifically, it is possible to propose a mechanism for the evolution of complex systems, alternative to those that go back to the theory of the origin of species by Charles Darwin.

- 1. Any 'complex' system is able to perceive and process information, therefore, it is an analogue of a neural network. Evidence of this thesis can be given, including on the basis of information theory [37]: information processing inevitably involves the transformation of external influences of an arbitrary nature into a signal (i.e. into an influence that has an information component). This can be done only through the emergence of a well-defined system of connections between the elements of the system, which proves the above statement.
- 2. A neural network (or a system complementary to a neural network) is able to evolve even when the properties of its elements remain unchanged. This is due to the fact that the functionality of a neural network as an information processing system most significantly depends on the architecture of connections between its elements. Consequently, if the structure of connections is rebuilt, then the neural network is also modified. Note that evolving neural networks have been considered in the literature for a long time [38, 39].
- 3. If the neural network has a physical embodiment, then its evolution as an integrity will lead to a 'directed' selection of its constituent elements. 'Preferences' will be given to those that best meet the new state of the system.
- 4. As a result, the evolution of the system as a whole leads to a 'directed' evolution of the constituent elements. From a philosophical point of view, this is fundamentally important: not random mutations determine the direction and nature of evolution, but something else systemic qualities.

We emphasize that the stages of evolution listed above were abstracted from the analysis of quite specific systems (for example, the voting Council [30]). By itself, the above list of stages in the evolution of complex systems is nothing more than an empirical generalization that can be made on the basis of identifying the behaviour of specific objects. Comparison with the judgments of A.S. Arsen'ev and researchers close to him in spirit forces, however, gives possibility to look at the issue under consideration more broadly, i.e. to provide a philosophical substantiation of the considered mechanism of evolution of complex systems.

In the above quotation, the emphasis is on the fact that the 'whole' is always prior to the 'parts'. The Darwinian point of view has in fact always asserted the exact opposite. If mutations are the driving 'force' of Evolution, then the 'part' becomes primary, by definition. The analysis of systemic properties (even talking only about biological species), in essence, has always been alien to the followers of Charles Darwin. They even considered the environment, in essence, as a kind of background, as a kind of given, predetermining the evolution of biological species.

The conclusion that the evolution of any complex system is determined by the fact that such a system is an analogue of a neural network radically changes the state of affairs. Here the 'whole', as in the judgments of A.S. Arsen'ev, is primary, and 'parts' are secondary. Moreover, even the thesis that aromorphoses are "a breakthrough into the empirical existence of whole qualitative forms ready for embodiment from the field of metaevolution and metahistory" [35] can also be justified from rational positions.

Indeed, if the evolution of a complex system is determined by the evolution of its complementary neural network, then it will inevitably go in two stages. At the first stage, the links between the elements of the system are restructured, while they themselves remain unchanged. Then comes a qualitative leap - the benefits 'unexpectedly' (emergently) receive elements that correspond to the new state of the system as a whole. There is a real 'breakthrough into existence' of the quality that was formed at a higher level of organization than the level of individual elements. It is often very difficult to follow the formation of such a quality by studying the behaviour of individual elements. Here we need a much broader view of things than that inherent in many modern concrete sciences, which returns to the question of the role of applied philosophy for modern natural science.

The thesis about the primacy of the 'whole' in relation to the 'part', when interpreted using examples borrowed from specific sciences, allows us to argue that evolution as such cannot be a matter of chance. It was originally incorporated into the properties of a system as whole, and the fact that certain manifestations of these properties are far from always observable is determined only by the fact that evolution has not yet reached the appropriate stages.

Taking into account the conclusions reached by V. Vanchurin [29], who demonstrated that the Universe as a whole can be considered as an analogue of a neural network, we can conclude that there is something global that can influence the development of the Universe as a systematic whole.

Neural networks that have passed a certain threshold of complexity can form a new quality. The most obvious example here is the human brain, which gives rise to consciousness, identities, etc. Both consciousness and identity are of a purely informational nature [40]; these are objects that are generated by the exchange of signals between neurons of the brain.

In a similar way, the exchange of signals between neurons, but related to the brain of different individuals, can give rise to a new quality - a transpersonal level of information processing. It is this level that is responsible for the formation, for example, of the collective unconscious [37]. The emergence of this new quality is also confirmed at the level of correct mathematical models [41].

A new quality appearing in a neural network that has crossed a certain threshold of complexity, obviously can only have an informational nature, which returns to Hegel's ideas about the World Spirit, which can be considered as a new quality generated by a neural network complementary to the Universe as a whole.

4. Removing the contradiction between idealism and materialism

The conclusion about the existence of a global essence of information nature, capable of at least influencing the nature of information processes, de facto removes the contradictions between idealism and materialism.

This entity has a purely informational nature, and it is 'ideal' in this sense, but at the same time it is material - it has a specific carrier, which, according to V. Vanchurin, is the Universe as a whole. More precisely, the question of how much a given entity is 'ideal' and how much 'material' may be solved in the same way in which a similar question is solved in relation to information as philosophical category. From the point of view of classical dialectics, the essence of information is dual, it simultaneously acts both as something material and as something ideal. This interpretation fully correlates with the definition of information as a dialectical category paired with the category of matter [20]. Objective reality has two 'components' - 'purely material' and 'purely informational'. These components, in full accordance with the law of unity and struggle of opposites, are connected with each other and cannot exist separately. Any material object carries information at least about itself, and information cannot exist without a carrier. The allocation of 'purely material' and 'purely informational' components, therefore, is speculative. Simplifying, these concepts are put into use only for the convenience of comprehending reality at the stage of analysis. The true picture is given by the use of these concepts in their dialectical unity.

Consequently, the discussion about whether the universe is material or ideal in nature is pointless. The universe is saturated with information structures only due to the existence of various forms of matter (in the physical sense of the term) capable of interacting with each other. At the highest level of consideration - at the level of the Universe as a whole - such an information structure, according to V. Vanchurin, is generated by the neural network, which is the Universe.

We emphasize that there is absolutely no mysticism in this. That neural network, which is formed by the nerve cells of the brain, is also a completely material object, but it generates entities of a completely different nature - the intellect, consciousness and mind of a person.

In the same way, the Universe, which, according to V. Vanchurin, forms a global neural network, generates some global information entities, the nature of which is still poorly understood. However, the very conclusion about the possibility of their appearance forces us to look at Hegel's views on the World Spirit from a significantly different perspective. It also allows us to assert that dialectical positivism is able to remove the contradictions between idealism and materialism, i.e. solve the problem that many positivist schools set themselves earlier.

5. Conclusions

Thus, the achievements of modern science and neural networks, in particular, the conclusions drawn based on the tools of classical physics applied to such networks, make it possible to remove the contradiction between idealism and materialism. The Universe, being an analogue of a neural network, is capable of generating a certain global information entity, just as systems belonging to other levels of the Universe hierarchy also generate information entities of a different nature. The most famous example here is the human brain the neural network that generates intelligence, reason and consciousness. However, this is just one of the examples. Thus, neural networks that have the ability to process information also arise at the level of physical and chemical systems.

The information entity that the Universe generates (as a neural network) as a whole can be identified with Hegel's World Spirit, especially since the neural network mechanism for the evolution of complex systems, considered in this work, allows us to give a rational interpretation of Hegel's ideas about self-development and self-knowledge of the World Spirit.

It is also appropriate to emphasize that the removal of the contradiction between materialism and idealism on a rational basis cannot but have a socioeconomic significance (at least in the future). Indeed, the darkest aspects of the consumer society are ultimately related to the fact that the factors associated with ideas about the 'spirit' have ceased to influence the economic behaviour of elites (from scientific and cultural to political). Formally, representatives of such elites may even consider themselves followers of one religion or another, but their economic behaviour is de facto most often determined by views characteristic of vulgar materialism.

There has already been a pronounced social demand for the formation of views in which the 'idealistic', or rather, the spiritual component, will be significant. But, for objective historical reasons, such views will be accepted only if they have a rational justification. The materials of this work show that the task of forming views of this nature is quite solvable.

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References

- [1] R.L. Heilbroner, *Marxism: For and against*, WW Norton & Company, New York, 1980, 188.
- [2] I. Wallerstein, Thesis Eleven, **27**(1) (1990) 40-53.
- [3] D. Rose and D. Brown, Perception, 44(4) (2015) 423-435.
- [4] T.F. Purcell, J. Agrar. Change, **22(3)** (2022) 632-637.
- [5] R.L. Heilbroner, *The worldly philosophers: The lives, times and ideas of the great economic thinkers*, Simon and Schuster, New York, 2011, 368.
- [6] C. Onunkwo and N.C. Olubunmi, International Journal of Applied Linguistics and English Literature, 8(4) (2019) 26-30.
- [7] H. Bai, J. Philos. Educa., 54(4) (2020) 916-926.
- [8] G. Serhat and B. Uzuncan, J. Tour. Cult. Change, **19(5)** (2021) 681-695.
- [9] C. Lu and C.J. Lu, J. Bus. Ethics, **94(2)** (2010) 193-210.
- [10] M.F. Jacobson, L.A. Mazur and R. Nader, *Marketing madness: A survival guide for a consumer society*, Routledge, New York, 2020, 260.
- [11] J. Baudrillard, *For a Critique of the Political Economy of the Sign*, Verso Books, New York, 2019, 272.
- [12] C. Pan and J. Ju, Kabankova Drevnekitajskoe uchenie fjenshuj v russkoj bytovoj kul'ture (The ancient Chinese teaching of feng shui in Russian everyday culture), V mire russkogo jazyka i russkoj kul'tury, Moscow, 2019, 183-185.
- [13] M.Y. Mak and T.S. Ng, Build. Environ., 40(3) (2005) 427-434.
- [14] Š. Kryžanowski, South East European Journal of Architecture and Design, 2021 (2021) 1-8.
- [15] R.P. Farrell, Int. Stud. Philos. Sci., 14(3) (2000) 257-266.
- [16] I. Suleimenov, D. Massalimova, A. Bakirov and Y. Vitulyova, Bulletin of KazNU. Religious Studies Series, 32(4) (2022) 3-13.
- [17] W. Samek, G. Montavon, S. Lapuschkin, C.J. Anders and K.R. Müller, P. IEEE, 109(3) (2021) 247-278.
- [18] E. Li, L. Zeng, Z. Zhou and X. Chen, IEEE T. Wirel. Commun., 19(1) (2019) 447-457.
- [19] O.I. Abiodun, A. Jantan, A.E. Omolara, K.V. Dada, N.A. Mohamed and H. Arshad, Heliyon, 4(11) (2018) e00938.
- [20] I.E. Suleimenov, O.A. Gabrielyan, A.S. Bakirov and Y.S Vitulyova, IOP Conf. Ser.-Mat. Sci., 630(1) (2019) 012007.
- [21] I. Suleimenov, A. Massalimova, A. Bakirov and O. Gabrielyan, MATEC Web Conf., **214** (2018) 02002.
- [22] I. Prigogine and P.M. Allen, *The Challenge of Complexity*, in *Self-organization and dissipative structures*, W.C. Schieve & P.M. Allen (eds.), University of Texas Press, Austin, 1982, 1-39.
- [23] W. Hofkirchner, Syst. Res. Behav. Sci., 36(3) (2019) 263-273.
- [24] Y.S. Vitulyova, A.S. Bakirov, S.T. Baipakbayeva and I.E. Suleimenov, IOP Conf. Ser.-Mat. Sci., 946(1) (2020) 012004.

- [25] D.S. Chernavskii, Phys.-Usp.+, 43(2) (2020) 151.
- [26] G.A. Mun, I. Moldakhan, A.M. Serikbay, D. Kaldybekov, I.E. Suleimenov and K. Park, International Journal of Biology and Chemistry, 13(1) (2020) 4-13.
- [27] I. Suleimenov, O. Güven, G. Mun, A. Beissegul, S. Panchenko and R. Ivlev, Polym. Int., 62(9) (2013) 1310-1315.
- [28] I. Suleimenov, D. Shaltykova, Z. Sedlakova, G. Mun, N. Semenyakin, D. Kaldybekov and P. Obukhova, Appl. Mech. Mater., 467(13) (2014) 58-63.
- [29] V. Vanchurin, Entropy, 22(11) (2020) 1210.
- [30] I. Suleimenov, S. Panchenko, O. Gabrielyan and I. Pak, Open Engineering, 6(1) (2016) 318-321.
- [31] I.E. Suleimenov, A.S. Bakirov, G. Niyazova and D.B. Shaltykova, E3S Web Conf., **258** (2021) 07056.
- [32] K. Ruiz-Mirazo, C. Briones and A. Escosura, Chemical Rev., 114(1) (2014) 285-366.
- [33] T.A. Williams, P.G. Foster, C.J. Cox and T.M. Embley, Nature, 504(7479) (2013) 231-236.
- [34] A.S. Arsen'ev, Continent, 73(3) (1992) 132-161.
- [35] A.S. Arsen'ev, Personal development, 2 (2013) 14-83.
- [36] H. Bergson, Creative evolution, Taylor & Francis, Abingdon, 2022, 688.
- [37] A.S. Bakirov, Y.S. Vitulyova, A.A. Zotkin and I.E. Suleimenov, International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLVI-4/W5-2021 (2021) 83-90.
- [38] S. Ding, H. Li, C. Su, J. Yu and F. Jin, Artif. Intell. Rev., 39(3) (2013) 251-260.
- [39] R. Miikkulainen, J. Liang, E. Meyerson, A. Rawal, D. Fink, O. Francon and B. Hodjat, *Evolving deep neural networks*, in *Artificial intelligence in the age of neural networks and brain computing*, Academic Press, New York, 2019, 293-312.
- [40] L. Floridi, Mind. Mach., 21(4) (2011) 549-566.
- [41] I.E. Suleimenov, D.K. Matrassulova, I. Moldakhan, Y.S. Vitulyova, S.B. Kabdushev and A.S. Bakirov, Bulletin of Electrical Engineering and Informatics, 11(1) (2022) 510-520.