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# CHARLES SANDERS PEIRCE AND THE PLACE OF CHAOS IN THE NEW WORLD ORDER

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***ABSTRACT***

This article examines the main ideas of the metaphysics of the prominent American logician and philosopher Charles Sanders Peirce. It is shown that a significant part of his "scientific metaphysics" is evolutionary cosmology, characterized, in particular, by the essential role of randomness in the world. Among the innovative ideas of evolutionary cosmology, the idea of the chaotic beginning of the Universe and constructive understanding of randomness stands out. The paper shows that this idea echoes some modern problems of quantum-relativistic cosmology, and first of all, the problems of the still popular "inflationary model," in which the idea of the chaotic beginning of the evolution of the Universe is one of the central ones.

**Keywords**: metaphysics, determinism, randomness, chaos, cosmology.

In the history of philosophy, there are outstanding individuals who, although they did not create coherent and consistent systems, left very significant traces in the history of philosophical thought through the exceptional breadth of their research. Charles Sanders Peirce (1839–1914) is such an individual. His pragmatism, the foundations of semiotics, and relational logic would be enough to consider this philosopher one of the most prominent thinkers in the United States.

Recently, there has been a noticeable increase in interest in Peirce's work. Nevertheless, in our opinion, the thematic diversity of his publications is a cause that his commentators and critics do not devote enough space to such topical issues as determinism, cosmology, and chaos.

Our interest in Peirce is caused by the fact that Peirce, as a philosopher, along with other major thinkers, is rather poorly represented on the historical and philosophical Olympus. Besides, the research topics presented by this American philosopher are striking in their extreme breadth, and we were also attracted by the situation in modern scientific cognition which has

parallels with some of Peirce's fundamental ideas. We are talking about his evolutionary cosmology, on the one hand, and modern quantum-cosmological models of the chaotic beginning of the evolution of the Universe, on the other hand. The present study is devoted to these parallels. Among modern cosmological models, we refer to the most relevant today, the so-called "inflationary" models of the Universe (Pavlenko, 2003; Obradovich, 2018).

From the point of view of the subject of this paper, we note the most significant publications: the monograph by Andrew Reynolds (Reynolds, 2002), which contains a detailed analysis of the "scientific metaphysics" of Peirce and the status of evolutionary cosmology in it; Roy A. Moxley (Moxley, 2007); John W. Oller (Oller, 1984); Karl Popper (Popper, 1959; 1972); Vincent G. Potter (Potter, 1996); Ian Hacking (Hacking, 1983; 1990); John Earman (Earman, 1986); Maria R. Brioschi (Brioschi, 2016); Thomas L. Short (Short, 2010); Carl Hoefer (Hoefer, 2016); Cheryl Misak (Misak, 2004); Rosa M. Mayorga (Mayorga, 2007).

Some authors and commentators do not allow, apparently, a more liberal, expansive attitude to determinism, just as in the history of quantum mechanics the rejection of the Laplacean version of it led physicists, in the end, to a generalized, non-classical treatment in the form of statistical determinism.

Among Peirce's researchers and commentators, there are those who inadequately present the critique of Laplacean determinism at the time, and also underestimate Peirce's contribution to such a critique. Moreover, the mentioned authors present the latter as Peirce's denial of determinism in general, which is not really correct. Therefore, our aim is, first, to present Peirce's actual position on determinism, which turns out to be unconventional, both in relation to the then-dominant Laplacean determinism and to the views on the relation between necessity and chance in the world. Secondly, to substantiate the possibility of presenting this position as a prerequisite for modern cosmological models based on the chaotic beginning of the Universe's evolution.

## 1. DETERMINISM AND PEIRCE'S "SCIENTIFIC METAPHYSICS"

First, we will focus on some general issues of determinism, and we devote much space to cosmology and Peirce's position on these issues. A considerable part of the paper presents and analyses the basic ideas of Peirce's evolutionary cosmology. Then we will try to draw some parallels and anticipations of his "scientific metaphysics" with some actual problems of modern science.

Let us first mention the main philosophical trends that particularly influenced the formation of the views of this original American thinker. Here we name medieval realism (Duns Scotus), New Age philosophy (Rene Descartes, Gottfried Leibniz, David Hume, etc.), and especially the German classics (Immanuel Kant, Friedrich Schelling, Georg Wilhelm Friedrich Hegel). The degree of influence of them on Peirce's philosophical work varied at different stages, but what was constant was Peirce's interest in science and its methodology. Some aspects of these influences will be further discussed in the context of determinism and its anthropomorphic character. This context is justifiably mentioned here because the concepts of chance and evolution are central to his philosophical work. Moreover, these concepts themselves can hardly be bypassed when discussing cosmological issues within the framework of the concept of determinism as a philosophical doctrine of world order.

However, we are more interested in the problem of Peirce's attitude to determinism. It is hardly possible to answer this question unambiguously, because, first, it is necessary to determine in what context the discussion will be conducted—philosophical (metaphysical) or natural science. Secondly, it should also be taken into account that Peirce was against the interpretation of determinism as a doctrine of rigid, absolute necessity, against, as he said, "necessitarianism," against the doctrine according to which the laws of nature are strict and precise principles that determine their results with exact, strict and unambiguous necessity.

This position, critical of absolute necessity, runs through Peirce's entire oeuvre. He could not accept a position which, in essence, leaves no room for real actual chance or novelty in the world, as he later repeatedly insisted. In contrast to necessitarianism, he believed that the principle of chance acts as the basis of all kinds of knowledge, including scientific knowledge; moreover, the possibility is accepted that chance can influence—and even change —the content of knowledge. The principle of randomness is expressed by him in different forms of fallibilism and tychism. These notions (more about them below) are united by Peirce's sceptical attitude to the rigour and accuracy of knowledge obtained by man (and science), to the derivation of once and for all given laws of nature, which would be based on universal epistemological principles.

The concepts of "tychism" and "fallibilism" form coherent concepts within his "scientific metaphysics" and thus express his attitude to determinism. To build metaphysics on scientific foundations was one of Peirce's most important intentions.

It can be said that one of the most important alternatives to necessitarianism was indeed Pierce’s tychism (from Greek — chance, fortune), according to which the world is not necessarily rigidly deterministic, unambiguously predictable, and "... no law of nature is exact..." (Reynolds, 2002, p.

11), and the search for the foundations of the world prioritizes chance over necessity and strict certainty. Note that Peirce recognized the existence of certainty in the world, but he denied the need for rigid and unambiguous certainty. Here tychism comes closer to fallibilism, including in the sense of rejecting the rigour and precision of the "fulfilment" of the law. Here is what prominent foreign philosophers of the twentieth century said about this concept:

> "Peirce's tychism is a well-considered metaphysical position, expressing his personal conviction that in nature there are certain manifestations of [...] of real randomness, real possibility, real freedom, real creativity, and hence a real indeterminism that would be logically impossible and therefore could not even be imagined ..." (Frimen, Skolimovski, 2000, p. 239).

Rejecting the metaphysical concept of absolute mechanical necessity, Peirce introduces the alternative metaphysical concept of absolute randomness, i.e. tychism. It is true that Peirce, as a natural scientist, does not deny either the existence of laws of nature or necessity in general. But, as a "scientific metaphysician," he places absolute chance next to them, peculiarly limiting, thus narrowing their scope. "I object," he wrote, "to necessity being universal, as well as to its ever being exact" (6.607).[1] More to the point, Peirce does not only place chance and law side by side, but he also favours chance, seeing chance as primary and law as secondary, arising out of chance. He believes in absolute randomness and in a universe in which the laws of nature were at best approximate and developed from chance processes. Chance in tychism was no longer the essence of iniquity but was at the heart of all laws of nature and all rational inductive inference.

His indeterminism is less striking when viewed as a consequence of the probabilistic nature of the world and our knowledge of it. Indeterminism does not deny the absence of connections in the world altogether, but affirms their ambiguous predictability. Peirce concluded that we live in a random universe not because of argument, but because probability and statistics permeate all aspects of life (Hacking, 1990). The absolute randomness in tychism is spontaneity, sometimes gratuitousness, chaotic as a (perhaps temporary) loss of connections between elements or events. "... If we are going to regard the universe as a result of evolution at all," Peirce wrote, " we must think that not merely the existing universe, that locus in the cosmos to which our reactions are limited, but the whole Platonic world, which in itself is equally real, is evolutionary in its origin, too. And among the

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[1] Here and hereafter we will use the Western tradition of referring to Peirce's collected works: (*Collected Papers of Charles Sanders Peirce. Ed. by C. Hartshorne, P. Weiss (vol-umes 1-6), and A. Burks (volumes 7-8), Cambridge, MA: Harvard University Press, 1931–1958).* In this case, after the quotation in parentheses, the number before the dot indicates the volume number, and the number after the dot indicates the paragraph number.

things so resulting are time and logic. The very first and most fundamental element that we have to assume is a Freedom, or Chance, or Spontaneity, by virtue of which the general vague nothing-in-particular-ness that preceded the chaos took a thousand definite qualities..." (6.200).

One of Peirce's fundamental intentions was to construct a new metaphysics on natural scientific grounds, in which tychism is given a prominent place along with two other concepts he developed, fallibilism and synechism (discussed later). "My philosophy," he wrote,

> "may be described as the attempt of a physicist to make such conjecture as to the constitution of the universe as the methods of science may permit, with the aid of all that has been done by previous philosophers. I shall support my propositions by such arguments as I can. Demonstrative proof is not to be thought of. The demonstrations of the metaphysicians are all moonshine. The best that can be done is to supply a hypothesis, not devoid of all likelihood, in the general line of growth of scientific ideas, and capable of being verified or refuted by future observers" (1.7).

Let us note several important points in this quotation. First, its scientific criticality and susceptibility to verification (and possibly falsification) of the ideas put forward; second, its active use of plausible scientifically- (or empirically-) valid explanatory hypotheses, followed by the development of its abduction. These two points are consistent with our setting of what we will mean by the term "scientific" in this article. By abduction here we mean the method of hypotheses, which Peirce first introduced and actively used in the methodology of natural science along with traditional deduction and induction.

This rather contradictory position influenced the entire work of the American philosopher. In this respect, somewhat later, the famous English positivist-oriented philosopher Alfred J. Ayer suggested that Peirce's theories suffer, in his opinion, from a certain split personality, because they represent a failed, in his opinion, mixture of two rival motives of his philosophy: scholasticism, producing abstract entities, and subsequent pragmatism, aimed at their elimination (Ayer, 1968, p. 179).

Speaking about Peirce's criticism in the process of constructing his "scientific metaphysics," let us mention his attitude to British empiricism. In the initial period of his work, when he was more associated with natural science research, a subjective-idealist tendency came to the fore in his works, for the results of empirical research often contained subjectivist evaluations. Later, when Peirce somewhat postponed his specialized natural science studies and became more interested in metaphysical, religious, ethical, and aesthetic problems, the objective-idealist tendency clearly took over. A well-known role played here and the fact that Peirce gradually became

convinced that subjective-idealist empiricism is too contrary to the actual needs of natural science, mathematics and logic, that it excludes the possibility of those broad and generally meaningful generalizations, without which science is unthinkable. Peirce sought to overcome these shortcomings of subjective-idealistic empiricism with the help of "scholastic realism", i.e. the objective-idealistic doctrine of the reality of universals and laws of nature, understood as some universal ideas.

The influence of his predecessors, especially those who led Peirce to anthropomorphism, should also be taken into account. Among the origins of the latter are usually named his efforts to "humanize" the scholastic realism of Duns Scotus together with overcoming the abstractness and "dryness" of the rationalism of his followers, as well as a kind of "anthropomorphization" of the idealism of Schelling and Hegel, to whom, as is well known, Peirce gravitated. In his articles of the 1890s, Peirce demonstrated his appreciation of the philosophical views of these German classics (see (Short, 2010; 2022)). For example, in the article "The Law of Mind," Peirce claimed that his philosophy is indeed close to Schelling's idealism. However, there is an important difference between Peirce's and Schelling's philosophical doctrines: Peirce understands mind (spirit) in a much more anthropomorphic way, as a psychic phenomenon, while surprisingly combining Platonist realism (in the sense of the reality of universals) with a kind of panpsychism, according to which the basis of the world is sensation and feeling.

Peirce's anthropomorphism appears as an ontological characteristic, for in the world itself he looks for the properties and attributes of man. He wrote: "... I do not believe that man can have the idea of any cause or agency so stupendous that there is any more adequate way of conceiving it than as vaguely like a man" (5.536).

Assessing rather low the modes of thought of earlier metaphysicians, Peirce lamented their "poor logic," "moonshine," etc. (1.5–1.7).

Peirce recognized that, in comparison with natural science and logic, "... in metaphysics, my training has been less systematic" (1.3). This "less systematicity" often led him to hesitate and to some eclecticism and ambiguity in his views. And so his natural-scientific materialism and determinism, adequate to his "spirit of the laboratory," are quite appropriately combined, in his view, with anthropomorphism.

In his *The Divisions of Science*, Peirce discusses the dependence of physics on philosophy and shows this dependence in numerous examples. In the same paper, he poses the question,

> "... whether or not it is proper to endeavour to find a mechanical explanation of electricity, or whether it is proper, on the contrary, to leave the differential equations of electrodynamics as the last word of science. This is manifestly only to be decided by a scientific philosophy..." (1.249).

We can agree with this if by the phrase "scientific philosophy" we mean a description whose proponents recognize the validity of empirically grounded objective in content laws of nature. Here Peirce's “scientific philosophy” seems to refer to his “scientific metaphysics,” which emphasizes the word “scientific” more than the word “philosophy/metaphysics.” Peirce is a rationalist logician and a pragmatist (including in the sense of a supporter of pragmatism) in one person, but apparently with some elements of subjectivism. Indeed, Peirce combined both a rigorous logician and a rigorous experimentalist; he strove both to form productive, valid hypotheses (his abduction) and to make ever more precise observations and measurements, aware, however—following his fallibilism—of the limitations of this precision.

Like every natural scientist of the time, Peirce agreed that

> "... the state of things existing at any time, together with certain immutable laws, completely determine the state of things at every other time... Thus, given the state of the universe in the original nebula, and the laws of mechanics, a sufficiently powerful mind could deduce from these data the precise form of every curlicue of every letter I am now writing." (6.37).

This is the formula of Laplacean determinism that was adopted by the natural scientists of the Peircean time, including, at times, Peirce the geophysicist himself.

In spite of numerous deviations, Peirce, as an experimental naturalist, still adhered to the view that the physical world is arranged in a regular, lawlike manner in the sense of objective scientific laws. Another matter is the view of determinism from philosophical positions. Here he also allowed numerous "immersions" in psychology and biology, making generalizations of often subjectivistic nature. In this regard, even in his youth, Peirce was attracted to the idea of his colleague Francis Ellingwood Abbot that

> "... the world owes its cognizability not to the a priori laws attributed to it by the cognizer, but to the fact that the very constitution of the world has the character of a set of relations actually present in the world and available for observation" (Kir`ushchenko, 2008, p. 88).

Paradoxically, and in this situation, at least two people really coexist in Peirce as a natural scientist: one is a sensible geophysicist who recognizes determinism and the laws of nature and recognizes their functional significance, and the other is that who is prone to psychological and metaphysical reasoning and which can be seen as often leading him into subjectivism.

The peculiarity of the combination of the natural scientific and philosophical sides of Peirce's reflections is illustrated by the following passage from his writings:

> "it is probable that some cultured bacilli (meaning, mainly, Schelling's transcendentalism—V.R.), some benignant form of the disease was implanted in my soul, unawares, and that now, after long incubation, it comes to the surface, modified by mathematical conceptions and by training in physical investigations" (6.102).

Along with his desire to make philosophical metaphysics more definite, rigorous, and scientific, he often allowed for arbitrary metaphysical speculation. Thus Peirce's ideas about determinism lacked coherence, as did many of his discussions of other fundamental philosophical questions. What is striking here is his insistence against mechanistic determinism and, in methodological terms, against the reductionism prevalent at the time. It should be noted in this connection that his criticism of mechanistic determinism was largely taken from Hegel.

This situation reminds us of what was developing in the twenties-thirties of the 20th century in the methodology of physics in the process of approval of quantum mechanics as a non-classical theory with a new ontology and new epistemological principles. The then critics of quantum mechanics called this non-classical theory indeterministic while ignoring the possibilities of generalization of classical, Laplacean determinism (for details see: (Jammer, 1966)). One can hardly agree with this view for two reasons: first, under "determinism" Peirce and the natural scientists of that time most often meant its Laplacean version, i.e., mechanistic determinism associated with necessitarianism; second, "determinism" can be interpreted in a somewhat broader context.

At the same time, Peirce seems to have been favoured at times to interpret determinism most of all as certainty in the world. He called determinism "... the common belief that every single fact in the universe is precisely determined by law" (6.36).

## 2. EVOLUTIONARY COSMOLOGY IN PEIRCE'S “SCIENTIFIC METAPHYSICS"

As we have noted, philosophical and natural science views and interpretations are often intertwined in Peirce, and this finds its expression in his keen interest in the idea of evolution, which he considered " a great and true idea" (1.5).

Although, as a chemist and physicist by training, he shared much of the views of British empiricism, in philosophical (metaphysical) matters he felt a marked influence of classical German philosophy. In particular, his metaphysical view of cosmology shows the influence of Hegel, for example, where he writes: "The one intelligible theory of the universe is that of objective idealism..." (6.25). However, his "objective idealism," as we have already noted, differs from the idealism of Hegel or Schelling. This difference is primarily due to his anthropomorphism, when he, for example, refers to the interpretation of the concept of "law" in the sense of habit. Peirce even sometimes attributes substantive qualities to sensation: He combines his logical, almost medieval, realism (with the recognition of the reality of the general). In this respect, it is no accident that Peirce's views are markedly influenced both by Hegelian philosophy and by scientific advances in geology (Charles Lyell) and biology (Charles Darwin, Alfred Wallace). Evolutionary ideas served as the basis for his determinism and metaphysics. Peirce believed that "... the only possible way of accounting for the laws of nature and for uniformity in general is to suppose them results of evolution" (6.13).

When Peirce was seriously engaged in metaphysical research, the idea of evolution became widespread in the scientific world. After Darwin and Herbert Spencer, it was almost impossible to put forward any static system of the universe, so his metaphysics was developed as a special form of evolutionism.

Note here the fact that there is an interesting connection between Peirce's tychism, his view of the objective spontaneity of the universe, and his objective-idealist treatment of its evolution. Peirce understood the universe of phenomena as a logical process, in much the same way that Hegel understood the universe of phenomena in his *Phenomenology of Spirit*. He was inclined to regard a given state of the universe as a given set of premises, so to speak, of a possible conclusion. Then the subsequent state of the universe could be regarded as a kind of logical conclusion of the actual conclusion. Peirce was thus forced to view the universe of phenomena as arising from a process that is ultimately logical. In other words, Peirce drew attention precisely to the processuality of change. Let us point out here that this perspective position was further developed by the famous English philosopher and mathematician Alfred North Whitehead. Darwin's evolutionary hypothesis is basically natural scientific in nature, while Peirce gives it an expansive meaning, endowing it with anthropomorphized connotations.

In reviewing three theories of evolution in his *The Architecture of Theories*, Peirce drew attention precisely to the process of evolution itself, to its qualitative specificity, meaning, for example, the status of chance in it (6.13–6.17).

It should be noted in this regard that Peirce criticizes Hegel's doctrine of development for its excessive emphasis on the idea of necessity (in the spirit

of his previously mentioned "necessitarianism"), and for underestimating, or even ignoring, the idea of chance and its role in this process. Peirce also criticizes Spencer for his mechanistic description of the process of evolution.

In his "scientific metaphysics" Peirce defended the fundamental unity of the laws of nature also in relation to cosmological questions (Reynolds, 2002, p. 21).

Peirce's first public presentation of his cosmology was in 1884 at a meeting of the "Metaphysical Club" at Johns Hopkins University. However, it was a cosmology as part of his future scientific metaphysics, although the term "scientific" here should be interpreted rather tentatively if we relate it to modern criteria of scientism. Similar to the above distinctions, in our opinion, it makes sense to distinguish between cosmology as a scientific discipline and cosmology as a general (e.g., philosophical) doctrine of the Universe, although perhaps not in the explicit form of this concept.

Andrew Reynolds seems to have rightly called Peirce's metaphysical theory of the universe inventive because it contains a minimum number of principles (Reynolds, 2002, p. 80–81). In this minimal list, Peirce included principles based, in turn, on the following fundamental categories: “Chance is First, Law is Second, the tendency to take habits is Third. Mind is First, Matter is Second, Evolution is Third” (6.32). This means that spirit corresponds to chance, matter to law and evolution to the process of acquiring habits.

In his evolutionary cosmology as a component of anthropomorphized metaphysics, he tried based on tychism to describe the evolution of the universe from its chaotic beginning to its present state of systemic orderliness, which he called "the development of concrete reasonableness" or the "crystallization of mind" (Reynolds, 2002, pp. 76–77). He regarded this description as a kind of final material, from which one can get an idea of the evolution of the Universe.

Here is how he described this as if "the way of the universe" in one of his final reflections:

> "... it would be a Cosmogonic Philosophy. It would suppose that in the beginning—infinitely remote—there was a chaos of unpersonalized feeling, which being without connection or regularity would properly be without existence. This feeling, sporting here and there in pure arbitrariness, would have started the germ of a generalizing tendency. Its other sportings would be evanescent, but this would have a growing virtue. Thus, the tendency to habit would be started; and from this, with the other principles of evolution, all the regularities of the universe would be evolved. At any time, however, an element of pure chance survives and will remain until the world becomes an absolutely perfect, rational, and symmetrical system, in which mind is at last crystallized in the infinitely distant future" (6.33).

Let us highlight several generalizing points in this conceptually important, in our opinion, fragment.

1. Peirce regarded the description of the "path of the universe" given here as a kind of summary of the development of natural science by the twentieth century. Here we have an object-idealist (see in the text: "... mind will crystallize") description in the spirit of the anthropomorphized concept of Schelling and Hegel. At the same time, "crystallization" seems to mean a kind of objectification, materialization of mind.

2. It is proclaimed that "the way of the Universe" is an evolutionary process essentially determined by randomness. Moreover, randomness is present throughout the evolutionary process and plays a fundamental role in it.

3. Moreover, this is an essentially anthropomorphized process: there is constant talk of "sensuality," though not "non-personal", in the initial stages of evolution. At the beginning of "the way of the Universe" there is nothing but the disorder of "pure sentience", when only undifferentiated "primordial chaos" takes place (Murphey, 2006, p. 172). From this starting point, the universe evolves through the development of habits. What we have here is a typical Spencerian transition from homogeneity to heterogeneity (diversification) but without the benefit of Spencer's mechanical model. Over time, the Universe becomes more and more regularized—but at any given time, "its habits" remain less regular.

4. The chaotic beginning of the Universe is asserted, at which "all regularities of the Universe would have evolved." At the same time, let us pay attention to the phrase "generalizing tendency" in the evolution of the Universe, which (tendency) indicates the regularity of the process of this evolution as a self-complicating process. If we turn to parallels with modernity, we can mention the so-called "self-reproducing universes" in modern inflationary models (Linde, 1994).

5. The evolutionary process is oriented toward the eventual formation of a rationally organized universe. Thus, in his tychism-based evolutionary cosmology, Peirce believed that, according to evolution, the world becomes increasingly rational and law-governed. Despite the generally unscientific (in terms of modern norms of scientificity) nature of this "scenario," containing such concepts as "sensuality," "materialization," etc., Peirce tended to adhere to basic norms of rationality, believing a dynamically evolving, chaotic beginning to the universe. Moreover, Peirce sought to introduce aesthetic parameters into his interpretation of rationality as well. The title *The Elegant Universe* of a popular science book on cosmology by Brian Greene echoes this situation (Greene, 1999).

6. Another of Peirce's aspirations is that of an objective understanding of the evolution of the universe, and this is despite the anthropomorphist orientation of his concept. The described "path of the universe" is a logical path, if we refer to Peirce's relevant work, *The Logic of the Universe* (6.189-

209); it is a logical conclusion from the relevant premises and the result is a regular, law-abiding universe.

Peirce already in his early 60s, reflecting on the architectonics of theoretical systems and later on scientific metaphysics, turns to cosmology as a kind of guiding ideal (Kir`ushchenko, 2008, p. 236; Reynolds, 2002, p. 14; Brioschi, 2016).

Another of Peirce's epistemological concepts is related to evolutionism and tychism—the already-known fallibilism, according to which our knowledge (including scientific knowledge) is fundamentally fallible, and inaccurate. For Peirce's "scientific metaphysics," tychism is of fundamental importance, since this concept justifies the objective status of randomness in the universe, and this gives grounds to consider the search for absolute accuracy of measurement, i.e. the grounds of his fallibilism, as utopian. In other words, Piers' fallibilism would hardly take place truly if there were no tychism.

## 3. PEIRCE'S TYCHISM AND MODERN COSMOLOGY

Modern science allows us to consider chance as one of the constitutive factors of our universe. Recognizing the objectivity of chance is just as the spontaneous deviations of Epicurus' "clinomena" were not a denial of necessity, but rather an extension of the world picture and an introduction of chance into it. So in modern science, the recognition of the fundamental role of randomness does not mean the denial of the role of necessity and determinacy of the phenomena of the surrounding reality. Werner Heisenberg's uncertainty relation, as well as the statistical nature of the regularities of the behaviour of micro-objects, testify to the extreme complexity of the cause-and-effect relations of the microcosm. But all this hardly gives grounds to question about the general principle of determinism. This is taught to us, in particular, by the successes of nonlinear dynamics, which after quantum mechanics is the second revolutionary challenge to Laplace determinism (Ratnikov, 2007).

However, such moderate and balanced views have not always existed, as we know. The question about the nature of randomness in history has undergone many metamorphoses (Chajkovskij, 2004).

By the 1890s, Peirce's reasoning about determinism had formed a conviction about the fundamental status of randomness in the world. It was called "tychism," which is, as we already know, the basis of Peirce's evolutionary cosmology (6.102). Peirce's introduction of tychism into the discourse on determinism leads to the generalization of the latter; the philosophical metaphysical component of his cosmology is close to Schelling and Hegel, and the evolution of the Universe is considered in the objective-idealistic plan.

In the previous paragraph, we analyzed this evolution in detail enough, so to speak, as "the way of evolution of the Universe" from chaos to its regular state. Some researchers of Peirce's work believe (Hacking, 1990, p. 202) that he formed his "philosophy of absolute randomness" by, among other things, summarizing his experience of efforts to improve the accuracy of the measuring instruments he used as an engineer in the U.S. Coast Guard.

Although Peirce wrote about chaos even before he introduced "tychism" into his vocabulary, tychism found its place in determinism. Thus, Peirce was usually guided by the attitude that "chance begets order" (6.297), including order in the universe. Retrospectively, from the modern point of view, the last phrase can be interpreted as a kind of creative "ability" of randomness and chaos, in the spirit of nonlinear dynamics, Ilya Prigozhin's concept, etc.

Peirce used such a concept of randomness to justify qualitative diversity in the evolution of the Universe. "The desire for variety (diversification) is the indispensable sign of spontaneity-randomness, and wherever variety occurs, chance must have dominion. On the other hand, wherever we encounter uniformity, habit must have dominion there." (Peirce, 1892, p. 19). He believed that the heterogeneity of the Universe cannot arise "purely from law," but is an expression of absolute spontaneous randomness. The existence of qualitative diversity of the Universe was for Peirce one of the most important arguments in favor of recognizing the existence of absolute randomness in the world, spontaneity or freedom. In his "scientific metaphysics" he also showed that purely quantitative mechanical laws are connected with purely quantitative changes, and they cannot give rise to qualitative diversity. He associated the emergence of a new quality, first of all, with absolute randomness and sometimes even with causelessness (more often having in mind the opposition of Laplacean causality). It should be noted, however, that the productivity of Peirce's critique of Laplacean determinism lies in the fact that it made it possible to explain the phenomenon of diversification, i.e. the tendency to expand diversity in the world. All this can be explained through the possibility of the formation of qualitatively new objects, or otherwise—through the constructiveness of randomness. It should be noted that the mentioned opposition of two tendencies—to unity and to diversity—is discussed even today. For example, we are talking about the discussion in theoretical physics devoted to two tendencies of development of its theories and models (Ratnikov, 2010). Supporters of the first tendency, striving to build a unified physical theory, are called unifiers, while supporters of the second tendency, encouraging the diversity of theoretical models, are called diversifiers.

Let us emphasize once again the fact that the concept of tychism, together with evolutionary ideas, played a fundamental role in Peirce's scientific metaphysics. The phenomenon of evolution itself was interpreted by Peirce

in terms of the constructive role of chance within the framework of tychism, whereas Darwin himself did not seriously take chance into account. The active use of randomness in describing evolution as a process is that randomness is presented in a non-classical way. Here we are really talking about its constructive role in the process. In other words, randomness appears here not as an element of chaos in its traditional sense, but precisely as an opportunity for qualitative transformations. In many respects, this interpretation was a consequence of his long study of protoplasm (for details, see (Kir`ushchenko, 2008, pp. 259–263)), as a result of which he discovered several surprising phenomena to which researchers have turned already relatively recently in nonlinear dynamics.

Considering cosmology as a doctrine of world order and as an integral part of determinism, Peirce quite naturally regarded tychism as the fundamental basis of his evolutionary cosmology. If we talk about the status of cosmology in the scientific picture of the world of the 1990s, we should take into account that evolutionary ideas were not yet properly represented in it at that time. Peirce in his "scientific metaphysics" discussed this topic in detail. However, the universe in the scientific cosmology of that time is a stationary non-evolving universe. Although after Kant cosmogonic ideas were already developing quite actively.

Modern evolutionary scientific cosmology originates approximately from the 20s of the XX century approximately from the classical works of the outstanding mathematician Alexander A. Friedman, who refined the Einsteinian solutions of the fundamental equations of the general theory of relativity. As a result, it turned out that these equations are capable of describing not only a stationary but also an evolving universe. A new stage in the development of evolutionary scientific cosmology came when it began to interact actively with the particle physics that had developed by that time. One of the brightest results was the Big Bang model, which has become standard by our time, especially after it received several successful empirical confirmations in the experiments of Arno A. Penzias and Robert. R. Wilson on the study of relic radiation, for which they were awarded the Nobel Prize.

Until recently, evolutionary cosmology was dominated by models based on the fact that the Universe emerged as a result of the so-called "Big Bang." They did not discuss what happened to the Universe before this phenomenon. The veil of fog in this question began to dissipate only by the end of the 1970s due to the success of studies by Alexei Starobinsky, Andrei Linde, Alan H. Guth and others. The breakthrough was the idea of "inflating" ("inflation"), which was woven into synthetic tendencies that consolidated the links between cosmology and elementary particle physics.

Since the 1980s, the inflation model has been actively developed by Linde (Linde, 1984). Many believe that it was a logical and even natural continuation of the previous studies in this area by Starobinsky, Guth and others.

The success of this model and its conceptual perfection spoke in favour of calling it a theory rather than a model. Although the validation of these theories is still not convincing enough from the modern point of view (see a rather heated discussion in this regard (Pavlenko, 1998, pp. 116–117)), these theories are still considered by cosmologists to be the most promising, which was confirmed by the next decade.

The next stage of development of evolutionary cosmology is connected with chaotic models of the origin of the Universe. And here we will return to Peirce's studies in the field of evolutionary cosmology and tychism and his anticipations, which are connected with the modern situation. We will touch on this connection in his reflections on chaos. This is precisely one of the parallels with Peirce's "scientific metaphysics," which we intended to discuss in this article. We have already mentioned that Peirce was interested in chaos even before his tychism was formed. In those long-ago reflections of his, chaos is not some antique abyss, but some dynamic entity. Gradually the theme of chaos enters the orbit of his tychism.

Modern astrophysics is characterized by a variety of cosmological models. Many of them describe the Universe as having a chaotic beginning of its evolution. However, the first attempts to rationally describe the chaotic dynamics of the Universe we find already in Peirce in his concepts of tychism and the evolving universe, although his descriptions hardly satisfy modern criteria of scientificity. This is evidenced, for example, by the fragment of his writings that we have already mentioned and analyzed in the previous paragraph. And here again, we must turn to pierce abduction, the methodological significance of which, together with the method of hypotheses, has noticeably increased in it, where the empirical basis is very scarce. And therefore, it is not by chance that modern philosophers of science, reflecting on this situation, drew attention to the peculiar phenomenon of "empirical weightlessness" in situations when the "specific weight" of the theoretical component increases significantly in cosmology (Pavlenko, 1998, pp. 116–117; Pavlenko, 2003).

Within the framework of synthesis with elementary particle physics, modern cosmology uses the concept of vacuum as a special kind of matter along with matter and field to describe the initial state of the Universe. Physicists investigated different states of vacuum, which, as it appeared, is capable of undergoing various phase transitions, as a result of which some relatively integral formations were formed, which, in turn, are likened to some potential universes with the richest energy possibilities (Guth, Steinhardt, 1984). These nascent universes of Planck (i.e., ultramicroscopic) scales are capable of expanding at a rate much higher than the usual expansion of the Universe at the Big Bang stage. The Universe will expand under the action of the so-called "anti-gravitational" forces of the vacuum. Vacuum energy density and its negative pressure lead to gravitational repulsion. The

gravitational repulsion forces essentially prevail over the attraction forces, and this provides exponential expansion. This super high speed of expansion is influenced, as cosmologists suppose, by appropriate topological structures of space and peculiar gravitational instability in it.

Thus, the fluctuating vacuum with its topological structure during the cascade of phase transitions is the initial stage of the Universe's evolution before the Big Bang epoch. Such vacuum, apparently, can be likened to the Pierce`s initial beginning chaos from the description of the "path of the Universe" already discussed by us.

## 4. A SUMMARY OF THE RESULTS OF THE CONSIDERATIONS

The philosophical and methodological premise of the inflationary cosmological models discussed here, as we have shown, is indeed Peirce's tychism and constructive treatment of randomness, as well as the generalized treatment of determinism he developed in the course of his comprehensive criticism of the Laplacean version of it. We have shown that those commentators of Peirce mentioned earlier, who deny him the recognition of determinism, often take his criticism as a negative attitude to determinism in general, and do not allow the possibility of a more general interpretation of this concept. Thus they treat determinism only in its Laplacean version, whereas Peirce did not accept it. In other words, these critics of determinism do not seem to recognize any other version of determinism than the Laplacean version. In this connection, we have recalled two historical lessons that natural science has taught to the evolution of determinism, starting from its classical version. Lesson one is quantum mechanics, and lesson two is nonlinear dynamics.

Let us add that, first, Peirce's interpretation of determinism looks quite modern, and not only in the sense of the variety of aspects of criticism of Laplace's version of determinism.

Secondly, Peircean tychism demonstrates the fundamental role of randomness and chaos in the modern world, which has indeed been actualized in recent years in both modern science and modern society. He was an adherent of the non-mechanistic approach, non-classical rationality and those means that later came to be called non-linear thinking ("butterfly effect", deterministic chaos, etc.).

Let us emphasize once again that circumstance in Peirce's philosophy, which speaks in favour of the fact that his ideas turned out to be promising and productive for the subsequent development of science, and we have shown it on the example of the cosmological idea of the chaotic beginning of the evolution of the Universe. The latter, in its turn, is based on the new, revolutionary idea of constructive understanding of randomness, which

found its place in the general evolutionary cosmology and, thereby, noticeably enriched the modern scientific picture of the world.

In this case, we can say that we are dealing with a situation where philosophical ideas are a prerequisite for the advancement of a new scientific concept.

## REFERENCES


Ayer, A. J., *The Origins of Pragmatism*, London 1968.

Brioschi, M. R., *Hints toward Cosmology: The Need for Cosmology in Peirce's philosophy*, Revista de Filosofía, 2016, 12, pp. 51–73.

Chajkovskij, Ju.V., *O prirode sluchajnosti* [On the Nature of Randomness], 2nd ed., Monografija, Moscow 2004 (in Russian).

Peirce, Ch. S. *Collected Papers of Charles Sanders Peirce*, Hartshorne, P. Weiss (ed.), Vols 1–6); Burks, A. ed. (volumes 7-8), Cambridge, MA: Harvard University Press, 1931–1958.

Earman J., *A Primer on Determinism*, D. Reidel Publishing Company, Dordrecht 1986.

Frimen, Ju., Skolimovski, G., *Poisk objektivnosti u Pirsa i Poppera* [The Search for Objectivity in Peirce and Popper], In: *Evol`utsionnaja epistemologija i logika sotsial`nuh nauk: Karl Popper i ego kritiki*, Moscow 2000, pp. 222–279 (in Russian).

Greene, B., *The Elegant Universe: Superstrings, Hidden Dimensions, and the Quest for the Ultimate Theory*, Vintage Books, New York 1999, p. 512.

Gut, A., Stejnhardt, P., *Razduvajushchajas`a Vselennaja* [Inflating Universe], V mire nauki, 1984, v. 7, pp. 56-69 (in Russian).

Hacking, I., *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science*, Cambridge University Press, 1983, p. 287.

Hacking I., *A Universe of Chance. The Taming of Chance*, Cambridge University Press, 1990, pp. 200–215.

Hoefer, C., *Causal Determinism*, in: Stanford Encyclopedia of Philosophy, 2016, URL: http://plato.stanford.edu/entries/determinism-causal/

Jammer, M., *The Conceptual Development of Quantum Mechanics*, Mc Graw-Hill book Company, New York 1966, p. 399.

Kir`ushchenko V., *Charl`z Sanders Pirs ili osa v butylke. Vvedenie v intellectual`nuju istoriju Ameriki* [Charles Sanders Pierce or Wasp in a Bottle. Introduction to the Intellectual History of America], Moscow 2008 (in Russian).

Linde, A., *The Inflationary Universe*, Rep. Prog. Phys., 1984, vol. 47, pp. 925–986.

Linde, A., *The Self-Reproducing Inflationary Universe*, Scientific American, 1994, 271 (5), pp. 48–55.

Mayorga, R. M., *From Realism to "Realicism": The Metaphysics of Charles Sanders Peirce*, Lexington Books, Lanham 2007; URL: https://www.felsemiotica.com/descargas/P%C3%A9rez-Ter%C3%A1n-Mayorga-Rosa-Mar%C3%ADa-From-Realism-to-Realicism.-The-Metaphysics-of-Charles-Sanders-Peirce.pdf

Misak, C. J., *Charles Sanders Peirce (1839–1914)*, in: The Cambridge Companion to Peirce, Cambridge University Press, Cambridge 2004, pp. 1–26.

Moxley, R., Ultimate Realities: Deterministic and Evolutionary, The Behavior Analyst, 2007, v. 1, pp. 59–77.

Murphey, M. G., *Peirce, Charles Sanders*, in: Encyclopedia of Philosophy, Borchert, D. M. (ed.), 2nd ed., vol. 7, Thomson Gale, Oakeshott–Presupposition Detroit–New York–San Francisco–San Diego–New Haven, Waterville, London–Munich 2006, pp. 163-173.

Obradovich, S., *Metafizicheskie aspektu kvantovoj kosmologii* [The Metaphysical Aspects of Quantum Cosmology], Voprosy Filosofii, 2018, 4 (79), pp. 58–67 (in Russian); DOI: 10.15372/PS20180405

Oller J. W., Jr., C. S. *Peirce's "Neglected Argument"*, Acts & Facts, Institute for Creation Research, 1984, 13 (3), pp. 1-4.

Pavlenko, A. N., *"Stadija empiricheskoj nevesomosti teorii" i ad hoc argumentatsija* ["The Stage of Empirical Weightlessness of Theory" and ad hoc Argumentation], Filosofija nauki, Moscow, 1998, 4, pp. 108–118 (in Russian).

Pavlenko A. N., *Mesto "Haosa" v novom mirovom "Por`adke:" (metodologicheskij analiz osnovanij haoticheskoj kosmologii)* [The Place of "Chaos" in the New World "Order:" (Methodological Analysis of the Foundations of Chaotic Cosmology)], Voprosy Filosofii, 2003, 9, pp. 39–53 (in Russian).

Peirce, C. S., *Man's Glassy Essence*, The Monist, October, 1892, 3 (1), pp. 1–22.

Popper, K. R., *Objective Knowledge: An Evolutionary Approach*, Oxford University Press, New York 1972.

Popper, K., *The Logic of Scientific Discovery*, Taylor & Francis e-Library, London–New York 2005.

Potter, V. G., *Peirce's Philosophical Perspectives*, Fordham University Press, New York 1996; https://doi.org/10.2307/j.ctvh4zg94

Ratnikov, V. S., *Sluchajnost` i poslelaplasovskie transformatsii determinizma* [Randomness and Post-Laplace Transformations of Determinism], Sententiae, 2007, 1, pp. 5–20 (in Russian).

___, *O liberalizatsii nauchnoj ratsional`nosti v sovremennom teoretiko-fizicheskom poznanii (na primere kosmomikrofiziki i modeli determinirovannogo haosa)* [On the Liberalization of Scientific Rationality in Modern Theoretical-Physical Knowledge (on the Example of Cosmic Microphysics and the Model of Deterministic Chaos)], Filosofija fiziki: actual`nye problemy. Materialy nauchnoj konferentsii, Mocow, 2010, pp. 129–132 (in Russian).

Reynolds, A., *Peirce's Scientific Metaphysics: The Philosophy of Chance, Law, and Evolution*, Vanderbilt University Press, Nashville 2002, p. 228.

Short, T. L., *Did Peirce Have a Cosmology?*, Transactions of the Charles S. Peirce Society: A Quarterly Journal in American Philosophy, 2010, 46 (4), pp. 521–543; https://doi.org/10.2979/trancharpeirsoc.2010.46.4.521

Short, T. L., *Charles Peirce and Modern Science*, Cambridge University Press, Cambridge 2022.

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