

PHILOSOPHY OF SCIENCE, METHODOLOGY
AND EPISTEMOLOGY

AN AXIOMATIC SYSTEM OF PHILOSOPHICAL ONTOLOGY

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Abstract: For the first time in the history of philosophy, this article presents an axiomatic system of philosophical ontology intending to demonstratively solve “eternal” questions related to the most fundamental problems of human cognition of the natural (material) world. The corresponding system of axioms and definitions of philosophical ontology is proposed. Proofs of the first 20 theorems of axiomatic ontology are presented as solutions to traditional and modern *aporias* (incompatible alternatives) of ontology. Finally, the principles and most general laws of modern physics, including the Microworld and cosmology, are used as an empirical base of the theoretical system of philosophical ontology.

Keywords: philosophical ontology, axioms and definitions of ontology, *aporias* of ontology, theorems of axiomatic ontology.

Introduction

The central structural part of modern philosophy, of course, is the theory of cognition. For this reason, we started our project of the axiomatic representation of philosophical knowledge with the theory of cognition, or epistemology (Djidjian & Hovhannisyanyan, 2023). This experience allowed us to undertake an axiomatic presentation of philosophical ontology with greater confidence. In the aspect of meta-theoretical and meta-philosophical research, we see the main advantage of the axiomatic representation in its argumentative power (Hovhannisyanyan, 2015; Hovhannisyanyan & Djidjian, 2017). Since we dwell on this aspect of the axiomatic method in our article mentioned above on axiomatic epistemology, here we confine ourselves to reminding that we will follow the traditional structure of the axiomatic presentation of the theory: an explicit for

mulation of the initial statements (axioms), definitions of the concepts used, and the derivation from axioms and definitions of consequences (theorems) using the rules of formal logic.

It is necessary to point out the next moment as well. We consider the criterion of success of the axiomatic presentation of philosophical doctrine to be the evidential resolution of the “eternal” questions of philosophy, which we present in the form of paradoxical questions (*aporias* - difficult questions in the Aristotelian understanding).

We also note that modern natural science’s corresponding general statements (principles, laws, provisions) serve as the initial empirical material for our construction of philosophical ontology.

Further presentation of the axiomatic construction of the ontology will proceed according to the following plan:

- explicit formulation of *aporias*, axioms, and

- definitions,
- detailed proof of theorems of axiomatic ontology,
- comparison of proved theorems and corresponding *aporias*,
- additional discussion of some of the difficulties of modern natural science concepts and hypotheses.

Let us start our enterprise with an explicit formulation of the traditional “eternal” questions of philosophical ontology - incompatible alternatives of possible answers.

Aporia 1. Is the world around us material, or rather it is based on ideas?

Aporia 2. Do the form and the matter have an independent existence, or instead, they exist as different aspects of the objects of reality?

Aporia 3. Is the source of motion an internal quality of matter, or rather motion in the world is provided by some external source?

Aporia 4. Is the motion contradictory by its very nature, or can we afford a non-contradictory description of motion?

Aporia 4a. Is Zeno’s “Arrow” aporia a reflection of the “dialectical contradiction,” or rather it is based on some logical error?

Aporia 5. Is space a receptacle for material bodies, or instead, space is a general characteristic of relations in the world of material objects?

Aporia 6. Is the Universe spatially infinite, or rather the world space is finite?

Aporia 7. Is matter infinitely divisible, or rather its truly indivisible bricks, “real atoms” exist?

Aporia 8. Does total determinism operate in nature, or only the average values of the characteristics of phenomena of reality are subject to determinism?

Aporia 9. Did the material world have a beginning in time, or instead, the world is eternal concerning the past and the future?

Aporia 10. Does the probability express our inability to describe natural phenomena unambiguously, or instead, physical interactions are probabilistic by their very origin?

Aporia 11. Is mechanical motion an attribute of matter, or instead, there are structures in the material world in which there is no mechanical motion?

Aporia 12. Is nature explicable based on a particular group of fundamental interactions, or rather principally, new scales of the natural world have their specific features and laws?

Axioms and Definitions of Philosophical Ontology

Axiom 1. Existence is inherent, first of all, in the objects (things) of the external world.

Axiom 1a. Every existing object (thing) consists of something.

Axiom 1b. Every existing object can interact.

Axiom 2. All objects of the world are in constant change and motion.

Axiom 2a. The material world is eternal, has no beginning, and there will be no end.

Axiom 3. The source of any motion and change in the world is the interaction of material objects.

Axiom 4. The basic types of physical interaction are the eternal qualities of physical bodies (elementary particles).

Axiom 5. Objects of the world have extensions and are in a specific mutual arrangement.

Axiom 6. The phenomena of the world have duration and alternate.

Axiom 7. The influences of surrounding bodies on a given body are summed up and superimposed.

Axiom 8. The effect of numerous and variable factors can only be estimated statistically, on average.

Axiom 9. The interaction of elementary particles is characterized as probabilistic by their very nature.

Axiom 10. The world as a whole cannot be given to man in his empirical experience of limited space and time.

Axiom 11. Different scales of reality have principally different laws.

Axiom 12. Interactions and transformations of material objects comprise an infinite chain.

Definitions

Definition 1. An object is a spatially separated material structure with a stable set of properties.

Definition 1a. Object 2 is a philosophical category for the subject of thought.

Definition 2. The category *form* denotes the set of essential properties of an object.

Definition 3. The *matter* is a philosophical category for designating *that from which* objects of the world are composed.

Definition 4. Form and matter are two exhaustive and complementary aspects of objects.

Definition 5. The essential properties of an object are those properties from the totality of which other properties, relations, and manifestations of the object follow.

Definition 6. The category “world” denotes the totality of all existing objects.

Definition 6a. The category “world” is equivalent to the expressions “material world,” “real world,” “outside world,” and “the world around us.”

Definition 6b. The world, considered in the aspect of ongoing physical interactions, is called nature or the physical world.

Definition 6c. The term phenomenon denotes a change in the material world (in nature).

Definition 6d. To exist means to be in interaction.

Definition 7. (Mechanical) motion is a change in the spatial position of objects.

Definition 8. Space is a philosophical category for expressing objects’ extension and relative position.

Definition 9. Time is a philosophical category for expressing the duration and alternation of phenomena.

Definition 9a. The infinite chain of interactions and transformations of material objects is called eternity.

Definition 10. Physical change is a concept denoting the ability to have a particular type of physical interaction.

Definition 10a. The unchanging and eternal quality of bodies is their inalienable quality.

Definition 11. An *attribute* is an internal, inalienable quality of bodies.

Definition 12. The cause of a phenomenon is the interaction that directly generates the phenomenon in question.

Definition 12a. The concepts “source of a phenomenon” and “cause of a phenomenon” are equivalent.

Definition 13. A set of objects and phenomena of the surrounding world that have a noticeable influence on the interaction under consideration form the *conditions* for its impact.

Definition 14. *Determinism* is the concept that a given cause produces the same effect under the same conditions.

Definition 15. A change leading to the appearance of a new object or phenomenon is called *emergence (genesis)*.

Definition 16. Development is a change in which

a qualitative improvement of some essential feature takes place.

Definition 17. “Nothingness” is that which, apart from nothing, does not contain anything.

Derivation of Theorems

So, let us turn to a detailed derivation of consequences from the suggested system of axioms and definitions of philosophical ontology.

Theorem 1. The world is material.

Proof

Consider jointly Axiom 1a and Definition 3:

Axiom 1a. Every existing object (thing) consists of something. (1)

Definition 3. *The matter* is a philosophical category for designating *that from which* objects of the world are composed. (2)

Premises (1) and (2) directly imply:

Corollary 1. Every existing object (thing) is material. (3)

Let us use Definition 6:

Definition 6. The category “world” denotes the totality of all existing objects. (4)

From premises (3) and (4), we directly obtain:

Corollary 2:

The world is the totality of all material objects. (5)

This corollary is equivalent to the shorter formulation:

The world is material. (6)

Theorem 1 is proved.

Theorem 2. The world around us is material.

Proof

Consider jointly Definition 6a and Theorem 1 proved above:

Theorem 1. The world is material. (1)

Definition 6a. The category “world” is equivalent to the expressions “real world,” “outside world,” and “the world around us.” (2)

Premises (1) and (2) directly imply Theorem 2:

The world around us is material.

Theorem 2 is proved.

Theorem 3. Form and matter are complementary aspects of the objects (things).

Proof

Consider jointly Axiom 1 and Definition 4:

Axiom 1. Existence is inherent, first of all, in the objects (things) of the external world. (1)

Definition 4. Form and matter are two exhaustive and complementary aspects of objects. (2)

Premises (1) and (2) directly imply:

Form and matter are the two complementary aspects of existing objects. (3)

Theorem 3 is proved.

Theorem 4. The paradox of the finiteness of the world, formulated by Archytas, is resolved by the modern definition of space.

Proof

Consider the formulation of Archytas' paradox:

If world space is finite, then it must have a boundary. However, where will the spear that can be thrown by a person who has approached the border of the Universe? (1)

It follows directly from the formulation of Archytas' paradox (1) that space is understood in it as something substantial:

Space is the repository of all objects of the material world. (2)

Now let us use the definition of space accepted in the modern philosophy of physics:

Definition 8. Space is a philosophical category for describing objects' extension and relative position. (3)

It is obvious that statement (2) is incompatible with the modern understanding of space (3).

This contradiction refutes statement (2) and thus resolves Archytas' paradox.

Theorem 4 is proved.

Theorem 5. Zeno's aporia "Arrow" is resolved by defining (mechanical) motion as displacement during a non-zero-time interval.

Proof

Consider the formulation of Zeno's aporia "Arrow."

At each instant in time, the flying arrow is in some place in space; therefore, at each particular instant, the flying arrow is motionless. (1)

It is not difficult to show that "instant of time" in Zeno's argument means zero-time interval. (2)

Indeed, if the "instant of time" in Zeno's aporia "Arrow" meant a non-zero interval of time, then during this interval, the flying arrow would have moved. This motion would disprove Zeno's argument (1) that at every "instant of

time," the flying arrow is in some place in space.

On the other hand, since Zeno understands the "instant of time" as the zero-time interval, he cannot assert that the arrow is motionless during the zero-time interval. Therefore, whether the arrow is moving or not can only be determined by setting the motion of the arrow during a non-zero interval of time, as required by Definition 7.

The unacceptability of argument (1) resolves Zeno's aporia "Arrow."

Theorem 5 is proved.

Theorem 6. Zeno's aporia "Achilles and the Tortoise" is not a paradox because his argument represents the time interval for which Achilles will catch up with the tortoise in the form of an infinite series. However, this series is a convergent series, the sum of whose terms gives a finite value.

Proof

Consider the formulation of Zeno's aporia "Achilles and the Tortoise":

"Let the quick-footed Achilles be at point A, while the slow tortoise is located a few steps at point B ahead of Achilles. To catch up with the tortoise, Achilles from point A must go to point B. The tortoise from point B will move to point C during this time. When Achilles reaches point C, the tortoise will already be at another point D, and so on *ad infinitum*. (1)

To analyze Zeno's reasoning, let us denote the initial distance AB between Achilles and the tortoise by L_1 and the ratio of the speed of Achilles V_1 to the speed of the tortoise V_2 - by N , that is, $V_1 = NV_2$. (2)

The time interval for which Achilles will cover the distance L_1 from point A to point B will be $T_1 = L_1 / V_1$. (3)

During this time interval, the tortoise will move from

point B to point C at a distance $L_2 = T_1 \times V_2 = (L_1 / V_1) \times V_2 = L_1 / N$. (4)

When Achilles moves from point B to point C, he spends time $T_2 = L_2 / V_1$. Substituting here the value set in (4) for $L_2 = L_1 / N$, we obtain $T_2 = (L_1 / N) / V_1 = (L_1 / V_1) / N = T_1 / N$. (5)

By a similar elementary calculation for the next interval T_3 , during which Achilles moves from point C to point D, we get $T_3 = T_1 / (N)^2$. (6)

The next intervals will be $T_4 = T_1 / (N)^3$, $T_5 = T_1 / (N)^4$ etc. (7)

Now we can sum up the terms of the series

described by Zeno:

$$T = (T_1 + T_2 + T_3 + T_4 + T_5 + \dots) = (T_1 + T_1/N + T_1/(N)^2 + T_1/(N)^3 + T_1/(N)^4 + \dots) \quad (8)$$

The expression in the last parenthesis is a geometric progression, a well-known convergent series, the sum of whose terms is easily calculated using the school formula. Thus, Zeno's expression "and so on to infinity" actually turns out to be finite time, which in the era of Zeno was unknown.

Theorem 6 is proved.

Theorem 7. The thesis of Kant's first antinomy about the spatial infinity of the world is resolved by pointing out the incompatibility of the substantial and relational concepts of space used in his argument.

Proof

Let us reproduce the argumentation of the thesis of Kant's first antinomy:

Let us assume that the world is spatially finite. (T₁) Then, an empty out-of-world space would have to exist outside the world. (T₂) But the idea of empty out-of-world space is incompatible with the very concept of space. (T₃)" (1)

It is easy to see that from assumption T₁, the conclusion of the statement T₂ can be carried out only on the basis of the *substantial* concept of space, which admits an empty world space outside the limits of the material world. (2)

In turn, it is easy to see that objection T₃ is based on the *relational* concept of space. (3)

Meanwhile, in the modern philosophy of natural science, it is established that the substantial and relational concepts of space are incompatible. (4)

The incompatibility of the substantial and relational concepts of space demonstrates the inconsistency of the argumentation of Kant's first antinomy thesis.

Theorem 7 is proved.

Theorem 8. The *antithesis* of Kant's first antinomy about the spatial finiteness of the world is resolved by pointing out the inaccuracy of his argument.

Proof

Let us reproduce the argumentation of the antithesis of Kant's first antinomy:

"Let us assume that the world space is infinite. (A1) Now, if we introduce some cubic measure of world space, then it will appear as an

infinite set of these "cubes." (A2), But since the world actually exists, this means that the considered infinite set of cubes also exists actually. (A3) Infinity, by its very definition, is potential and cannot be actual. (A4)" (1)

Actually, the statement (A2) of Kant's argument contains a significant inaccuracy. To get the "many cubes" of world space, you need to measure this volume. That is the "set of cubes" of the world space is not given to us actually but is formed as a result of the process of (mental) measurement of the world space, thus forming a *potential* infinity, contrary to Kant's statement (A2).

Theorem 8 is proved.

Theorem 9. The source of any motion and change in nature is an attribute of matter itself.

Proof

Consider jointly Axiom 3 and Axiom 4.

Axiom 3. The source of any motion and change in nature is the interaction of material objects. (1)

Axiom 4. Interaction is an internal, inalienable quality of material objects. (2)

Premises (1) and (2) directly imply:

The source of any motion and change in nature is the internal, inalienable quality of material objects. (3)

Let's use Definition 11 "Attribute of the matter is an internal, inalienable quality of material objects."

From the corollary (3) and Definition 11, it follows:

The source of all motion and change in nature is an attribute of matter itself. (7)

Theorem 9 is proved.

Theorem 10. The cause of motion in the material world is *the materia* itself.

Proof

Consider jointly Definition 12a and Theorem 9:

Definition 12a. The concepts "source of a phenomenon" and "cause of a phenomenon" are equivalent.

Theorem 9. The source of any motion and change in nature is an attribute of matter itself.

It follows directly from Theorem 9 proved above and Definition 12a:

The cause of all motion and change in the material world are the attributes of matter.

Or in the equivalent form:

The cause of all motion and change in the material world is materia itself. (The famous principle *Materia est causa sui*).

Theorem 10 is proved.

Theorem 11. The effect of the influence of the cause depends on the conditions of the influence.

Proof

Consider jointly Axiom 3 and Definition 6c:

Axiom 3. The source of any motion and change in the world is the interaction of material objects.

Definition 6c. A change in the material world (in nature) is denoted by the term phenomenon.

It follows directly from these premises:

The source of any phenomenon is a (concrete) interaction. (1)

Let's take a look at the cause:

Definition 12. The cause of a phenomenon is the interaction that generates the phenomenon under consideration. (2)

Premises (1) and (2) directly imply:

Every phenomenon is caused by a (concrete) interaction. (3)

Let us use the axiom about the imposition of the action of many bodies:

Axiom 8. The influences of other bodies on a given body are summed up and superimposed on each other. (4)

Premises (3) and (4) directly imply:

The primary influence that causes this phenomenon is superimposed by the influence of other (surrounding) objects. (5)

Let us draw the definition of the concept of condition:

Definition 13. A set of objects and phenomena of the surrounding world that have a noticeable influence on the interaction under consideration from the conditions of influence. (6)

Premises (5) and (6) directly imply:

The primary influence that causes this phenomenon is superimposed by the influence of conditions. (7)

Statement (7) immediately leads to a more concise conclusion:

The effect of the influence of the cause depends on the conditions of the influence. (8)

Theorem 11 is proved.

Theorem 12. There is no phenomenon without a cause.

Proof

Consider together Axiom 5 and Definition 6b:

Axiom 5. The material objects' interaction is the source of any motion and change in the world. (1)

Definition 6b. The world, considered in the aspect of ongoing physical interactions, is called nature or the physical world. (2)

Premises (1) and (2) directly imply:

The source of all motion and change in nature is the interaction of material objects. (3)

Let us use the definition of the phenomenon:

Definition 6c. The term phenomenon denotes a change in the material world (in nature). (4)

Premises (3) and (4) directly imply:

The source of every natural phenomenon is the interaction of material objects. (5)

Premise (5) directly implies:

Every natural phenomenon has a source. (6)

Let us use Definition 12a: The concepts "source of a phenomenon" and "cause of a phenomenon" are equivalent. (7)

Premises (6) and (7) directly imply:

Every natural phenomenon has a cause. (8)

This conclusion (8) is logically equivalent to the statement:

There is no phenomenon without a cause. (9)

Theorem 12 is proved.

Theorem 13. From "nothingness," nothing can arise.

Proof

Consider Definition 17:

"Nothingness" is that which, apart from nothing, does not contain anything. (1)

This definition directly entails:

"Nothingness" contains no source of change in the material world. (2)

Let us use Definition 15:

A change leading to the genesis of a new object or phenomenon is called emergence. (3)

From premises (2) and (3), it follows:

Nothing can arise from "nothingness" (*ex nihilo nihil fit*).

Theorem 13 is proved.

Theorem 14. The question of the origin of the world as a whole, in principle, cannot have a demonstrative solution within the framework of scientific knowledge.

Proof

Consider Axiom 11 about the relationship be-

tween the world as a whole and man:

Axiom 11. The world as a whole cannot be given to man in his limited empirical experience. (1)

It follows directly from this:

Science is not allowed to assert anything demonstrative about the world as a whole. (2)

Statement (2) can be given an equivalent formulation:

The question of the origin of the world as a whole, in principle, cannot have a demonstrative solution within the framework of scientific knowledge. (3)

It follows directly from this:

The origin of the material world can only be postulated.

Theorem 14 is proved.

Theorem 15. Zeno's aporia "Dichotomy" is based on the wrong understanding of convergent infinite series.

Proof

Zeno's argument goes like this: in order to traverse a path, one must first traverse the first half of it; and to go half-way, you must first go half a half; and so on *ad infinitum*. (1)

Let us analyze Zeno's argument. Consider an equivalent task of moving from point A to point B. Let us denote by the letter S the distance between the points A and B. To move from A to B, one has to pass half-way $\frac{1}{2} S$, then half of the half-way $\frac{1}{4} S$, and so on. The sequence of "halves of halves" builds a convergent infinite series $\frac{1}{2} S, \frac{1}{4} S, \frac{1}{8} S, \dots$ (2). For Zeno and for any human without knowledge of convergent infinite series is quite clear that the sum of elements of convergent infinite series is infinite. But modern-time high school algebra teaches pupils that the sum of the elements of the convergent infinite series $\frac{1}{2} S, \frac{1}{4} S, \frac{1}{8} S, \dots$ (2) is equal to S, a finite value. This simple algebraic knowledge refutes Zeno's argument.

Theorem 15 is proved.

Theorem 16. Kant's argumentation of the thesis of the temporal part of the first antinomy contains an erroneous proposition that deprives it of probative force.

Consider Kant's argumentation of the thesis of the temporal part of the first antinomy:

Thesis: The world has a beginning in time.

Assume the opposite: the world did not have a beginning in time. Then, up to any given instant of time, eternity elapsed, and, therefore, an endless series of successive states of things passed. But this would mean the completion of infinity, which contradicts the very essence of infinity as potency, as the possibility of an unlimited continuation.

Kant's reasoning sounds almost flawless here. However, the assertion of completeness, that is, the actual existence of an infinite series of past states of things, turns out to be erroneous. Here we can be helped by considering the following pair of similar cases. First, let's consider a series of natural numbers on the real axis, starting from 1 and moving toward positive infinity. This series of natural numbers is a potential infinity, which could be extended indefinitely. Quite similarly, the negative integers from -1 towards negative infinity form a potentially infinite series. That is, both the series of positive natural numbers increasing towards positive infinity and the series of negative integers towards negative infinity are potentially infinite. If we now replace the numerical axis with the time axis, then the sequence toward positive infinity will express the events of the future, and the sequence toward negative infinity will express the events of the past.

Consider now, in light of what has been said, the sequence of world events in the direction of the past. Here we need to understand that the number of world events of the past can be considered as extending in the direction of negative infinity without limit. *A series of past events toward negative infinity is also a potential infinity.*

Therefore, when we follow Kant's argument and assume that the world had no beginning in time, then we have no right to say that "eternity has elapsed" before any present time. It would be correct to say that the series of past successive states of things can be continued indefinitely, forming a potentially infinite series. Such a picture is entirely consistent with the concept of potential infinity and does not cause any contradiction or form any paradox.

The analysis carried out above demonstrates that the argumentation of the thesis of the first antinomy's temporal part contains an erroneous provision that deprives it of probative force.

Theorem 16 is proved.

Theorem 17. Kant's argumentation of the antithesis of the temporal part of the first antinomy contains an erroneous proposition that deprives it of probative force.

Consider Kant's argumentation of the antithesis of the first antinomy:

Antithesis. The world has no beginning in time.

Assume the opposite: the world had a beginning in time. Then we had to accept the existence of an empty pre-world time. But such a position completely contradicts the concept of time.

Here the same error is repeated, which we revealed in the argumentation of the antithesis regarding the spatial extension of the world. Namely, the conclusion about the existence of empty pre-world time comes from a *substantial* understanding of time as a container of phenomena and events. While mentioning that the concept of the "empty pre-world time" contradicts the very essence of the concept of time, Kant comes from the *relational* concept of time, where time is inextricably linked with the phenomena of the material world.

Since the substantial and relational concepts of time are incompatible, this error demonstrates that the argumentation of the antithesis of the temporal part of the first antinomy is devoid of probative force.

Theorem 17 is proved.

Theorem 18. At the level of the Microworld, spatial relations, and mechanical quantities do not play a significant role.

Proof

Already at the level of processes in atomic nuclei, the description of physical states and interactions, as well as the theoretical explanation of the observed phenomena, is carried out in terms of energy characteristics without any use of spatial relations and mechanical quantities.

Theorem 18 is proved.

Theorem 19. At the level of elementary particles, the concept of the spatial structure of particles cannot be applied.

Proof

The assumption of the spatial structure of elementary particles leads to a contradiction with the data on the interaction of elementary particles at high kinetic energies. It has been reliably established that the collision of two high-energy

particles can produce particles whose mass is much greater than the masses of the initial interacting particles. Assuming that the produced particles were in the structure of the original particles, we come to the logically contradictory conclusion that particles with a small mass contained particles with a superior mass.

Theorem 19 is proved.

For the convenience of the reader, we compile the list of proven theorems:

Theorem 1. The world is material.

Theorem 2. The world around us is material.

Theorem 3. Form and matter exist insofar as they are sides of the objects of reality.

Theorem 4. The paradox of the finiteness of the world, formulated by Archytas, is resolved by the modern relational definition of space.

Theorem 5. Zeno's aporia "Arrow" is resolved by defining (mechanical) motion as displacement during a *non-zero-time interval*.

Theorem 6. Zeno's aporia "Achilles and the Tortoise" actually is not a paradox.

Theorem 7. The thesis of Kant's first antinomy about the spatial infinity of the world is resolved by pointing out the incompatibility of the substantial and relational concepts of space used in his argument.

Theorem 8. The antithesis of Kant's first antinomy about the spatial finiteness of the world is resolved by revealing the fallacy of his argument.

Theorem 9. The source of any motion and change in nature is the attribute of matter itself.

Theorem 10. The cause of motion in the material world is matter itself.

Theorem 11. The effect of the influence of the cause depends on the conditions of the influence.

Theorem 11a. The effect of the interaction that causes the phenomenon under consideration can only be estimated statistically, only on average.

Theorem 12. There is no phenomenon without a cause.

Theorem 13. From "nothingness," nothing arises.

Theorem 14. The question of the origin of the world as a whole, in principle, cannot have a demonstrative solution.

Theorem 14a. The origin of the material world can only be postulated.

Theorem 15. Zeno's aporia "Dichotomy" concerns the divisibility of a segment of the path

but has nothing to do with the problems of physical motion.

Theorem 16. Kant's argumentation of the *thesis* of the temporal part of the first antinomy contains an erroneous proposition that deprives it of probative force.

Theorem 17. Kant's argumentation of the *antithesis* of the temporal part of the first antinomy contains an erroneous proposition that deprives it of probative force.

Theorem 18. At the level of the Microworld, spatial relations, and mechanical motion do not play a significant role.

Theorem 19. At the level of elementary particles, the concept of the spatial structure of particles cannot be applied.

Answers to the *Aporias* of Ontology

The axiomatic system proposed in this article gives the following demonstrative answers to the questions of the *aporias* of ontology.

The answer to *Aporia 1* ("Is the world around us material, or rather it is based on ideas?") is given by Theorem 1 ("The world is material").

The answer to *Aporia 1a* ("Is the eternity of the world based on the eternity of ideas, or rather the eternity of the world is *based* on the eternity of matter?") is given by Axiom 2a ("The material world is eternal, had no beginning and there will be no end to it").

The answer to *Aporia 2* ("Do form and matter have an independent existence, or rather the form and the matter exist only as separate sides of objects of reality?") is given by Theorem 3 ("Form and matter have existence only insofar as they are sides of objects of reality").

The answer to *Aporia 3* ("Is the source of motion an internal quality of matter, or rather the motion in the world is provided by some external source?") is given by Theorem 4 ("The source of any motion and change in the world is an internal quality (*attribute*) of matter").

The answer to *Aporia 4* ("Is motion contradictory by its very nature, or rather a non-contradictory description of motion is possible?") is given by Theorem 5 ("Zeno's *Aporia* 'Arrow' is resolved by defining (mechanical) motion as displacement during a non-zero-time interval").

The answer to *Aporia 5* ("Is space a recepta-

cle for material bodies and phenomena, or rather space is a general characteristic of relations in the world of material objects?") is given by Axiom 5 ("Objects of the external world have an extension and are in a certain mutual arrangement") and Definition 8 ("Space is a philosophical category for expressing the extension and relative position of objects").

The answer to *Aporia 6* ("Is the Universe spatially infinite, or the world space is finite?") is given by Axiom 10 ("The world as a whole cannot be given to man in his empirical experience of limited space and time").

The answer to *Aporia 7* ("Is matter infinitely divisible, or there are its 'last,' hereinafter indivisible bricks, 'real atoms'?") is given by Axiom 11 ("At the level of principally new scales of the natural world, there are specific, irreducible features").

The answer to *Aporia 8* ("Does total determinism operate in nature or only the average values of the characteristics of objects and phenomena of reality are subject to determinism?") is given by Axiom 7 ("The influences of other bodies on a given body are summed up, superimposed") and Axiom 8 ("The effect of numerous and variable factors can only be estimated statistically, only on average").

The answer to *Aporia 9* ("Did the material world have a beginning in time, or rather the world is eternal both in relation to the past and the future") is given by Axiom 2a ("The material world is eternal, it had no beginning and will not have an end"), Theorem 14 ("The question of the emergence of the world as a whole, in principle, cannot have a demonstrative solution") and Theorem 14a ("The answer to the question on the beginning of the material world can only be postulated").

The answer to *Aporia 10* ("Does the probability express our inability to describe phenomena unambiguously, or rather there are initially probabilistic interactions operating in nature?") is given by Axiom 9 ("The interaction of elementary particles is characterized as probabilistic by their very nature").

The answer to *Aporia 11* ("Is mechanical motion an attribute of matter, or rather there are structures in the material world in which there is no mechanical motion?") is given by Theorem 18 ("At the level of the microworld, spatial relations, mechanical motion, and mechanical quan-

tities do not play a significant role”).

The answer of *Aporia 12* (“Is nature explicable on the basis of a certain group of fundamental interactions, or rather the principally new scales of the natural world have their specific features and laws?”) is given by Axiom 11 (“At the level of principally new scales of the natural world, there are specific, irreducible features”).

Notes

Note 1. The authoritative “Stanford Encyclopedia of Philosophy” gives the following explanation: “*Ontology*, as etymology suggests, is the study of being, of what there is. The ontologist asks: What entities or kinds of entities exist? Are there abstract entities, such as sets or numbers, in addition to concrete entities, such as people and puddles and protons? Are there properties or universals in addition to (or instead of) the particular entities that, as we say, instantiate them?” (Bricker, 2016).

Note 2. Thomas Ainsworth (2020), in his review of the history of the discussion of the relationship between the philosophical categories of *form* and *content*, gives the following general assessment of Aristotle’s position: “Aristotle famously contends that every physical object is a compound of matter and form. This doctrine has been dubbed “hylomorphism,” a portmanteau of the Greek words for matter (*hylê*) and form (*eidos* or *morphê*). Highly influential in the development of Medieval philosophy, Aristotle’s hylomorphism has also enjoyed something of a renaissance in contemporary metaphysics”.

Note 3. Logicians and mathematicians found long ago that Zeno’s aporias receive an unambiguous resolution with the help of strict definitions and appropriate knowledge about the sum of terms of convergent infinite series. But in works where Zeno’s aporias are discussed at the level of philosophical reasoning without the use of clear definitions and without concretization of the context, Zeno’s aporias get such complex and confusing formulations that even logicians cannot cope with them (see Huggett, 2019).

Note 4. The historical confrontation between the relational and substantive concepts of space and time has given rise to a wide variety of ideas, approaches, and subtleties that are incredibly

hard to figure out (Torretti, 2000; Maudlin, 2012). Here is how a group of modern authors summarizes their vision of the current situation: “We will see that similar concerns pervade all these works: Is there any kind of privileged sense of motion: a sense in which things can be said to move or not, not just relative to this or that reference body, but ‘truly’? If so, can this proper motion be analyzed in terms of motions relative to other bodies – to some special body or the entire Universe, perhaps? (And in relativity, in which distances, times, and measures of relative motion are frame-dependent, what relations are relevant?) If not, then how is the privileged kind of motion to be understood as relative to space itself – something physical but non-material – perhaps? Alternatively, can some kinds of motion be best understood as not being spatial changes – changes of relative location or place – at all?” (Hoefer et al., 2023).

Only axiomatic ontology can resolve the situation.

Moreover, there is a fact that denies the concept of absolute space. This fact is that Lorentz’s transformations of coordinates are verified in 20th-century physics to an absolute degree. However, on the other hand, Lorentz transformations rigorously reject the concept of absolute space.

Note 5. Since the time of Aristotle, the daily rotation of the stars has been taken as unequivocal evidence of the existence of a stellar celestial sphere. Aristotle postulated that the stellar sphere is the boundary of the material world, outside of which there was no matter, no space, no time. Telescopes of modern astronomers “destroyed” the firmament, and Newtonian mechanics and Cartesian coordinate axes formed the belief in the spatial infinity of the world. Einstein’s concept of the unity of space, time, and the gravitational field allowed him to offer a fantastic model of a spatially finite but without a boundary.

Unfortunately, it was soon found that this model of the Universe is gravitationally unstable, subject to gravitational collapse. Moreover, the hypothetical model of the Big Bang (self-expansion of the world space) that replaced it faces the threat of observational refutation since ultra-distant galaxies have already been discovered whose age has come close to the hypothetical age of the Universe itself.

Today, it would be correct to admit that science is unaware of any observational data that

testify in favor of the spatial finiteness of the world. However, understanding the infinity of the Universe is a rather tricky task. The authors of the review article “Infinity” (Easwaran et al., 2021) conclude it with the following words: “We are well aware that our discussion of infinity is incomplete - but then, so is any such discussion. We take some comfort from the fact that it is impossible to give balanced coverage to a boundless set of issues in finite space. Nevertheless, ... overall, the prospects for our relationship with infinity are good: we can indeed live with it”.

Note 6. Since the end of the last century, observational data have appeared that needed to fit into the framework of the widely accepted theory of the Big Bang - the so-called lambda-CDM model. Initially, it was assumed that the self-expansion of the world proto-atom would eventually slow down and stop, and then a new phase of contraction would begin. Moreover, it could not occur to any supporter that the most distant galaxies can accelerate their movement. The discovery of such a radically contradictory fact would have to mean the complete unacceptability of the accepted Big Bang model concept. However, as has always been the case in the history of science, supporters of the lambda-CDM model began to come up with additional factors to save it. First, the idea of “dark matter” was proposed, and then the more radical (and less understood) idea of “dark energy” (Peebles & Ratra, 2003; Durrer, 2011). Quite naturally, articles like “The End of Cosmology” appeared in several journals (Krauss & Scherrer, 2008).

Note 7. The problem of knowing the Universe as a whole

One of the lessons of the history of science is the law of the different scales: “*Different scales of reality have principally different laws*” (Djidjian, 2002, p. 291). Just this law we have chosen as the Axiom 11 of our system of philosophical ontology. The term “scale” of reality that we use justifies itself verbatim when we compare the Mega-world and the Microworld with our surroundings – the Macroworld. At the same time, the difference in scale does not mean at all that worlds of different scales do not have common laws. Today, scientists are convinced that electric and gravitational charges operate in all worlds. At the same time, the quantum nature of radiation and absorption of energy manifests itself precisely at the level of atomic phenomena.

Hubble’s empirical redshift law prompts theorists to consider the possibility of the variability of physical constants on the scale of billions of years of time.

Of course, hasty interpretations contain a high probability of putting forward erroneous hypotheses. Niels Bohr and Werner Heisenberg were ready to abandon the newly born quantum mechanics in the name of a more striking revolutionary idea. Niels Bohr proposed that the fundamental law of conservation of energy might appear not necessary on the level of individual subatomic events. Werner Heisenberg considered the possibility of the “quantized” structure of space to build the theory of interactions of high-energy elementary particles.

The law of the different scales most vividly demonstrates itself in physical sciences. For example, the study of the atomic world revealed that even the conception of the space-time motion of bodies loses its meaning on this level.

Some scientists dream of developing “the theory of everything” and explaining the Universe as a whole, drawing its present picture and trying to reveal its genesis from the very “beginning.” Already Aristotle mentioned this peculiar human striving: “They wondered originally at the obvious difficulties, then advanced little by little and stated difficulties about the greater matters, e.g., about the phenomena of the moon and those of the sun and the stars, and the genesis of the universe” (Aristotle, ca. 350 B.C.E./n.d., A 2, 982 b11). For example, believing in the infinity of the Universe, Isaac Newton realized well that there was a complicated problem with the masses of innumerable stars creating infinite gravitational tension at any point in space.

Modern astrophysics has established that the observable Universe is a network of galactic filaments immersed in absolute emptiness (Tempel et al., 2014). So nothing prevents you from getting used to this bizarre picture of the Universe. Nevertheless, these filaments comprise billions of galaxies, and each galaxy contains, on average, billions of stars.

Let us also consider that at the level of galaxies, the only acting force is gravitational attraction. It becomes clear that no life span will be enough for humans to think up conditions under which gravity could compress the matter of the Universe into billions of billions of stars in thin galactic filaments spanning millions of

light years.

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