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AXIOMATIC EPISTEMOLOGY

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Abstract: This article is the first complete axiomatic presentation of the theory of cognition (epistemology). It presents the axioms of the theory of cognition, the definitions of the concepts and categories used in the text of the theory, and also provides detailed proofs of the propositions (theorems) arising from them. Based on this axiomatic system, evidence-based solutions to the problems (*aporias*) of the theory of cognition are proposed. This system of axiomatic epistemology can serve as a step in building a rigorous scientific theory of human cognition. The axioms of the proposed system follow the Aristotelian general understanding of the essence of human cognition.

Keywords: theory of cognition, axiomatic system, definitions of concepts, proof of theorems.

Introduction

Aristotle was convinced that “all proving sciences equally use axioms” (Aristotle, *Metaphysics*, II 3, 997 a 10). A clear idea of axioms as the basis of proof is set out in the first book of the “Second analytics”. Jan Lukasiewicz demonstrated that the Aristotelian syllogistic theory was the first axiomatic theory in the history of science (Lukasiewicz, 1957). Aristotle himself had not yet used the axiomatic method of presenting his syllogistic doctrine. He called the general syllogisms of the first figure “perfect syllogisms”. These two general syllogisms of the first figure in medieval logic were designated as the modes *Barbara* and *Celarent* and received a brief formulation “dictum de omni et de nullo”. Only much later, within the framework of traditional formal logic, the “dictum” principle began to be called the “axiom of the syllogism”. Interest in the axiomatic method revived with the development of the first systems of non-Euclidean ge-

ometry of the early 19th century (Rav, 2008; Lobachevsky, 2010; Lavenda, 2012). This new trend of the axiomatization of 19th-century mathematical theories J. Hintikka (2011) has called “conceptualization”.

The outstanding mathematician of the beginning of the 20th century, David Hilbert, believed that everything that is ripe for the formation of a scientific theory is subject to the axiomatic method and, at the same time, of mathematics. Today, it is widely accepted that for the possibility of an axiomatic construction of a theory, some initial provisions are necessary, namely, axioms that are epistemological in their nature. At the next stage of analysis, one can abstract from the meaningful nature of the axioms. At this “higher stage”, one can consider the exclusively internal structure of the axiomatic system. Moreover, this structural analysis is devoid of knowledge, gleaned from experience. Hence the conclusion is drawn that thereby the theory becomes the object of “purely mathematical re-

search”.

The general spirit of Hilbert’s program of substantiation of mathematics (Hilbert, 1971/1899) is seen a serious basis for considering David Hilbert the founder of the concept of formalism in the study of the foundations of mathematics, although the brilliant mathematician himself practically did not use the term *formalism*, and put the problem of proving consistency by finite methods at the forefront of his program. In modern literature, the approach of abstraction from the cognitive content of the theory, in combination with its completely symbolic representation, is called *formalization*, and accordingly, purely mathematical research is adequately interpreted as metamathematical or metatheoretical research (Kleene, 1952).

The concept of meta-mathematics soon gave rise to the idea of meta-theory, to which representatives of many non-mathematical sciences gradually responded (Munafò, 2017; Fortunato, 2018). Hasmik Hovhannisyán studied the perspectives of the metatheoretical approach in the field of argumentation and philosophy (Hovhannisyán, 2008, 2014, 2015). She concluded that regarding non-mathematical sciences metatheoretical research requires certain self-reflection concerning the logical buildup of theories in the given field of scientific knowledge (Hovhannisyán & Djidjian, 2017).

Aristotle interpreted philosophy as the science of principles (*ἀρχή*) and called this science wisdom. One of the most important purposes of wisdom is the understanding of the “difficult and not easily comprehensible”. The founder of theoretical philosophy believed that philosophical science should be built by explicitly indicating the principles or “axioms” of the doctrine. He assessed the law of contradiction as the “most reliable” of all axioms (Aristotle, *Metaphysics*, 1005 b 10 and 1005 b 20). Aristotle considered the law of contradiction as the law of the real world, from which, according to the definition of truth, the formulation of the law of contradiction as the law of thinking already followed (Djidjian & Hovhannisyán, 2020).

In subsequent centuries, the development of scientific knowledge proceeded in such a way that, until the end of the 19th century, the axiomatic formulation of theories found application only within the framework of mathematical knowledge (Hintikka, 2011; Lavenda, 2012).

The magnificent building of axiomatic geometry was so perfect that some philosophers dreamed with envy of building a palace of wisdom “by the geometric method”. Each solution to any question within the framework of an axiomatically constructed theory is strictly proved on the basis of the axioms and definitions of this theory. Therefore, the opponent of an axiomatic theory must point out which axiom is wrong or which definition is unsatisfactory.

A characteristic feature of philosophical knowledge is the “eternal” nature of philosophical problems. Due to the extreme abstractness of philosophical categories and principles, it is difficult even to imagine the criteria for verifying their truth. Hence, we get a notable number of trends and philosophical schools, not only in historical terms but also in modern philosophy. Secondly, since the philosophical teachings about morality, and in general, about social relations, are directly related to the life and activities of a person, it often turns out that personal interests can be weightier than the opposed positions of the truth of wisdom.

The fundamental advantage of the axiomatic method manifests itself precisely in the field of an objective assessment of the truth of philosophical teachings. An axiomatically constructed theory is based on clearly and unambiguously expressed axioms and definitions. All other assertions of the axiomatic theory are derived from these explicitly formulated principles and rigorous definitions. If an opponent questions the truth of a particular proposition of an axiomatic theory, then he must object to a specific axiom or definition of the theory under discussion. It is very difficult to do this since the author of the theory always chooses as axioms the most reliable, unshakable, generally accepted statements. So, if it were possible to realize the axiomatic representation of philosophy (or its certain branch), then thanks to this, the old dream of rational philosophy could become a reality, and philosophy could be included in the category of rigorous sciences based on logical proofs.

However, we must admit that apart from two books – “Axiomatik Alles Moglichen Philosophierens” (1950) by the German philosopher Eberhard Rogge and “Axiomatic Philosophy” by the modern Indian physicist and philosopher Pritam Sen (1996) - we could not find not a single publication concerning the axiomatization of

philosophical doctrines or theories. Although the book of Eberhard Rogge did not present his readers with any axiomatized philosophical doctrine, nevertheless, he received a result that deserves serious attention. E. Rogge managed to identify the universal foundations of positivism, rationalism, and hermeneutics. According to E. Rogge, each of these directions considers meaningless the problems of other philosophical teachings. The positivists consider only the epistemological problems of natural science and mathematics worthy of attention; modern rationalism is interested in questions of the critical analysis of language; hermeneutics studies the interpretation of life and the world as a text, in the same way as theologians interpret the texts of the Bible.

It is very instructive to consider the method of revealing the axioms of philosophical doctrines. E. Rogge recommends, firstly, starting with a relatively independent section of philosophical doctrines, for example, with the theory of cognition. The second step is the analysis of “immanent” discussions within each philosophical direction on the problems of each section. The third step is to identify the “prejudices” of the opponents, to reveal their underlying prerequisites and foundations.

At the end of the last century, the Indian physicist Pritam Sen published the monograph “Axiomatic Philosophy”. Independently of his predecessor Eberhard Rogge, whose book remained little known outside of Germany, P. Sen also explores the axioms of the philosophical systems of the most famous thinkers of the past. P. Sen devoted separate sections of his book to

the goal of identifying the foundations of the philosophy of Plato, Aristotle, Kant, and Russell, the two main systems of Indian religious philosophy Bhagavad Gita and Samkara, as well as the teachings of Confucius and Lao Tzu.

Unfortunately, either Eberhard Rogge or Pritam San, apparently, had no intention of using the axioms they had identified to construct a corresponding philosophical theory on their basis. They did not even try to show, at least by separate examples, how these axioms are used in strict logical proofs of philosophical statements, and in logical conclusions of solutions to specific philosophical problems from the axioms they identified.

It is the achievement of an axiomatic proof of

the provisions and conclusions of the theory of cognition that is the main goal of our study. There a question may arise: of the many possible axiomatic representations of the theory, which one deserves preference? The answer is pragmatic: that one axiomatic representation is preferable, which is capable of offering axiomatic proofs for all true statements of the theory under consideration. It must be admitted that the axiomatization of a developed theory means only its refinement. On the other hand, only a successful axiomatization can give the theory an unshakable foundation. Anyone who tries to question the validity of an axiomatic theory must either point out the flimsiness, disputability of a particular axiom, or point out the flaws in the group of axioms used. To express reasonable doubt about the truth of an axiom is the most difficult task since axioms are the most verified and confirmed statements in this area of scientific and philosophical knowledge.

Based on the foregoing, we build an axiomatic system of the theory of cognition in the following successive steps. We, first, compile a list of the most important and widely discussed issues in the theory of cognition in the literature (*aporias* in the terminology of Aristotle). Secondly, we explicitly formulate the axioms and definitions of our system, based on personal experience of philosophical discussions. Thirdly, we carry out rigorous proofs of the statements (theorems) of interest to us within the framework of the constructed axiomatic system of the theory of cognition, and finally, we show that each of the *aporias* formulated above receives its demonstrative answer on the basis of the constructed axiomatic system of the theory of cognition.

According to the outlined steps, here is a list of fundamental questions (*aporias*) of the theory of cognition:

Aporia 1.

Do sensations and sensual perceptions arise under the influence of the external world? Or rather, sensations and sensual perceptions are the elements of human consciousness independent of the external world.

Aporia 2.

Do sense-concepts imply some form of generalization of the accumulated experience of perceiving an object? Or rather, generalization is an operation inherent only in abstract verbal thinking.

Aporia 3.

Is it right to trust the data of the senses? Or rather, our sensations and sensual perceptions distort the true picture of the world.

Aporia 4.

Does the truth consist in accordance with reality? Or rather, it is the intuitive clarity of thought, its success, or even a temporary agreement between scientists.

Aporia 5.

Is there an objective criterion of truth? Or rather, it all comes down to temporary, conditional agreements about the truth of certain general statements.

Aporia 6.

Does the empirical material contain the whole truth? Or rather, the prerogative of putting forward general ideas and laws belongs to the ability of rational thinking.

Aporia 7.

Is there absolutely true scientific knowledge? Or rather, one can doubt even the most obvious truths of mathematics.

Aporia 8.

Are the mind and reason the highest form of cognition? Or rather, mind and reason are the two main and inalienable sides of a single process of human cognition.

Aporia 9.

Are thought and consciousness a kind of independent substance (*substantia*)? Or thinking is a function of a certain way structured and organized material system - the brain.

As a basis for a demonstrative answer to these fundamental questions, we adopted the presented below well-known fundamental statements and definitions as the axiomatic basis of the theory of cognition.

Axioms

Axiom 1.

Objects of the external world, acting on the sense organs, cause sensations and sensory perceptions (images) in the human brain (see Aristotle, *Metaphysics*, 1010b33; Aristotle, *On the Soul*, 417b19-25 and Note 1).

Axiom 1a.

The evolution of living nature has developed the ability of the brain to organize sensory data and form visual images of the external world ob-

jects (see Note 1a).

Axiom 2.

Sensations and sensory perceptions correspond to the properties of the sensed objects that cause them (see Aristotle, *On the Soul*, 424 a16-20, 427b12, 428a12 and Note 2).

Axiom 2a.

A sense-concept is formed by generalizing separate sensory perceptions of a particular object (see Note 2a).

Axiom 3.

The *reliability* of sensations and sensory perceptions is established by practice and the success of human activity (see Note 3).

Axiom 4.

Human cognition has two levels - the level of sensory cognition and the level of verbal (abstract, rational) thinking based on it (see Note 4).

Axiom 5.

Elementary (initial) verbal concepts are formed by naming sense-concepts (see Note 5).

Axiom 5a.

A new (not elementary) verbal concept is formed by generalizing an already-formed concept.

Axiom 6.

Verbal thinking, with the help of generalizations and abstractions, reveals the essential (“internal”) properties of objects and phenomena in the surrounding world (see Note 6).

Axiom 7.

The truth of thoughts is established by their confirmation through life experience, practice, and scientific experiments (see Note 7).

Axiom 8.

Correspondence of general statements and reality is never complete (see Note 8).

Axiom 9.

A new truth is born as a hypothesis (see Note 12).

Definitions

Definition 1.

Scientific knowledge is a true generalization (see Note 13).

Definition 2.

Practice is the life experience of mankind, including production activities and scientific experiments.

Definition 3.

Reliable sense data are sense data confirmed

by life experience.

Definition 4.

Words denoting (naming) specific sense-concept are concepts of the lowest level of abstraction.

Definition 4a.

A *thought* is a statement that some object has a certain property.

Definition 5.

True *thought* is a thought corresponding (adequate) to reality.

Definition 5a.

Correspondence and *adequacy* are synonyms.

Definition 6.

The adequacy of thought to reality is characterized as the *objectivity* of truth.

Definition 7. T

he incomplete adequacy of thought to reality is characterized as the *relativity* of truth.

Definition 7a.

Absolute truth is unshakable (timeless) knowledge.

Definition 8.

Scientific knowledge is a set (system) of general truths. (Aristotle, *Metaphysics*, 982a20-25)

Definition 9.

Reliable knowledge is knowledge confirmed by practice and experiments.

Definition 9a.

The historical process of the incessant replacement of less reliable knowledge by more reliable one is called scientific progress.

Definition 10.

Intelligence is the set of cognitive abilities of a person.

Definition 11.

Cognition is the process of acquiring knowledge.

Definition 12.

(Scientific) thinking is the process of finding an answer (solution) to a certain question or problem.

Definition 13.

Reasoning is the process of logical consideration of the problem under consideration.

Definition 14.

The totality of the principles and laws of the fundamental sciences of a given era forms its *scientific picture* of the world.

Definition 15.

To be a sensual image of a particular object means to be its reflection (see Aristotle, *On the*

Soul, 424 a16-20).

Definition 16.

The terms abstraction and generalization are synonymous.

Definition 17.

Consciousness is an active state of all mental and psychic abilities of the brain that provide the life activity of the individual.

Definition 18.

Understanding is the result of reasoning (see Note 10).

Definition 19.

Language (speech) is a means and ability of verbal communication and cognition.

Definition 20.

Imagination is an innate ability to form an internal visual image at will based on the available set of sensory perceptions and sense-concepts.

Definition 21.

Confirmation of thought means a positive result of its testing.

Theorems of the Theory of Cognition

The above axioms and definitions make it possible to prove the following general statements (theorems) that provide strictly substantiated solutions to the main problems of the theory of cognition.

Theorem 1.

The principle of philosophical solipsism “The world is my sensations (my consciousness)” is erroneous.

Proof. Solipsism is denied directly by Axiom 1 “Objects of the external world, acting on the sense organs, cause sensations and sensory perceptions (images) in the human brain”.

Theorem 2.

All variations of philosophical idealism based on the postulate of the independent existence of sensory perceptions, abstractions, and ideas are erroneous.

Proof. Axioms 1-3, which offer an explicit scheme for the formation of a picture of the world based on sensory perceptions arising under the influence of the external world, refute all those models of idealism that proceed from the postulate of the independent existence of sensory sensations and sensory perceptions. The said postulate of idealism hinders the construction of a rational picture of the world.

Theorem 3.

The skepticism of ancient thinkers in relation to sensory data is erroneous.

Proof. The mind overcomes skeptical doubts by checking the validity of sense data and thoughts by comparing them with the actual state of things, as well as by checking them in the wider field of life practice (Axiom 3, Axiom 7, and Definition 5).

Theorem 4.

Agnosticism in relation to sensory data is erroneous.

Proof. Axiom 1a directly states the ability of the human brain and higher animals to process and organize the data coming from the sense organs and to form an objective sensory (visual) picture of the world under the control of life practice.

Theorem 5.

Sense-concepts serve as a connecting link on the path of ascent from the level of sensory cognition to the level of abstract (verbal) thinking.

Proof. Sense perceptions, which are the initial data contained in the memory of animals, are by their nature singular (Axiom 1). Each sensory perception of an external object at different moments of time, at different distances, and in different positions is fixed in memory as a single sensory image. To be of any use in the life of an animal, this vast number of single perceptions must function as an image of the same object. Possessing an elementary level of generalization of individual perceptions, the memory (brain) of an individual solves this problem with the help of sense-concepts, forming the generalized sensory image of a given object on the basis of its numerous sensual perceptions. In the living world, this is achieved by the evolutionarily arisen ability of object vision. Thus, sense-concepts, as generalizations, serve as a transitional form that connects the world of singular sensory perceptions with the field of generalized verbal (abstract) thinking.

Theorem 6.

Sense-concepts are the only form of acquiring knowledge at the level of sensory cognition.

Proof. According to Theorem 5, a sense-concept is formed in memory as a generalization of the available sensory perceptions of a given object. On the other hand, "Every generalization is knowledge" (Definition 3). Since among the forms of sensory cognition only sense-concepts

have the ability to generalize, it directly follows from the above premises that sense-concepts are the only form of acquiring knowledge at the level of sensory cognition.

Theorem 7.

Sensual and abstract levels of cognition are inseparable.

Proof. Axiom 5 states: "Natural language forms elementary concepts by naming sense-concepts". Since the mental operation of naming is carried out in a person's memory, the latter keeps the word ("name") and the corresponding sensory image together, in unity. When a person pronounces a word (concept), the sensory image (sensory representation) is simultaneously activated in memory.

Theorem 8.

The new concept of natural language has a higher level of abstraction than the concept generalized by it.

Proof. Elementary concepts (words) of a natural language denote sense-concepts (Axiom 5). Since a new concept is formed by a generalization of the sense-concepts of a given concept (Axiom 5a), this means that natural language forms new concepts by generalizing the existing concepts. Consequently, the new concept has a higher level of generalization than the concept generalized by it. And since the terms abstraction and generalization are synonyms (Definition 16), it follows from this that new concepts have a higher level of abstraction than the concepts they generalize.

Theorem 9.

Thought reflects reality (the surrounding world).

Proof. Consider Axiom 2a and Definition 15:

Axiom 2a. A sense-concept is formed by generalizing separate sensory perceptions of a particular object.

Definition 15. To be a sensual image of an object of reality means to be its reflection.

From these two statements, it directly follows that "sense-concept is a reflection of the object of reality". Or in a shorter version: "Sense-concept is a reflection of reality". (A)

Recall axioms 5 and 5a:

Axiom 5. Elementary (initial) concepts (words) are formed by naming (designating) sense-concepts.

Axiom 5a. A new (not elementary) verbal concept is formed by generalizing an already-

formed concept.

These two axioms together imply:

Concepts (words) are generalizations of sense-concepts. (B)

From premises (A) and (B) it immediately follows:

“Concepts reflect reality”. (C)

Further, according to Definition 4a,

“A thought is a statement that some object has a certain property”.

And since objects and their properties are denoted by concepts, and according to the statement (C) above, concepts reflect reality, it immediately follows from this:

“Thoughts reflect reality”. (Theorem 9 is proven)

Theorem 10.

The truth of thoughts is constantly *tested* by life experience, practice, and scientific experiments.

Proof. Let us use Axiom 7 and Definition 21:

Axiom 7. The truth of thoughts is *established* by their confirmation through life experience, practice, and scientific experiments.

Definition 22. Confirmation of thought means a positive result of its testing.

From these two premises, it follows:

The truth of thoughts is constantly tested by life experience, practice, and scientific experiments. (Theorem 10 is proven)

Theorem 11.

In the process of constant verification, less reliable knowledge is constantly replaced by more reliable knowledge.

Proof. Let's use Definition 8 and Theorem 10:

Definition 8. Knowledge is a set of general truths.

Theorem 10.

The truth of thoughts is constantly tested by observation, practice, and scientific experiments.

From these two premises, it follows:

Knowledge is constantly tested by observation, practice, and experimentation. (A)

Let's take into account Definition 9:

“Reliable knowledge is knowledge sufficiently confirmed by practice and experiments.”

Now we can deduce from (A) and Definition 9:

In the process of constant verification, less reliable knowledge is replaced by more reliable. (Theorem 11 is proven.)

Theorem 12.

The history of science and technology testifies to the constant progress of scientific and technical knowledge.

Proof. We have proved above that in the process of constant verification, less reliable knowledge is replaced by more reliable (Theorem 11).

According to Definition 9a, we have the premise “The historical process of the incessant replacement of less reliable knowledge by more reliable is called scientific progress”.

Theorem 11 and Definition 9a directly imply:

The history of science and technology testifies to the constant progress of scientific knowledge. (Theorem 12 is proved.)

Theorem 13.

The world is cognizable.

Proof. If the world were unknowable, then the high level of scientific progress of our day would be impossible.

Theorem 14.

Truth is relative in three aspects - general philosophical, qualitative, and quantitative.

Proof. According to Axiom 8, “The adequacy of thoughts and objects of reality is never complete”.

On the other hand, thought is true if it is adequate to reality. (Definition 5)

At the same time, according to Definition 7, “The incomplete adequacy of thought to reality is characterized as the relativity of truth”.

The conclusion about the relativity of truth in the general philosophical aspect follows directly from the above 3 premises.

To demonstrate the relativity of truth in a qualitative aspect, we will use the concept of a *scientific picture* of the world:

Definition 14. The totality of the principles and laws of the fundamental sciences of a given era forms its scientific picture of the world.

On the other hand, we have the following valid scientific statement (Knowledge):

Knowledge 1. The history of science has recorded that scientific eras successively replace each other.

From Definition 18 and Knowledge 1, it follows that “Scientific worldviews of historical eras successively replace each other”. This means that truth is relative also in its qualitative aspect.

To demonstrate the relativity of truth in a

quantitative aspect, we will use the following general position of the empirical sciences:

Knowledge 2. Quantitative statements need measurement operations.

On the other hand, we also have the following general statement of the history of science:

Knowledge 3. The accuracy of measuring operations is constantly improving.

From the statements Knowledge 2 and Knowledge 3, it directly follows that the truth of quantitative statements is relative in the aspect of their constant refinement. Thus, we have obtained the proof of all three aspects of Theorem 14.

Theorem 15.

There is not and cannot be absolute truth in the field of general theoretical statements.

Proof. According to Definition 7a, “Absolute truth is unshakable general knowledge, fully adequate to reality”.

According to Axiom 8, “The adequacy of general statements and objects of reality is never complete”.

At the same time, we have Definition 5: “A true thought is a thought that is adequate to reality”.

It directly follows from these three premises that there can be no absolute truth in the field of general theoretical statements (Theorem 15).

Theorem 16.

All alternative conceptions of truth are erroneous as one-sided approaches.

Proof. (A) All main alternative concepts of truth focus on some particular aspect of the process of knowing:

The consistency concept does not consider conditions and essence of the truthfulness focusing mainly on its result.

Conventionalism is only a transition period in the formation of a true scientific concept.

Pragmatism is a characteristic of the applied use of truth but does not reveal its essence.

Intuitionism proceeds from a subjective assessment of the obviousness of truths, which is generally absent in the case of new theories of natural science (e.g. quantum mechanics and relativistic mechanics).

(B) No particular aspect of the process of cognition can replace the task of achieving knowledge adequate to reality.

From premises (A) and (B) it immediately follows that all alternative conceptions of truth

are erroneous as one-sided approaches (Note 13).

We are now ready to present evidence-based answers to the epistemological aporias formulated above.

The answer to *Aporia 1*:

“Do sensations and perceptions arise under the influence of the external world? Or rather, sensations and sensual perceptions are the elements of human consciousness the senses, cause sensations and sensory images in the brain”;

The answer to *Aporia 2*:

“Do sense-concepts imply some form of generalization of the accumulated experience of perceiving an object? Or rather, generalization is an operation inherent only in abstract verbal thinking” is given in Axiom 2a “Sense-concept is formed by a generalization of separate sensory perceptions of a certain object”;

The answer to *Aporia 3*:

“Is it right to trust the data of the senses? Or rather, our sensations and sensual perceptions distort the true picture of the world” is given in Axiom 2 “Sensations and sensory images correspond to the properties of the sensed object that causes them”;

The answer to *Aporia 4*:

“Does the truth consist in accordance with reality? Or rather, it is the intuitive clarity of thought, its success, or even a temporary agreement between scientists” is given in Definition 5 “A true thought is a thought corresponding (adequate) to reality”;

The answer to *Aporia 5*:

“Is there an objective criterion of truth? Or rather, it all comes down to temporary, conditional agreements about the truth of certain general statements” is given by Axiom 7 “The truth of thoughts is established by their confirmation in life experience, practice, and scientific experiments” and Theorem 16 “All alternative conceptions of truth are erroneous as one-sided approaches” (Note 13);

The answer to *Aporia 6*:

“Does the empirical material contain the whole truth? Or rather, the prerogative of putting forward general ideas and laws belongs to the ability of rational thinking” can be briefly expressed as follows: general ideas and laws are developed by rational thinking (Axiom 4 and Axiom 6), but empirical facts serve as their basis and means of verifying the truth. (Note 14);

The answer to *Aporia 7*:

“Is there absolutely true scientific knowledge? Or rather, one can doubt even the most obvious truths of mathematics” is given in Theorem 15 “There is not and cannot be absolute truth in the field of general theoretical statements.” (Note 15);

The answer to *Aporia 8*:

“Are the mind and reason the highest forms of cognition? Or rather, mind and reason are the two main and inalienable sides of a single process of human cognition.” is given in Definitions 18 and 18a (Mind, as intellect, is based on the understanding achieved by reason.);

The answer to *Aporia 9*:

“Are thought and consciousness a kind of independent substance (*substantia*)? Or rather, thinking is a function of a certain way structured and organized material system - the brain” is given in the following modern view on the subject: The brain of an individual, based on the data of the sense organs, forms in memory a picture of the surrounding reality; then this picture is described and studied at the level of abstract (verbal) thinking, which makes it possible to put forward hypothetical positions about essential properties and laws of the objective world; eventually, the reliability and truth of hypothetical positions are established by scientific experiments and practice”.

Notes

Note 1.

In search of an answer to the main question of the “first philosophy” about being as such, Aristotle begins the 2nd chapter of the VII book of *Metaphysics* with the words “Most of all, it is believed that essence is inherent in bodies” (Aristotle, *Metaphysics*, VII 2, 1028 b 9). Whether there are other entities as well is something to be considered. In this group of entities, sense perception cannot be included. Sensory perception cannot perceive itself, “but there is something else besides perception, which is necessary first of all, for that which moves by nature is first of what is moved, and the matter does not change whether they are correlated with each other or not” (Aristotle, *Metaphysics*, IV 5, 1010 b 35).

Note 1a.

Immanuel Kant’s correct observation that sensory data entering the brain creates informa-

tional chaos reflects the fundamental difficulty of the pre-evolutionary theory of cognition of his time. This difficulty has been resolved by the evolutionary concept of the origin of species (Darwin, 2001/1859).

Note 2.

“Regarding any type of sense perception, it is generally necessary to recognize that it is something that is capable of perceiving the forms of the sensed without its matter, just as wax takes the imprint of a ring without iron or gold,” wrote Aristotle (Aristotle, *On the Soul*, 424 a16 - 20). The significance of the formulation of the great thinker is not only in the unforgettable figurative comparison of sensory perception and the imprint of a ring but also in the convincing remark that sensory perception provides us with the shape of an object without distortion, akin to the imprint of a ring on wax.

Note 2a.

This thought is implied in the idea of resolving the paradox of *senses versus rational*: “Sense data provide elementary knowledge from which rational thinking forms general concepts” (Djidjian, 2016, p. 50). Since of the types of sensory cognition, only sense-concept contains knowledge, and knowledge is knowledge of general, it follows from the cited thought that sense-concepts are generalizations of sensory perceptions.

Note 3.

Francis Bacon has mentioned that although the senses quite often deceive and mislead, in alliance with the activity of a person, they can provide quite sufficient knowledge. Of course, for philosophers, who, according to the specifics of their subject, deal with the most general problems of being and cognition, it is completely unusual to turn to the practical activity of a person as a criterion for the truth of certain provisions. Such an “impractical” mood of philosophers can even be justified if we accept the general thesis that the starting material for philosophizing and building philosophical concepts are the most general statements of the relevant scientific disciplines. But even in this case, the specific sciences will confirm that their belief in the adequacy of sensory perceptions is based on the success of a person’s vigorous activity, in particular, on agreement with experimental data.

Note 4.

Immanuel Kant has mentioned that we cannot

think of a single object except with the help of reason but at the same time we cannot cognize a conceivable object except with the help of sensory intuitions. Since no object can be known without the help of sensory perceptions, thinking without sensory perceptions turns out to be objectless. Symmetrically, knowledge of objects is impossible without rational thinking. This way we reach Kant's famous aphorism: "Reason without sensations is empty, sensations without reason are blind".

Note 5.

About the individual nature of sensations and the general nature of concepts, Aristotle wrote the following: "Sensation in action can be likened to the activity of contemplation; it differs from the latter in that what puts it into action is something external, visible and audible, as well as something else that is felt. The reason for this is that sensation in action is directed to the individual, while knowledge is directed to the general. And the common in some way is in the soul itself. Therefore, to think is in the power of the thinker himself, whenever he wants to think; the sensation is not in the power of the one who perceives, for it is necessary that the sensed be present" (Aristotle, *On the Soul*, II 5, 417 b 19-25).

Note 6.

Famous aphorisms of John Locke – "There is no essential in single things", "Every abstract idea represents an essence" - clearly demonstrate his correct understanding of the place and meaning of abstract, verbal thinking. Locke, using accessible examples, explained that "powers and abilities" are inaccessible to knowledge by sensory perceptions alone and require the participation of abstract thinking.

Note 7.

The aphorism 77 of *The New Organon* begins with the following sentence: "The procedure that starts with experience and sticks close to it is the best demonstration by far" (Bacon, 1620, p. 19). The principle of practice was adopted by Soviet philosophers. They interpreted practice as an activity of people aimed at transforming objects in order to meet social needs. The most popular was the assessment of the dual role of practice - as a source of knowledge and as a criterion of truth.

Note 8.

In connection with the concept of the relativity of truth arises the problem of absolute truth, usually in the form of the question: "Can an edu-

cated person imagine that any theorem or axiom of geometry is a *relative* truth?" There is no doubt that the result of such a survey will be predominantly negative. In principle, one can *imagine an experiment* on a cosmic scale that allows one to measure the sum of the interior angles of a triangle whose vertices are the stars closest to us. The results of this experiment could serve as a test for the Euclidean "flat" model of world space.

Note 9.

"From the definition here, the one who has the greatest knowledge of the general must necessarily have knowledge of everything, application in the meaning he knows everything that falls under the general," explained Aristotle. "But perhaps the most difficult thing for a person to know is precisely this, the most general, it is the furthest from sensory perceptions" (Aristotle, *Metaphysics*, 982a20-25).

Note 10.

In modern publications, three main meanings of the category of mind can be distinguished: Mind₁ (reason in the wide sense) as equivalent to the category of consciousness; Reason₂ as an assessment of the mental abilities of a person ("intelligence", "Mind") and Reason₃ as the ability of logical reasoning.

Note 11.

It is not difficult to verify that sensory representations are also present in higher animals. For example, lions attack cardboard images of lions. It can be assumed that the sensory representations of humans and animals arise according to an inborn, innate mechanism applied to the personal experience of sensory perceptions (visual images) and representations. Human dreams testify that in the human brain, there is also an innate mechanism for the formation of visual images, by analogy with the available baggage of ideas. This is the basis of the mechanism of imagination.

Note 12.

The term *artificial intelligence* has been widely used in all spheres and at all levels of public life since the first decades of the 21st century. A few decades earlier, it was customary to emphasize that the potential of the state is determined by the power of its computers. Today, it is already required to achieve a wide application of software tools (artificial intelligence in this narrow sense) in all areas of society, primarily in

design organizations and in production. In turn, computer programs are the implementation in programming languages of algorithms for the corresponding activity. We are gradually approaching that historical date when the first “truly thinking” machine will be created - an autonomous system of artificial intelligence capable of independently perceiving, describing, and researching the surrounding reality.

There can be no doubt that in developing a “truly thinking” machine, those computer scientists who will be guided by the correct version of the general theory of cognition will have a decisive advantage. An intermediate step on this path will be a universal algorithm for finding solutions to intellectual problems - the Algorithm of thinking.

Here is a version of the formulation of *the Algorithm of thinking* that we developed in (Djidjian, 2004, pp. 80-81). To successfully solve the problem under study, one must first achieve a sufficient level of understanding of the problem under study. The analysis of the problem under study is carried out in the following steps:

- a. to identify the main features of the problem,
- b. present the problem under study in a standard form,
- c. divide the original problem into a set of sub-problems,
- d. to draw deductive consequences from the totality of data on the problem under study.

In the case of serious research problems, the analysis of the problem reveals a sub-problem that does not lend itself to further subdivision. Such a sub-problem can be solved only by synthesizing the idea of its solution by analogy with the idea of solving a similar prototype problem.

Note 13.

Definition 1 concerns, first of all, scientific knowledge, which is distinguished by its generalizing character. In contrast to scientific knowledge, factual knowledge occupies a significant place in everyday knowledge.

Note 14.

The progress of science and technology leaves no doubt that the success of the implementation of scientific and technical projects is based on true, proven, reliable theoretical knowledge. It is in this sense that theory is the best practice. True knowledge is the key to successful practice, truth brings success, and truth will never fail.

But the success of the activity just by itself is a significant value. Moreover, taking practice as a criterion of truth, we give the palm to practice. There is a subtle but significant separation line here. One should clearly distinguish between “the truth in progress” and “the truth already tested”. Undoubtedly, in the process of the formation of a truth and its approbation, the main role belongs to practice. But the proven truth is already self-sufficient and serves as a condition for the success of its further practical use. It is the proven, verified truth that will never fail.

Momentary success can end in failure if it is not comprehended in the form of true knowledge, as an adequate theoretical generalization. There are many examples of this. Jean-Baptiste Lamarck successfully explained the evolution and development of the animal world in light of his concept. But it soon became clear that he was fundamentally mistaken in his belief that evolution takes place under the direct influence of the conditions of life and due to the exercise of the organs. There are many examples also in the field of modern technology. The catastrophe of the Concorde supersonic airliner on July 25, 2000, made the strongest impression on the world community. Due to this single disaster, the popularity of supersonic liners sharply declined, their operation began to bring losses, and since 2003 all Concorde were decommissioned and became museum exhibits.

The author of the Stanford Encyclopedia of Philosophy article “Theory of Correspondence” M. David joins the common assessment among professional philosophers that “the theory of correspondence is too obvious to merit much or any discussion” (David, 2022). The noted specificity of scientific articles on the problems of philosophy contrasts sharply with the fact that, according to a special study conducted among teachers and students of philosophy departments in the United States, more than 80 percent of the respondents accept the principles of the materiality and cognizability of the world (“non-skeptical realism”), while supporters of idealism are only 4.3 percent (*The 2009 PhilPapers survey. Results, analysis and discussion*, 2009).

It seems to us not superfluous to note that the understanding of the Western pragmatic concept that is customary for the Soviet and post-Soviet philosophical community as success in practical activity is not accurate. The fathers of pragma-

tism, Charles Peirce, William James, and John Dewey, and their followers, had in mind not the success of people's practical activities, but the success of research work. For example, Ch. Peirce's interpretation of truth comes down to the following: "The opinion with which all researchers are destined to agree in the end is what we mean by truth, and the object represented in this opinion is reality" (Peirce, 1878 (citation by Capps, 2019)). Researchers of pragmatist epistemology are forced to acknowledge that "Often the significant differences between various pragmatic theories of truth can make it difficult to determine their general principles (if any)" (Capps, 2019).

It is the absence of a criterion of practice that forces many philosophers to lean towards an idealistic approach to questions of epistemology (Stove, 1991). Here, for example, is how Immanuel Kant argued. It is generally accepted that we cannot go beyond our own mind to compare our thoughts with mind-independent reality. But according to the correspondence theory, that is exactly what we would have to do in order to gain knowledge. We would have to access reality as it is in itself, independent of our cognition, and determine whether our thoughts correspond to it. But since this is impossible, then all our access to the world is mediated by our knowledge, and the concept of correspondence makes knowledge impossible. This is the basis for Kant's concept of "thing-in-itself".

We also note that the "Theory of Truth" section of the Stanford Encyclopedia of Philosophy includes an "Axiomatic Theory of Truth" subsection, which describes attempts to give formal axiomatic descriptions of truth and draw conclusions from them, such as Gödel's theorem or Tarski's concept of the indefinability of truth in formalized mathematical theories (Halbach & Leigh, 2022). But they fail to take into account that the axiomatic representation (in this case, the axiomatic theory of truth) is justified only if there is an appropriately developed theoretical concept of the truth.

Note 15.

The answer to Aporia 6 requires careful consideration. Here philosophers should concentrate their attention

- 1) on the comparison of sensory and rational levels of cognition (Axiom 4),
- 2) on the comparison of "factual" statements and

general theoretical statements in terms of their genesis (see Axiom 5a and Axiom 5b),

- 3) on comparing the empirical and experimental knowledge about natural phenomena and the knowledge of abstract logico-mathematical sciences about ideal objects (see Axiom 6), and
- 4) on the comparison of the empirical (pre-theoretical, fragmentary) level of knowledge and theoretical knowledge (as a system of evidence-based knowledge). Unfortunately, the consideration of points (2)-(4) takes us beyond the theory of cognition and touches upon the issues of methodology and theory of science, which we intend to dwell on in our study of the possibility of an axiomatic representation of the methodology of scientific research.

Note 16.

Knowledge about reality, according to Definition 1 and Definition 8, is a claim for a valid generalization, which, by the very nature of the generalization, is neither guaranteed to be true for all time nor exhaustive. This is also stated in Axiom 8 "The correspondence between a general statement and reality cannot be complete".

As for purely mathematical knowledge (mathematical theory), the characteristic "truth" is in principle inapplicable to it, since there is no natural world of mathematical objects. In fact, mathematical objects are ideal objects, abstractions. If we talk about mathematical theories of the "first level of abstraction from reality", such as Euclidean geometry, then in them certain provisions are indeed correlated with reality, so to say, are "obvious". Yet there can be no guarantee that a fact of real reality will not be revealed, which is not "obvious" and contradicts a certain provision of this theory. In geometry, the postulate of a straight line is obvious, but the postulate of the sum of the angles of a triangle is not at all obvious. Moreover, according to modern cosmology, the curvature of world space depends on the average density of matter in world space. There is a certain possibility of experimental verification of the postulate of Euclidean geometry about the sum of the interior angles of a triangle. Already modern spacecraft, in principle allow experimental verification of this postulate by measuring the angles between three spacecraft spaced apart outside the solar system. As mentioned above, a strictly conclusive answer to Aporia 7 is

given in Theorem 15 “There is not and cannot be absolute truth in the field of general theoretical statements”.

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